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FOREWORD

I am pleased to put into the hands of readers Volume-8; Issue-4: 2021 (April, 2021) of **"International Journal of Advanced Engineering Research and Science (IJAERS) (ISSN: 2349-6495(P) | 2456-1908(O)",** an international journal which publishes peer-reviewed quality research papers on a wide variety of topics related to Science, Technology, Management and Humanities. Looking to the keen interest shown by the authors and readers, the editorial board has decided to release print issue also, but this decision the journal issue will be available in various library also in print and online version. This will motivate authors for quick publication of their research papers. Even with these changes our objective remains the same, that is, to encourage young researchers and academicians to think innovatively and share their research findings with others for the betterment of mankind. This journal has DOI (Digital Object Identifier) also, this will improve citation of research papers. Now journal has also been indexed in **Qualis (Interdisciplinary Area) (Brazilian system for the evaluation of periodicals, maintained by CAPES).**

I thank all the authors of the research papers for contributing their scholarly articles. Despite many challenges, the entire editorial board has worked tirelessly and helped me to bring out this issue of the journal well in time. They all deserve my heartfelt thanks.

Finally, I hope the readers will make good use of this valuable research material and continue to contribute their research finding for publication in this journal. Constructive comments and suggestions from our readers are welcome for further improvement of the quality and usefulness of the journal.

With warm regards.

Dr. Swapnesh Taterh
Editor-in-Chief
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International Editorial/ Reviewer Board

The Theory of Isolationism as an Instrument of Criminal Policy and the Confrontation of Organized Crime in Brazil

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Abstract— The purpose of this paper is to address the relevance of confronting organized crime in the Brazilian scenario upon the disorderly structures of prison systems that provide, with the constant transfer of prisoners, the communication between leaders of criminal factions, and the isolation of leaders, that is, the "intelligence" of organized crime as a new paradigm of criminal policy. The levels of violence are alarming and generally rising, with each new research published in the media, which justifies the concern with the theme. It starts, firstly, with the different species of sentences and their function in the Brazilian prison system, examining their origin and evolution. It was also analyzed the Organized Crime and its action in the global scenario, as well as the relevant legislation Addresses the topic of criminalizing the poor of Wacquant and diffuse criminality, starting from a legitimizing concept of the penal system, which analyzes the problem of mass incarceration in Brazil, in order to separate dangerous leaders from subjugated prisoners. by power structures in prison. Finally, we study the regulation of organized crime by the violence, the impact on homicide reduction and lastly, the direct correlation between them. It is concluded that the disarticulation of transnational Organized Crime and the isolation of the command of these organizations are a new necessary paradigm to be incorporated into the Brazilian punitive system, in the phase of criminal execution.

I. INTRODUCTION

The article deals with the instruments of criminal policy, and their limits and possibilities in confronting organized crime in the Brazilian scenario, especially the disarticulation of transnational Organized Crime and the isolation of the command of these organizations, as a new paradigm of necessary incorporation into the Brazilian punitive system in the phase of criminal execution.

The general objective is to demonstrate the relevance of confronting organized crime in the country, given the disordered structures of prison systems, which provide over the years, communication between leaders of criminal factions, (to the point of enabling its spread to all Brazilian states), and the enrulement of the Theory of Isolationism of these leaders, as a way to mitigate intelligence actions, logistics and administration of organized crime, in order to constitute a new paradigm to be adopted in the execution of criminal policies in Brazil.

The levels of violence are alarming and generally ascending with each new research disseminated in the media, which justifies the concern with the theme. Mass

incarceration and the fundamental right to public safety are compared, while discussing the movement of prisoners between state and federal prison models, which follow different prison methodologies and end up contributing to the dissemination of information, and expansion of prison gangs, with the stimulation of the emergence of new collectives of prisoners active in prisons in the federal states. This whole chain of events impacts on the monopoly of violence and on state control of prisons, without government agencies realising or presenting solutions to the problem.

The methodology used consists of bibliographic research, with operational description of the terms, and use of the deductive method.

In the first item, the functions of the penalty and the transition between repression, retribution and resocialization will be analyzed. Then, we analyze the lack of intimidation of Organized Crime, which increasingly expands its ballast of action and addresses the criticisms of the inoperability of the functions of the penalty that means the ineffectiveness of the penalty as an instrument of intimidation to organized crime. The problem of the criminalization of the poor of Wacquant, the overcrowding in prisons in Brazil, and diffuse crime are addressed. Next, in the third item, the phenomenon of Organized Crime and its worldwide expansion constitute the theme of the discussion. In this sense, with Roxin's theory, the criminal pronouncement is subdivided in the phases of: incrimination conducts, application or fixation of the penalty and criminal execution. In this last phase lies the issue of maintaining chains of command and the actors of Organized Crime and their ballast of action even when the leaders of criminal organizations are arrested.

Organized Crime extends around the world on the global stage. Thus, the Palermo Convention was held, projecting its reflections and implications in the Brazilian and other countries' legal framework. Incarceration in Brazil and diffuse crime is the object of bibliographic research a fundamental right to public security. The following question arises: does incarceration solve the issue of Organized Crime?

Isolationism in the confrontation of organized crime is compared in the final item of the work, where the consequences of the disordered structures of prison systems are discussed, which eventually promote communication and exchange of information between leaders of criminal factions.

The influences of criminal networks on patterns of violence and the need to break the logistics chain of the actions of these Organizations are discussed, as a way of weakening their illicit activities. In addition, the issue of regulating violence by organized crime and the impact on the reduction of homicides.

Mitigating the actions of intelligence, logistics and administration of organized crime, as a new paradigm to be adopted in the execution of criminal policies in Brazil is what is proposed to the debate in the article.

II. PEN FUNCTION

2.1 Retribution, Prevention, Repression and Resocialization

In order to discuss the feasibility and understand the importance of adopting certain preventive measures during criminal execution, such as the implementation of isolationism, it is relevant to evaluate the essential positions around the purposes of the penalty, developed by sociological, criminological and criminal doctrines.

In Roxin's doctrine, in his work, "Meaning and limits of the state penalty", the author states that Criminal Law is a kind of last trench. He questions the bases and assumptions justify the fact that a "group of men associated in the State deprives some of its members of liberty or intervenes otherwise conforming their life". [1]

Only in the event of a violation of the legal good of great value to society, is it legitimate that the action of the punitive power of the State is shown. This action should reflect the need for proportional and reasonable pacification to the social reality. The penalty, however, despite the theories formulated, "cannot be reduced to a single point of view", since its foundations make up a "highly complex reality",[2] thus "it is a social necessity – ultima ratio legis, but also indispensable for the real protection oflegal goods", the penalty must be, in a democracy, "always fair, inrenably attached to the culpability (principle and dogmatic category) of the author of the punishable fact". [3] Criminal law only interferes in the social environment to protect citizens, to allow them to live ina society free of danger,[4] thus serves to protect legal assets of greater relevance.

Incident about this interference of criminal law, that is, in this area is that the "limits of political democracy, understood as the power or will of the people and, therefore, of the majority". [5] Only with these assumptions will the legitimacy for punishment be found. The idea of pen as a means of resocialization was a theoretical-practical construction that was forged over time. Several stages were overcome in this process, such as theories of state or social revenge.

The Absolute Theory of Punishment was formulated based on the idea that the penalty should serve to repay the unjust practiced. [6] It was his own end and found self-

legitimization by applying sanctions under the legislation, thereby practicing justice.

Another theory, called Relativistic Theory, values the prevention of crimes through the application of the penalty, which can happen in two ways: the first is the general prevention that relates to the control of violence, limiting it or even reaching its inoccurrence,[7] or an obstruction by "deprivation to the perpetrator" or by the "intimidation" resulting from the application of the sanction, "which will result in the inhibition of other criminal conducts. [8]

Carnelutti argues that the penalty boils down to inflicting suffering on those who committed the crime, that is, it aims to offer a disincentive:

> [to] the committing of others; therefore punitur ne peccetur, that is, in order to try to dissuade the condemned to put himself in a position to have to be punished again. In this respect, criminal law operates on necessity, constituting a link quo necessitate adstringimur alicuius... rei faciendae vel non faciendade; the criminal obligation, which deals with the science of material criminal law, is the expression of the preventive purpose of Criminal Law. [9]

For Dieter, the functions of the pen, from a formal point of view, are constantly redefined. However, they lean on prevention, now for resocialization, but in their critical view, the legitimate arguments of the penalty, such as retribution and prevention, would only wish to "perpetuate the power relations defined by the unequal distribution of modes of production", stating that there is an "abyssal cleavage between the declared functions and the reality of their execution". [10]

After retribution and prevention, the idea of general prevention arises, which can be negative or positive. The first, positive general prevention, occurs when it can be demonstrated that the criminal law is valid and is able to be applied to any specific case. The negative, according to Feuerbach, considered the father of modern criminal law, is that capable of influencing the mood of the agent, who will be affected by a fear, of a "psychological coerce", which will discourage him to commit crimes.

The second subcategory of the Relativistic Theory of The Penalty deals with special prevention, which is intended directly for the condemned. At this point, it differs from the previous one (general prevention), because it is not intended for the collectivity, but for the person who commits the crime. Special prevention can also be positive or negative.

The special positive prevention seeks the resocialization of the condemned, who, after the execution of the sentence, must the individual present himself with full aptitude for normal social interaction. By special negative prevention, it leads to intimidation of the condemned, so that he no longer commits criminal acts in order to avoid recidivism. There is also the Mixed or Eclectic Theory, which combines the function of the penalty as an instrument of retribution to the condemned, of the evil practiced by him, without overlooking the preventive disincentive to the practice of new criminal crimes.

Albergaria states that this theory aggregates the various stages and phases of the sentence, each one, fulfilling different scopes: "at the moment of the threat of the penalty", where the criminal legislator must act, the idea of general prevention is decisive, while "at the time of the application of the sentence, the idea of retribution predominates", and in its execution, the so-called "special prevention, because then the reeducation and socialization of the offender" will prevail. [11]

Therefore, a multi function of feathers is recognized. Retribution, prevention and resocialization, and this was the position adopted by the Brazilian legislature, as can be seen from the command of Article 59, caput,of the Penal Code. [12]

Despite the technical adjustments in relation to penalties, it is reputed that in order to have resocialization, it is necessary to implement the legal guidelines of criminal execution and promote effective means for social reintegration, removing from the hands of experienced criminals, people in situations of economic and socio-environmental vulnerability, which pushes them to the webs of organized crime.

The starting point for such success is to give attractive options for the promotion of emancipatoryeducation,[13] as well as offering the acquisition of legal professional techniques, through the learning of crafts, development of skills and abilities and thus provide ways for the inpenados of yesterday, to be received in society as holders of rights and duties, and in particular as citizens able to develop productive activities.

2.2 Crime, transnationality and daring: what to expect when Organized Crime is not intimidated?

Despite all the theories addressed about the functions of intimidation of the penalty, organized crime is increasingly bold and globalized. Anthony Giddens, in "The world in the age of Globalization" stated that globalization transforms the world into one, that is, into something unique. "Solid like granite" companies can fall apart from one hour to the other, pressured by external competition. Globalization brings advantages and disadvantages. [14]

The morphology of the culture of "Network Life" constitutes a "drastic source of] reorganization of power relations", [15] and also of crime.

The Internet is one of the means of communication, dissemination of information and exchange of ideas that represents the globalized era, but also becomes an instrument that organized crime makes use of, expanded its actions and reach. Several types of crime are "offered", via the worldwide network of computers. Through it are applied scams, drugs are sold, crimes are ordered, finally, all kinds of violation of the law occurs in this medium.

The advance of Organized Crime, empowered by access to "easy money", and permeability in social and even political bodies, affects not only the internal environment of states. Criminal organizations, but become increasingly transnational, entremeand by the inland border zones of several countries, affecting the local and global economy. One of the biggest challenges faced by governments is the advance of transnational organized crime in global society since crime acts in a way that operates in a way that is rampant in networks, this process expands with globalization, especially in the last decades of the twentieth century.

The transnational character, a phenomenon of the globalized era, has made organized crime more specialized, more professionalized and dynamic. The increasing integration of world economies, trade and financial flows and also the transit of people, whether due to work or the scientific area (technology) intensify this process, which permeates the most diverse areas of social life, promote the "revolution in information and communication technologies and practices"; it causes the "erosion of the national state and the rediscovery of civil society to the exponential increase in social inequalities", which highlights the problem of "emigrants, tourists or shipwrecked people", as well as the "protagonism of multinational companies and multilateral financial institutions, of new cultural and identity practices to globalized consumption styles". [16]

The global electronic economy " means that companies, managers and investors can transfer large sums of capital" with a simple touch of hand, and with that, they can also destabilize economies that once demonstrated robustness. [17]

Organized crime uses these tools and is not intimidated, often being open ly on social networks of the worldwide computer network, including offering "services" of delivery of weapons, drugs, prostitution, etc. Through the virtual environment, various crimes are committed, such as fraud, fraud, and even virtual kidnapping, in which a computer virus is manipulated that "crashes" that of the

recipient (kidnapped), usually companies, and for the release of the machine, is extorted a sum of money. The Judge of the TJ SP, Dr. José Carlos, described in his work a typology, in which he can kill himself by computer, as in the case of a mafia whistleblower who had his relative killed by a hacker hired in Switzerland, having succeeded in invading the patient's medication system, hospitalized, leading him to death for revenge. [18] It is possible to easily commit murders with a hacker, computer and internet.

Scams such as bitcoin and other cryptocurrencies are common to Organized Crime. The report called "Organised Crime in Australia 2017", points out that the use of bitcoin currency and other cryptocurrencies, by organized crime, have been very efficient formoney laundering and financial movements that go off the radar. These virtual currencies are used in an abusive manner since they can be sold anonymously online, without control or dependence on a central bank or financial institution that can oversee transactions. [19]

If, on the one hand, organized crime is not intimidated, there is a problem of the inoperability of the penalty and the criminalization of the poor, issues of which we will start to address.

2.3 Criticism of the inoperability of the functions of the sentence and the problem of the criminalization of the poor in Wacquant

This item addresses the effectiveness of the application of the penalty as a preventive means, that is, to avoid the occurrence of new offenses, which reveals the inoperability of the penalty. At first historical moment, man, organized in society, realized the ineffectiveness of the application of the penalty, in the midst of enlightenment philosophical discussions.

The prison emerged as the "centre of gravity of political-criminal schemes", widespread from the second half of the 17th century in Europe. To date, it has not succeeded in achieving an effective system that would replace prison, but it has been profoundly modified over time.

In Brazilian legislation, the adoption of pecuniary and restrictive penalties of rights is highlighted, especially in the systematics of the Law of Special Justices No. 9099/95, which emphasizes the alternative penalties of scarcerizadoras, pointing to the incorporation of reformulations of new concepts, theories and ideas about criminal law and its norms.

However, Amaral writes that there is a paradox between these new decriminalizing rules and the resurgence of legislation, giving "broad prestige to the exasperation of

deprivation of liberty (v. g. Laws 8072.90, 9034/95,9455/97, 9503/97 (CTB) and96l3/98)". [20]

Scholars began to openly criticize the application of torturous punishments and use of inhuman esum misins as a form of punishment to offenders. The idea of revenge is replaced by preventive contours.

Beccaria states that the best cost-benefit is in preventing crimes, rather than having to punish them, because "every wise legislator should seek rather to prevent evil than repair it", being good legislation, the art of "providing men with the greatest possible well-being and preserving them" from evils such as suffering. [21] Faced with the ill-fated crisis of legitimacy of the penal system, markedly in relation to the foundation of the penalty, and the existence of selectivity, new theories and criticisms of the inoperability of the penalty are increasingly presented in the scenario where the directions of criminal politics are discussed in Brazil and in the world. In this context, the penalty, it is said, was "humanized", having abandoned its contours of human degradation, although the issue of "humiliation" may be present, justified by the need for social regulation.

Veloso says that the crisis of legitimacy of the penal system is partly caused by society itself because "there are other ways of repressing the offender", which is not necessarily "the seclusion in cells as if they were animals", however, social claims, in part, are triggered by the media, sensationalists, who lead to believe that prison is the only way to guarantee punishment of offenders. [22] The worse the environment, the better, without realising that it aggravates the problem, it does not solve it.

Jus puniendi, over the years and the development of new theories, the humanization of penalties became a necessary agenda, required "by men themselves, by scholars", so that the updated penalty is content to "deprive man of his rights reaching his greatest conquest, freedom", and thus we move to a more human "concept of pity" by undressing the individual with greater humiliation, "for only the fact of being judged, even if cleared, is a bitterness". [23]

Aggravate the situation, elements of destructuring of the penal system, such as: a) Reproduction of violence, b) Creation of conditions progression of simple conducts for other more harmful, c) Institutionalized corruption, d) Concentration of power and social vulnerability, e) Destruction of "horizontal and/or community relations". [24]

In particular with the case of social vulnerability and the conversion of part of the population in a situation of miserancy to the functional frameworks of trafficking, it is necessary to discusswhat some authors [25] call the criminalization of the poor based, especially on

Wacquant's thinking, for whom "punitive management of poverty", ghettoization and ethnic marginalization have been forged as a "component of neoliberalism". [26]

According to Wacquant, in the United States, "a new policy" and a new "management device for urban marginality" emerged, (which seems to spread across the continent), from a state action that restricted social policy, with "the replacement of protective welfare with compulsory workfare", employing a growing and expansive penal policy. [27] There is the "regulation of the poor" by welfare: on one side is the left hand with the obligatory workfare and on the other, the right hand of the State unite resulting in the "'double punitive regulation' of the untapped fractions of the post-industrial proletariat"[28].

Regarding Latin America, the author states that:

The same logic is on the scene in Latin America, which is where I finally take the reader, in order to examine the militarization of poverty in the Brazilian metropolis as revealing the profound logic of penalization (cf. Wacquant, 2008b). In a context of extreme inequalities and rampant street violence, backed by a heritage state that tolerates routine judicial discrimination, caused by both class and color and police brutality without restraints, and considering the terrible conditions of confinement, imposing punitive restraint on residents of decaying slums and degraded housing estates amounts to treating them as enemies of the nation.   This policy is ensured by feeding the disrespect of the law and the routine abuse, as well as the uncontrolled expansion of criminal power, which, in fact, is observed throughout South America in response to the joint increase in inequality and marginality (cf. Müller, 2012). This Brazilian excursion confirms that the penalty vector always acts in an extremely selective way, reaching, as a matter of structural priority, those categories doubly subordinated in the material order of class and in the symbolic order of honor. [29]

 With this thought it is justified that, in the absence of a criminal justice system with greater operation, to apply the penalty of restriction of freedom, with greater efficiency and / or effectiveness to the intricacies of the command of Organized Crime. But prison is still the means that the State can and must use to protect not only the so-called unavailable, unreprehensible and indispensable legal assets, but also the population itself, which is held hostage to the threats and lack of choice of life and maintenance of this (subsistence), inserted in this concept, physical integrity and social peace. There is a sense that the government is always drying up ice on this issue: much is incarcerated and little resocialized, and there is no social

peace. Violence predominates, resulting in more criminal status and repressive policies.

The need to isolate and make it impossible for the individual to commit crimes is what provides the legal and legitimizing foundation that, in turn, served as "a basis for the construction of maximum security prison units",[30] as well as, enabled the adoption of the so-called RDD – Differentiated Disciplinary Regime, which will be better explored in the last topic of work, with the necessary analysis and critical confrontation. For now, we are committed to the discussion of organized crime as a global and local phenomenon.

III. ORGANIZED CRIME: A WORLDWIDE AND BRAZILIAN PHENOMENON

The term organized crime was well defined from the Palermo Convention in Italy on December 15, 2000, which, in its art. 2, qualified as "Organized criminal group" all those groups that form structured, composed of three or more people, and is "existing for some time [...] acting concertedly for the purpose of committing one or more serious offenses" or other offenses mentioned in that Convention, "with the intention of obtaining, directly or indirectly, an economic benefit or other material benefit". [31]

The Convention was necessary since organized crime was structured around the world under the most diverse configurations, purposes and denominations: mafia, gangs, gangs, gangs, commands, triads, yakuza etc. acting nationally and transactionally. [32]

Several previous attempts to print satisfactory legislation had already been the subject of the legislative interest of the countries. In Italy, on July 31, 1874, the report entitled "Organized crime in the Balkan region" was published at the request of the Ministry of the Interior, referring to a Law of 1875, where Giocchino Rasponi defined the mafia as a "city rascal". [33]

The Italian mafias in the 19th century were structured and organized according to codes of conduct, and initiation rituals. In the 20th century these organizations branched out around the world, becoming transnational, the Cosa Nostra (Sicily), Ndrangheta (Calabria) and Camorra (Naples). Each, with approximately 25 (twenty-five) thousand members and 250 (two hundred and fifty) thousand affiliates around the world.

In Brazil, organized crime has controversial origins according to the author Lidiany; Nivaldo *apud* Silva, 2003, while for other authors its origin would be in the Brazilian Northeast through the cangaceiros of the time the so-called "gang of Lampião and Maria Bonita" since these criminals

were already organized hierarchically, making extortions, kidnappings, threats and counted on the collaboration of corrupt politicians and police. [34]

But it is claimed that organized crime actually emerged in Brazil, in the prisons of the 1970s and 1980s, with the formations of criminal groups. Others defend the idea that it would have arisen in Rio's favelas due to the lack of adequate public policies by the state in what the author calls the "generation of excluded". [35]

This item will deal with the denominations of Organized Crime and its ballast of action in the Brazilian scenario.

3.1 Actors and denominations of Organized Crime and their ballast of acting in the Brazilian scenario

In the internal scenario, the situation is very serious, which makes urgent the need to rethink actions in internal public security, markedly in prisons. The prison system as it works today, is serving, now as an "office", or "college" for Organized Crime. [36]

Sergio Oliveira Souza, in Brazil, prisons have been transformed into "offices for organized crime leaders, conditions of overcrowding and precariousness show that, without planning, there are no possibilities for rehabilitation and resocialization of detainees"[37]. These factions absorb a "generation of excluded who in response to this exclusion and with great insight and intelligence organized themselves in order to meet their basic survival needs." [38]

Organized Crime studies, is "qualified" for its illicit activities. In July 2014, it was reported that the "bosses" of the criminal factions were living and "studying" abroad in order to specialize with cartels in Mexico and Paraguay. Others preferred to command the actions from the United States, defying the intelligence of that country. Police investigations have found that leaders of the First Command of the Capital (PCC) organize trafficking and other criminal activities in the state directly from abroad [...] the top leader of the faction, Marco Willians Herbas Camacho, Marcola, is now called Russian." [39]

The tentacles of these Criminal Organizations are also spread across the three powers. [40] In prisons, the war on drugs, like the Americanmodel,[41] caused an over-incarceration that provoked a revolution in the organization of these establishments. "From within the jails, the main collective of crime in the state was strengthened. This [criminal] policy is bankrupt, but it continues to operate", this collective is the First Command of the Capital, which is one of the large Criminal Organizations active in Brazil, "present in 22 States of Brazil, and has become a major supplier of weapons and drugs to other factions". [42]

News nationwide[43] and local[44] are broadcast every day, and report arrests and the blunt practices of lawyers co-opted by Organized Crime.

The heads of these factions are not intimidated, nor with federal intervention for public security, even less with threats of legislative change.

The red phalanx was created in the 1970s, the red command would have appeared in the maximum security prison of Ilha Grande, having as mentor Rogério Lemgruber, known as Bagulhão (the acronym C.V.R.L Comando Vermelho Rogério Lemgruber is created). The faction was forged in the "maximum security prison of Ilha Grande during the years of the dictatorship, when the guerrillas of the armed struggle mingle for four years with common prisoners those who practiced the crime of theft and robbery". [45] It was this faction that originated the Red Command. [46]

Comando Vermelho – CV, was formed by some members of the red phalanx, and originated in bangu i prison, having as main founder the famous "Escadinha", a Chilean fugitive from the Pinochet dictatorship. The faction stemmed from the union of ordinary prisoners and political prisoners, who within the prisons had access to the teachings of guerrilla manuals. Some authors claim that the Brazilian left helped the Red Command: "whatever the case may be, one thing is certain: if the militants of the armed left trained guerrilla bandits inside the prison, those on the unarmed left, outside it, are consistently following their initiative", because they help the faction to conquer a position of popular political leadership, "artificially legitimized". [47]

Primeiro Comando da Capital - PCC became known in the media as a response to the police intervention of Carandiru (1992). In this episode 111 (one hundred and eleven) prisoners collected in the prison were killed. "Carandiru prisoners after their deactivation were transferred to prisons throughout são Paulo state and in 2001, they would have begun to organize." The leader of this faction, Marco Willians Herbas Camacho, (Marcola[48]), commanded frominside the Prison of Venceslau Braz, in the interior of São Paulo, this response with cellular use, determining the attack on the main civilian and military targets of the State of São Paulo and Brazil.

It is estimated that the faction currently controls 137 (one hundred and thirty-seven) prisons, that is, 90% (ninety percent) of the prison system of the State of São Paulo, making 123 million reais, in crimes of drug trafficking, raffle, toll and monthly fees that are paid by inmates and family members. [49] There are authors who argue that with the control of the PCC in prisons decreases the number of deaths,[50] since the focus of the faction

ceased to follow the molds of a union, to defend prisoners, and went to objective profits as a company. [51]

Currently, the prison population of São Paulo is around 210,677,000, or 40% (forty percent) of Brazil's prison population. Having 155 (one hundred and fifty-five) prisons to house these inmates, according to the Secretary of Penitentiary Administration.

The PCC has several rivals of other criminal organizations, such as the Satanic Sect, which originated in the Detention House of the City of São Paulo in 1994, by Ildefonso José de Souza, sentenced to 22 (twenty-two) years for latrocinium. "In June 2001, he was found in the Mario de Moura Albuquerque Penitentiary in Franco da Rocha, a document that translates the oath" of entry, where one should despise God and swear allegiance to hell. [52]

Comando Democrático da Liberdade – CDL, was created in the penitentiary of Avaré, in 1996. It controls some prisons in São Paulo and riots in the interior of the State of São Paulo.

Comando Revolucionário do Crime Brasileiro (CRCB) was founded in Guarulhos prison in 1999. The faction is responsible for assaults, kidnappings and attacks on public targets. Mauá, in the article that informs that the rivals of the PCC are the ones who kill the most in prison, says that this faction acts motivated by "greed, extortion, cowardice, unpreparedness, mental disability, disrespect to visitors, rapes of visitors, war within their own domains", which generates the chaos of the Criminal Act of the State of São Paulo. It states that one cannot live with such "garbage, scum, animals without the slightest sense of rationality", that they could not and should not live with other prisoners who have their families taken almost hostages and fight against the difficulties of our country". [53]

Terceiro Comando da Capital – TCC, was created by César Augusto Roris da Silva, alias Cesinha, former leader of the PCC, "hunted" and killed in 2006. [54] After his death the organization would have lost strength in prisons. According to the President of the Union of Prison Security Agents of the State of São Paulo (SINDASP), Daniel Grandolfo, the TCC is extremely rival to other criminal factions such as the PCC and makes this very clear, not usually acting behind its back. [55]

Família do Norte – FDN, at the moment, is currently the largest criminal organization in the North and third largest faction in the country. Created in the State of Amazonas, its leaders are the drug traffickers Zé Roberto da Compensa, João Branco and Gerson Lima Carnaúba. They operate mainly on the route of drug and weapons trafficking. Its enemies declared the criminal organization of the PCC, which resulted in a recent massacre in the prison complex of Manaus in 2016.

The violence in the Capital of Amazonas culminated in the murder of 38 (thirty-eight) people in just three days known as "Bloody Weekend" spreading in all national and international media as in the New York Times.

The sheriffs are also responsible for determining several massacres that triggered one of the greatest atrocities that occurred in prisons of the States of Amazonas, capital Manaus, and Rondônia, in the capital of Porto Velho, in recent years, had repercussions in all national and international media, mainly due to great violence that carried out as torn bodies, without head, burned alive, mutilations etc.

According to the La Muralla Report[56] it was concluded that virtually all drug negotiations in the State of Amazonas have tentacles of the FDN, with this it can be observed how it is a highly structured transnational organization and seek not to have direct submission to other known criminal organizations of the country as is the case of pcc (São Paulo) and CV (Rio de Janeiro) in what leads us to analyze that organized crime grows alarmingly with the emergence of new factions in Brazil and in the border strip.

They flaunt their weapons, threaten and have prosecutors, judges, delegates, servants, police and penitentiary agents executed, in short, all who put themselves in their way. Many of these orders, departing directly from prisons spread across the country.

Organized crime in Brazil, especially in the Northern Region, also presents transnationality as a characteristic. Public safety, at the state and federal level, cannot face the expansion of existing criminal practices. Several groups form, groups already formed dispute power among themselves, change, other groups combine, and thus, these alliances begin to exercise an increasing dominance, and their actions are increasingly violent.

Criminals form species of societies, from groups that use violence and symbolic actions to establish their power and the so-called delinquent economy, which consists of allowances, tolls, imposing restrictions on trade on certain days and places, curfew, etc.

3.2 *The Brazilian legislation on organized crime and the reflections of the Palermo Convention*

Until the emergence of Law 12,694/12, the Brazilian legal system did not even have a legal definition of "criminal organization". That is why the definition given by the Palermo Convention was adopted. The Supreme Court, however, in a trial of habeas corpus filed by members of the Church Reborn in Christ, accused of the practice of money laundering, ruled that the use of the Palermo Convention would violate the principle of legality, before

the lack of law in a formal and material sense that defined what should be understood as a criminal organization. [57]

On July 24, 2012, inspired by the Palermo Convention, Law 12,693 was published, with the case and the first-degree collegiate trial of crimes committed by criminal organizations. [58]

The route chosen was the edition of a Decree (5.015/04), which passed incorporated the concept into the Brazilian legal framework, where, by criminal organization, it was understood that structured by three or more people, pre-existing for some time that acted in a coordinated way, with the purpose of committing serious infractions and thus the intention to obtain, directly or indirectly, an economic or material benefit.

Following the new guidelines and trends of the United Nations - UN and international conventions such as the Palermo Convention Against Transnational Organized Crime, it became necessary to issue a law more appropriate to the current reality law No. 12850/2013 on Criminal Organizations.

From there, the norm incorporates and several changes arise from the new law of organized crime, Law 12.850/13, which has as main differential the concept of criminal organization, being characterized as an organized structured activity, markedly by the division of tasks. [59]

Not only the mere association for the practice of crimes, it is necessary that it is at least structured among its members, there is the so-called hierarchy in different nuclei.

Another differential in the previous law used the term "crimes" in law no. 12,850/13, in its paragraph 2 covers the term "criminal offenses". It was also sought, in paragraph 1, to punish that subject who prevented or in any way would embarrass the investigation of criminal offense involving criminal organization, which complies with the provisions of the United Nations Convention against Transnational Organized Crime – that is, in the Palermo Convention, promulgated through Decree No. 5,015/2004, art. 23, which gave greater punishment to those who wish to obstruct evidence.

There is also an aggravation of the penalty of the person who becomes head of the criminal organization, even without personal practice of execution. The penalty will be increased from 1/6 (one sixth) to 2/3 (two third) if there is participation of child or adolescent, in known cases of mediata authorship when criminals use inimputable in the practice of their crimes. It also refers in Article 2, item II, to the aggravation of the penalty when there is a public official competition, with a view to the "betrayal" of that official in relation to state designs. [60].

IV. THEORY OF ISOLATIONISM AND COPING WITH ORGANIZED CRIME

This item discusses the consequences of the disordered structures of prison systems, which eventually admit, if not promote, communication and exchange of information between leaders of criminal factions. The collectives of prisoners increasingly become a reality in Brazilian prison institutions, which in turn begin to organize themselves to insert themselves into the democratic system, including electoral, their representatives.

From within prisons, when the execution of their sentence, criminals, administrators and managers of trafficking, extend the tentacles of their criminal organizations, forcing minor criminals to join their organization,[61] getting new "deals", and also, raising partnerships, co-opting lawyers "partners" in their crimes, people from other communities and align or fight with other criminal factions, all at the expense of society and the criminal system.

Criminal networks in the patterns of violence, nodded in homicides in Brazil, have to do with the greater or lesser freedom of action for these criminals. Therefore, the need to break the logistics chain of the actions of organizations for crime is justified, as a way to undermine their illicit activities. This permeates the following questions: How to establish a regime that can prevent the communication of leaders with their subordinates, in order to isolate the actions of command, logistics and planning of organized crime through criminal isolationism?

Is the disarticulation of transnational Organized Crime and the intelligence of these organizations a new paradigm necessary to be incorporated into Brazilian criminal policy?

It seeks to analyze the enstillment between the isolation of organized crime intelligence and a new paradigm of criminal policy in a scenario of expansion of criminal factions in prisons in Brazil. Mitigating the actions of intelligence, logistics and administration of organized crime, as a new paradigm to be adopted, which aims to asphyxiate the command of factions, in the execution of policies, criminal in Brazil is the proposal discussed here.

4.1 The disarticulation of transnational organized crime and the isolation of organized crime intelligence as a new paradigm of criminal policy

The disarticulation of Organized Crime is impartin transnational intelligence actions and cooperation between police in the main drug-producing countries. That's because these cops and their staff must be more organized than the leaders of the drug trade.

When he was imprisoned in the Prison of Papuda, Brasília-DF, "Marcola created an arm of the PCC called by the criminals of Partido Liberdade e Direito (PLD)". After the investigations carried out by the Special Division to Combat Organized Crime (Deco) it was possible to identify the creation of this faction, which "followed the molds of the creation of the PCC, including in relation to the rules contained in its statute". According to these parastate norms, the "dome" passes the guideline to prisons, which are called "towers" and thus, the "criminals responsible for the transfer of information" are the so-called "pilots" - who are "prisoners chosen to coordinate the members of the PCC who were behind bars". [62]

Looking at the information about the transfers, I found that Marcolinha (Marcola's brother) would have been transferred to Papuda. 'But is it the Benedito' who transferred him to the site that previously his brother would have founded a branch of the PCC in one of the criminogenic policies of the State of SP? As absurd as that is, unfortunately it's another truth. In the transfer of 'Marcolinha' (Marcola's brother) they transferred him to Brasilia, the same place where his brother (thanks to the State of SP) founded the PLD. [63]

There is also a very well organized arm of the PCC, long-standing, active in the Federal District, having been recorded by police investigations at the start date: March 5, 2001, after the commander in chief of the organization had spent a period collected in the Federal Capital. [64]

After a pilgrimage through several prisons in the country, Marcos Herbas Camacho, the "Marcola", was collected to the Center for Hospitalization and Reeducation (CIR). Although the stay was short – he was imprisoned until February 8, 2002, he left deep marks, both in the mentality of the prison mass and in the public safety of the Federal [...] The surveys made by the police mapped that the organization chart of the PCC would be rigid and similar to a military structure, with hierarchical levels of command, divided into levels according to the power exercised by the members and their respective functions within the faction. The criminal organization also built a network of collaborators, formed by lawyers, family members, girlfriends and visitors. [65]

Although the oldest and most powerful prison gangs operating in Brazilian prisons have emerged in the states of Rio de Janeiro and São Paulo, today, there is no right address. They present themselves in Brazil or abroad, controlling their actions remotely.

Organized crime, based on the techniques of militias, he quickly evolved his modus operandis to act in networks, which consolidated themselves in other axes outside Rio-São Paulo[66], in particular, "when transferred toother states" because they coordinated withother prisoners,[67] contributing "to the incentiveand help in the constitution of

new organized collectives of prisoners"[68] that led to the density of a "culture of delinquency". [69]

The Brazilian prisons, which already suffered without physical structure and human resources, "buffeted by a growing prison mass (mostly poor and unassisted)", a situation aggravated by the adhering, often compulsory for the "formation of criminal groups, of brotherhoods of crime",[70] they found themselves unchecked and became what commonly adjected from powder barrels, marked by the constant massacres that shame the nation and systematically violate the human rights of those collected from the nightmare of the Brazilian prison system.

The situation is less painful in federal prisons, created 2000, the Federal Penitentiary System (SPF), materialized by the need to confront organized crime. To create it, it was necessary to regulate art. 86, 1 st of Law 7,210 of July 11, 1984, the Criminal Enforcement Law. The Federal Penitentiary System was created through the National Penitentiary Department (DEPEN-MJ)", decree 6,061 of March 15, 2007, with the implementation of "maximum security prisons and drawing an adequate profile of prisoners who could be referred to a federal penitentiary, as directed by Decrees 6,509/2007 and 6,877/2009". The federal prisons that make up the Federal Penitentiary System, today in number of five (Catanduvas - PR, Campo Grande - MS, Porto Velho - RO, Mossoró - RN and Brasília - DF), each is "maximum security prison unit", with 208 (two hundred and eight) vacancies. "In addition, each federal penitentiary also has 14 (fourteen) isolation cells, differentiated disciplinary regime (RDD)"[71], stricter regime applied to those who do not have good prison behavior.

Far from presenting a ready and finished solution to the problem, it is necessary to rethink the systematics of the constant transfers of prisoners and readapt the regime of execution of punishment of prisoners who have proven to perform the role of head and direction of criminal factions. [72] The constant transfers of prisoners between prisons – some indicated by the prisoner himself, fostered the interaction and dissemination of the plans "of criminal groups and also of their criminal leaders". According to Manso and Dias, some rebellions were provoked with the premeditated goal of the leaders being transferred, functioning the transferred individual, as an instrument for disseminating the ideals of the dominant criminal factions in new units[74].

It is necessary, first, to ensure that these leading prisoners stay as far away from their places of action as possible, secondly, that these people are kept in systems of Differentiated or similar Disciplinary Regime, as far as necessary, in order to undermine the control of the places

in which they operate, so that their threats no longer have any effectiveness, including prison officers, who often find themselves threatened without any state shelter.

There can be no inversion of values and social rights, where the right of a high-risk incarcerate, with a function of command of great ballast in the factions is more privileged than the communities held by the criminal desideratos, deceived by the easy money coming from trafficking and related crimes. [75] At the end of the day, the whole society becomes subdued and unprotected.

In this discussion, in addition to the fact that prisoner transfers contribute to the articulation between the factions, one still has to deal with disputes and the fact that support houses for the relatives of prisoners has functioned as "HQ's" of crime, as Teixeira warns:

[...] in federal penitentiators, where prisoners from different states and different criminal factions are sheltered, the conviviality and possible alliances between the prisoners collected there are inevitable, which can be confirmed by the studies of Dias (2011) Manso and Dias (2017, 2018) and also santos (2016).

Therefore, there is no doubt that, in fact, there is interconnection between members of the same faction or even between prisoners of various factions, inside federal prisons, being certain that such agreements can be complemented in support houses, where the elements that support the criminal faction are found. It then becomes the house of support, an important point of intersection between criminals of the same gang of prisoners or between these prisoners and their sympathizers, future soldiers to join a criminal organization. [76]

It is necessary to adjust the function of the penalty for certain individuals who use their high degree of knowledge and administrative specialization to promote, direct and guide criminal actions. However, the simple use of prison does not lead to the desired result, it is necessary a systematic, lasting and joint action of all those involved in the criminal system, such as government, police, judiciary, prosecutors, prison officers, civil society and their organizations, in short, all those interested in a less violent world and with fairer distribution of the penalty, since these measures are restricted to the high command of organized crime. It is the conscious use of selective state violence. [77]

This is because, proven and absurdly, the greater or lesser violence in cities is directly or indirectly linked to the actions of these imprisoned criminals,[78] moreover, it should be considered that "worldwide research concludes that criminal occurrences in association with drugs have increased worldwide, evenin those where drug policy has been relaxed".

Temperance is necessary, because there is an erroneous common sense that: if all criminals (excessive generalization) are not applied the penalty of deprivation of liberty, Brazil is confirmed as a country of impunity where everything that is wrong, "ends in pizza". [80]

The possibility of applying the restrictive penalty of rights, for certain crimes, has better effects than the restrictive penalty of freedom itself, in so far as it is "paid" to what has been done – "but because of this feeling of impunity [or fear of it], the State, in the figure of the judge, is very modest in its application". [81] The most drastic measures in the execution of the sentence should be reserved only to those inprisons with a high degree of dangerousness and manipulation of subordinates internal and external to prisons for the committing of their crimes and administration of their business.

As Teixeira said, the "problem of gangs of prisoners has no simple solution", there is no methodology, rule or standard pre-established to combat them, but "represents social and political intelligence the adoption of measures that can reduce their powers, including, of course, the reduction of mass incarceration" replacing this practice with "better use of prison spaces, including, of course, the Federal Penitentiary System", reserving them only to the leaders of criminal factions and prison gangs. [82]

However, for the members of the criminal organizations command it is necessary to insert these individuals, in different regimes, in order to dismantle the Central Committee of Crime – a direct byproduct of the system of transfers of prisoners between federal prisons. As soon as the high-ranking inmate in the chains of command of crime enters at the beginning of criminal execution, due to its dangerousness and capacity to generate social damage, it should be placed in "very rigorous programs for the treatment of the prisoner, asloreing him in an isolated cell, without contact with other prisoners, with supervised visits and without intimate contact" and with the supervised contact with his lawyer, for the sake of collective security so destiture in the current legal-criminal scenario of today. [83].

V.   FINAL CONSIDERATIONS

The work presented intended, through bibliographic, documentary research and direct observation, to study the intentions of the penalty and its ideological-historical evolution, focusing on criminal execution, to later deal with isolationism, as a form of disarticulation of criminal organizations in Brazil, undermining their strategies of action, logistics, co-optation of "members" and places, neighborhoods, slums, places where the State has no interference , but especially the forms of issuing orders,

exchanging information and monitoring criminal activities, by those who are inserted in the prison system.

The functions of the penalty in criminal law are a reflection of the state criminal policy program, which the criminal dogmatics institutes, from the attribution given to the penalty. This, in turn, configures the official response in the face of conduct or the punishable fact, exarada by the criminal justice system – in which are inserted the police, the judiciary and its powers, and prison institutions and their executive developments. It happens that the functions of prevention, disapproval, normative-criminal repression by themselves have not achieved the necessary success for the confrontation of criminal organizations. When organized crime is not intimidated, the result can only be the expansion of its violent domains, increased associated crime and expansion of its highly profitable businesses, a fact capable of shaking world economies.

Transnational organized crime, far from retracting, growing and innovating, therefore, requires specific, intelligent and coordinated actions between the police and other financial and public security surveillance agencies. But not only that, once these coordinated actions are successful, it is necessary to ensure that the regions, previously dominated by trafficking, have new educational, professional and occupational perspectives (sport, leisure, etc.). And that the "economy" previously practiced, to end, replaced by these activities. It is necessary to decriminalize the poor, to reject the ghettoization and favelization, and to educate them, to professionalize them and to insert them in activities that can guarantee them subsistence and dignity, because the way Mainardi would say, a good way to get rid of the poor safely, is to make them a little less poor.

The proposed objective was achieved, since it was sought to demonstrate the relevance of confronting organized crime in the country, in view of the disordered structures of prison systems, which provide over the years, communication between leaders of criminal factions, resulting in the creation of a Central Committee between leaders – which reinforces the urgency of mitigating the actions of intelligence, logistics and administration of organized crime. The isolation of leaders, even if this measure is not unanimous, is a possible way to adopt in the execution of criminal policies in Brazil, to reduce violence in the country.

As for the questions, on how to establish a regime that can prevent the communication of leaders with their subordinates, in order to isolate the actions of command, logistics and planning of organized crime through criminal isolationism, several joint actions and transnational cooperation are necessary, in order to dismantle the chain

of command, logistics and communications, either by physical or by signs. These actions should be thought of as a new paradigm necessary to be incorporated into Brazilian criminal policy.

The actions necessary to confront Organized Crime are to obstruct communication, to make the integrations between the leaders, that is, between those who exercise some form of management of drug trafficking, theft of charges, virtual crimes, transnational actions, in short, which cloud the mediatas and immediate instructions emanating from a command to their cells linked to some criminal group or faction. The most drastic measures and socio-criminal restraint, which we call isolationism, should be reserved only for prisoners with a high level of dangerousness and who manipulate their subordinates intra and extrapenitentiary to commit their crimes and administer their business.

Given the organization of criminals, it is essential to direct the function of the penalty to certain individuals, who use their intellectual qualities and administrative specialization to promote, direct and guide criminal actions. Nevertheless, the mere use of prison does not lead to the end of crime. It takes a systematic, lasting and joint action of all those involved in the criminal system, such as government, police, judiciary, prosecutors, prison officers, civil society and their organizations.

The custodial sentence, as seen, still represents a central element of the penal system, and a means still considered effective, to protect the social body from criminal obstinacy, whether arising out of or promoted by cultural, economic or social factors. When using it, it is necessary to have in mind its limitation to those who have a high level of command of crime, according to the most up-to-date doctrines and criminal policies.

In addition, it is not overseen that social policies, such as education, health and the promotion of decent work, are the best preventive means of crime, organized or not, in accordance with the reference legislation.

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[44] TROMBETA, Mayara Maria Colaço. O Crime Organizado e o instituto da Delação Premiada. Revista Intertemas: São Paulo, 2010.

[45] VELOSO, Cesar Cury. Função social da pena. 2011. Disponível em:

<https://www.direitonet.com.br/artigos/exibir/6439/Funcao-social-da-pena>. Acesso em 23 mai. 2019.

[46] WACQUANT, Loïc. Punishing the poor: the neoliberal government of social insecurity.

[47] Durham/Londres: Duke University Press, 2009.

[48] WACQUANT, Loïc. Marginalidade, etnicidade e penalidade na cidade neoliberal. Tempo Social, revista de sociologia da USP, v. 26, n. 2, 2014, pp. 139-164.

[49] WILLIS, Graham Denyer. The killing consensus: Police, organized crime, and the regulation of life and death in urban Brazil. Berkeley, University of California Press, 2015.

[50] ZALUAR, Alba. "Condomínio do diabo: as classes populares urbanas e a lógica do ferro e do fumo". In: PINHEIRO, Paulo Sérgio. (Org.) Crime, violência e poder. São Paulo: Brasiliense, 1983.

[51] ZAFFARONI, Eugenio Raúl. Em busca das penas perdidas: A perda de legitimidade do sistema penal. Rio de Janeiro: Revan, 1991.

[1] Roxin, Claus. **Fundamental problems of criminal law**. Lisbon: Vega, 1986, p. 15 es.

[2] PRADO, Luiz Regis Prado. **Brazilian Criminal Law Course.** Vol.1, 5º ed., São Paulo: Revista dos Tribunais, 2005, p. 567

[3] PRADO, Luiz Regis Prado. **Brazilian Criminal Law Course.** Vol. 1, 5º ed., São Paulo: Revista dos Tribunais, 2005, p. 567

[4] Roxin, Claus. **Fundamental problems of criminal law**. Lisbon: Vega, 1986, p. 27.

[5] FERRAJOLI, Luigi. The penalty in a democratic society. *In:* **Sediciosos discourses**: crime, law and society. Year 7. n. 12. Rio de Janeiro: Revan, 2002, p. 31.

[6] NETO, Arthur da Motta Trigueiros**. Criminal Law:** penalties until the extinction of punishability. São Paulo: Saraiva, 2012, p. 18.

[7] NETO, Arthur da Motta Trigueiros. **Criminal Law:** penalties until the extinction of punishability. São Paulo: Saraiva, 2012, p.15.

[8] THUMÉ, Paulo Renato(**An approach on penalties and their execution in Brazilian criminal**law. Santa Cruz do Sul: UNISC, 2015. Available from: <https://repositorio.unisc.br/jspui/bitstream/11624/865/1/Paulo%20Renato%20Thum%C3%A9.pdf>. Access on May 15. 2019, p. 23.

[9] CARNELUTTI, Francesco(**Lessons on Criminal Procedure.** Vol. 1, 1º ed., Campinas: Bookseller, 2004, p. 73.

[10] DIETER, Maurício Stegemann. The symbolic function of the penalty in Brazil. Brief criticism of the function of positive general prevention of criminal punishment in Jakobs. **Journal of the Ufpr Law**School. Available from: <https://revistas.ufpr.br/direito/article/view/7036>. Access on May 20. 2019, p. 3. In the current search for new argumentative resources that authorize the penalty, appears in German doctrine – based on a new sociological construction – the rescue of the function of positive general prevention, based on the need to maintain normative behavioral expectations (*Idem*).

[11] I'D HARBOR, Jason. **Penalties and Criminal Execution.** Belo Horizonte: DelRey, 1996, p. 20.

[12] Art. 59 - The judge, in view of the guilt, background, social conduct, personality of the agent, motives, circumstances and consequences (SIC) of the crime, as well as the victim's behavior, shall establish, as necessary and sufficient for disapproval and prevention of the crime: (Writing given by Law No. 7,209, of 7.11.1984)

I - the penalties applicable among the cominadas; (Writing by Law No. 7,209, 7.7.1984)

II - the amount of penalty applicable, within the limits provided for; (Writing by Law No. 7,209, 7.7.1984)

III - the initial regime for the execution of the custodial sentence; (Included in Law No. 7,209, 7.11.1984). Brazil. IV - the replacement of the custodial sentence imposed by another type of sentence, if appropriate. (Included in Law No. 7,209, 7.7.1984) (our griffin).

Brazil. **Penal Code.** Decree-Law No. 2,848 of December 7, 1940. Available from: <http://www.planalto.gov.br/ccivil_03/decreto-lei/del2848compiled.htm>. Access on May 12. 2019. The provision was reappropriated by Federal Law No. 7,209/1984, where the concept of main and ancillary penalties was replaced and appropriated to Article 32 of the CP. In the Brazilian criminal legal system, the penalties will be: custodial, restrictive of law and fine.

[13] Beccaria, Cesare. **Crimes and penalties.** S.L. Ed. Ridendo Castigat Mores, (1764). Available from: <http://www.dominiopublico.gov.br/download/texto/eb000015.pdf>. Access on May 23. 2019, 70.

[14] Giddens, Anthony. **The world in the age of globalization.** Translation by Saul Barta. Publisher: Presence. 6. Ed. Lisbon: Editorial Presença, 2006, pp. 20-21.

[15] Castells, Manuel. **Networksociety**. The information age: economy, society and culture. 17. ed. São Paulo: Peace and Earth, 2016, p. 498.

[16] SANTOS, Boaventura de Sousa. (Org.). **Globalization and the Social Sciences.** São Paulo: Cortez, 2002, p. 11.

[17] Almeida, Andreia Alves. **Transnational organized crime in northern Brazil: The need for a systemic model.** Doctoral thesis. Itajaí: UNIVALI, 2019.

[18] AQUINO, **Jose Carlos G. Xavier de. Organized crime and globalization.** Available from: <http://www.aopmbm.org.br/aopmbm-em-acao/vale-a-pena-ler-de-novo/218-o-crime-organizado-e-a-globalizacao>. Accessed Feb 19. 2019.

[19] Sa, Victor. **Bitcon is causing the proliferation of organized crime, Says Australian**Government. Available from: <https://portaldobitcoin.com/bitcoin-esta-causando-proliferacao-do-crime-organizado-diz-governo-australiano/>. Access on May 30. 2019.

[20]   CABETTE, Eduardo Luiz Santos. The demystification of the character of the penalty: the ineffectiveness of criminal law as a factor of containment of crime. **Jurid Newspaper,** 2016. Available from: <https://www.jornaljurid.com.br/print/doutrina/penal/a-demysmysificao-do-carater-da-pena-a-ineficacia-do-direito-penal-como-fator-de-contencao-da-crime>. Accessed On March 4, 2019.

[21]   Beccaria, Cesare. **Crimes and penalties.** S.L. Ed. Ridendo Castigat Mores, (1764). Available from: <http://www.dominiopublico.gov.br/download/texto/eb000015.pdf>. Access on May 23. 2019, p.67.

[22]   Veloso, Cesar Cury. **Social feather function.** 2011. Available at: <https://www.direitonet.com.br/artigos/exibir/6439/Funcao-social-da-pena>. Access on May 23. 2019.

[23]   Veloso, Cesar Cury. **Social feather function.** 2011. Available at: <https://www.direitonet.com.br/artigos/exibir/6439/Funcao-social-da-pena>. Access on May 23. 2019.

[24]   AMARAL, Augusto Jobim do. Essay on an agnostic theory of the penalty: boundaries between the political and the criminal law. **I'VE CONMANI.** Manaus. Available from: <http://www.publicadireito.com.br/conpedi/manaus/arquivos/anais/salvador/augusto_jobim_do_amaral.pdf>. Access on May 30. 2019.

[25]   For example, Kilduff says, that "In a context characteristicized by the backsliding of social policies", since it was observed, in the American penal system an "increase in the criminal and police functions of the state" that came to occupy "the place of social policy, with a strong displacement of public resources from social areas to the area of 'public security', thus, the "basically repressive and punitive policies" were favored, which in addition to expanding the penal system, elected it "as a privileged strategy by capitalist states to contain and manage in a criminalizing way the growing and increasingly complex manifestations of the 'social issue'". KILDUFF, Fernanda. Poverty control operated through the penal system. **Rev. Katál**. Florianópolis v. 13 n. 2 p. 240-249 Jul./dez. 2010, pp. 240-241.

[26]   For the French sociologist Wacquant, prison is the substitute for the ghetto or the urban precarious. WACQUANT, Loïc. Marginality, ethnicity and penalty in the neoliberal city. **Tempo Social,** sociology magazine of USP, v. 26, n. 2, 2014, pp. 143-145. Zaluar concludes that the problem of crime is not exclusive to poverty, and there is a complexity in the surroundings. ZALUAR, Alba. "Devil condo: the urban popular classes and the logic of iron and smoke". In: PINHEIRO, Paulo Sérgio. (Org.) **Crime, violence and**power. São Paulo: Brasiliense, 1983.

[27]   *WACQUANT, Loïc.* ***Punishing the poor:*** *the neoliberal government of social insecurity.*

Durham/Londres: Duke University Press, 2009, pp. 11-17.

[28]   WACQUANT, Loïc. Marginality, ethnicity and penalty in the neoliberal city. **Tempo Social,** sociology magazine of USP, v. 26, n. 2, 2014, pp. 143-145.

[29]   WACQUANT, Loïc. Marginality, ethnicity and penalty in the neoliberal city. **Tempo Social,** sociology magazine of USP, v. 26, n. 2, 2014, pp. 143-145.

[30]   TEIXEIRA, Sergio William Domingues. **High walls and rivers of blood:** the federal prison system and the expansion of criminal factions. Doctoral thesis. Porto Alegre: UFRGS, 2018. Available from: <https://lume.ufrgs.br/handle/10183/193205>. Access: 31 Jul. 2019, p. 36.

[31]   UNODC. PALERMO CONVENTION. Available from: <http://www.planalto.gov.br/ccivil_03/_ato2004-2006/2004/decreto/d5015.htm >. Accessed On April 22, 2019.

[32]   Spread around the world, organized crime is present on several continents, more identifiable in countries such as Mexico, Colombia, Africa, Japan (Yakusa); in the Balkans and China (Triads).

[33]   LUPO, Salvatore. **Mafia history: from the origins to our day.** I'm sorry. Álvaro Lorencini. São Paulo: Unesp, 2002, p. 15.

[34]   CAMPOS, Lidiany Mendes and SANTOS, Nivaldo. Organized Crime and prisons in Brazil. **MPA.** S.D., p.10.

[35]   CAMPOS, Lidiany Mendes and SANTOS, Nivaldo. Organized Crime and prisons in Brazil. **MPA.** S.D., p.10.

[36]   Understood as "the security-oriented collective based on identity and association, in which work is usually subdivided to generate goods and/or services established as illegal by existing States". *WILLIS, Graham Denyer.* ***The killing consensus:*** *Police, organized crime, and the regulation of life and death in urban Brazil. Berkeley, University of California Press, 2015, p. 08.*

[37]   SOUZA, Sergio Oliveira de. **Brazilian prisons are offices for organized crime**leaders. Available from: <https://sergiooliveiradesouza.jusbrasil.com.br/artigos/128105251/presidios-brasileiros-sao-escritorios-para-lideres-do-crime-organizado>. Access on May 13. 2019.

[38]   CAMPOS, Lidiany Mendes and SANTOS, Nivaldo. Organized Crime and prisons in Brazil. **MPA.** S.D., p.10.

[39]   This is- THAT'S IT. **PCC chiefs command drug trafficking in the u.S. and Paraguay's prison.** 2014. Available at: <https://istoe.com.br/373097_CHEFES+DO+PCC+COMANDAM+TRAFICO+DA+PRISAO+DOS+USA+E+DO+PARAGUAY/>. Access on Jun 1. 2019. Investigations of the Civil Police of São Paulo. The Civil Police has information that Wilson José Lima de Oliveira, the Neno, is in Orlando in the United States. According to Giudice, the suspicion is that he traveled to learn how Mexico's drug cartels organize.

[40]   RODRIGUES, Galtiery and CARNEIRO, Mariana. Assistant judge and lawyer are arrested suspected of selling sentences to faction in Goiás. **Newspaper O Popular.** Available from: <https://www.opopular.com.br/noticias/cidades/assistente-de-juiz-e-advogado-s%C3%A3o-presos-suspeitos-de-venda-de-senten%C3%A7as-para-fac%C3%A7%C3%A3o-em-goi%C3%A1s-1.1768965>. Accessed May 29. 2019.

[41]   WACQUANT, Loïc. **Punishing the poor:** *the neoliberal government of social insecurity.*

Durham/Londres: Duke University Press, 2009, p. 61.

[42]   FABIO. Andre Cabette. How overcrowding of jails contributes to the strengthening of organized crime. **I'm not a newspaper.** 2016. Available at: <https://www.nexojornal.com.br/expresso/2016/05/03/Como-a-overcrowding%C3%A7%C3%A3o-das-cadeias-contribui-para-o-fortalecimento-do-crime-organizado>. Access on Jun 1. 2019.

[43]   DALAPOLA, Kaique. Justice reduces penalty of 12 lawyers allegedly linked to the PCC. **R7.** 2018. Available at: <https://noticias.r7.com/sao-paulo/justica-reduz-pena-de-12-advogados-supostamente-ligados-ao-pcc-29102018>. Access on Jun 1. 2019.

[44]   RONDONIAGORA. **Lawyers are arrested accused of handing over a letter from a criminal faction to the inmate in Porto Velho.** Available from: <https://www.rondoniagora.com/policia/advogados-sao-presos-acusados-de-entregarem-carta-de-faccao-criminosa-a-presidiario-em-porto-velho>. Accessed On 01 Jun.2019.

[45]   Veloso (2003, p. 1)

[46]   FRANCE, Ronaldo França and CARNEIRO, Marcelo (March 5, 2003). **State of Calamity.** SEE online. Available from:<http://veja.abril.com.br/050303/p_036.html >. Access: 13 May. 2019.

[47]   RIBEIRO, Fabricio. **The state against the state.** São Paulo: Editora Clube dos Autores, 2017, p. 44.

[48]   Marcola was sentenced to 40 years in prison and also went on trial for having been one of the commanding officers of the murder against judge-correctionantonio Antônio José Machado Dias, murdered in 2003, in the city of Presidente Prudente. The victim was allegedly chosen because he was too strict with the prisoners and as a symbol to soften the faction's power because PCC leaders were under their jurisdiction.

[49]   SUPER INTERESTING MAGAZINE. **Organized Crime.** Sao Paulo, 2014, p. 24.

[50]   The PCC has the domain of approximately "90% of são Paulo prisons and for this time these deaths no longer occur. In the chains controlled by the PCC there are almost no murders." MAUÁ, Thales. **Rivals of the PCC are the ones who kill the most in prisons.** Available at <http://www.diariodolitoral.com.br/conteudo/26429-rivais-do-pcc-sao-os-que-mais-matam-em-presidis>. Accessed Feb 26. 2019.

[51]   Azevedo, Solange. Marcola's strange ascent. **Magazine This Is**. Available from:<http://www.terra.com.br/istoe-temp/edicoes/2087/imprime155568.htm >. Accessed Feb 26. 2019.

[52]   TRUMPET, Mayara Maria Colaço. Organized Crime and the Award-winning Delation Institute. **Intertemas Magazine**: São Paulo, 2010, p 25.

[53]   MAUÁ, Thales. **Rivals of the PCC are the ones who kill the most in**prison. Available at <http://www.diariodolitoral.com.br/conteudo/26429-rivais-do-pcc-sao-os-que-mais-matam-em-presidios>. Access in 26. Feb. 2019.

[54]   After having Marcos Williams' wife Herbas Camacho killed, Marcola, another PCC leader.

[55]   MAUÁ, Thales. **Rivals of the PCC are the ones who kill the most in**prison. Available at <http://www.diariodolitoral.com.br/conteudo/26429-rivais-do-pcc-sao-os-que-mais-matam-em-presidios>. Access in 26. Feb. 2019.

[56]   FEDERAL POLICE. **Final report IPL 222 of 2014 DRE - Operation la muralla**. Available from: <http://politica.estadao.com.br/ >. Access on May 10. 2019.

[57]   BALDRECA, Raecler(**The definition of competence for the prosecution and prosecution of crimes committed by criminal organizations.** São Paulo: USP, 2016. Available from: <https://tede2.pucsp.br/bitstream/handle/19548/2/Raecler%20Baldresca.pdf>. Access on 31 Jul. 2019.

[58]   SUPREME COURT. **Habeas Corpus 96.007 - Sao Paulo**. Available from: <http://portal.stf.jus.br/processos/downloadPeca.asp?id=124306255&ext=.pdf>. Access on 3 Jul. 2019. On August 2, 2013, Law 12,850/2013 was published, defining criminal organization in its article 1, §1, as: "the association of 4 (four) or more people structurally ordered and characterized by the division of tasks, even if informally, with the aim of obtaining, directly or indirectly, the advantage of any kind, through the commission of criminal offenses whose maximum sentences are more than 4 (four) years, or which are transnational", thus expanding the minimum number of members (from three to four) and the penalty to be considered (before or greater than four; now more than four years).

[59]   LEMOS JÚNIOR, Artur Pinto de; OLIVEIRA, Beatriz Lopes de. **Organized Crime and Law 12,850/13.** São Paulo: Verbatim Publishing House, 2014, p 17.

[60]   MENDRONI, Marcelo Batlouni(**Comments to the law against organized crime:** Law No. 12,850/13. São Paulo: Atlas, 2014, p. 17.

[61]   According to Santos, "To remove this leadership of oppressors of other prisoners, almost always occasional and occasional criminals, of little or no dangerousness is, above all, an act of humanity." SANTOS, Astério Pereira *apud* COSATE, Tatiana Moraes. Differentiated disciplinary regime (RDD): a necessary evil? **Public Law Magazine.** Londrina, V. 2, n. 2, May/Aug. 2007, p. 208.

[62]   CARONE, Carlos. PINE, Mirelle. Branching of the PCC in df works for 14 years and even has credit union. **Metropolises.** 2015. Available at: <https://www.metropoles.com/distrito-federal/seguranca-df/ramificacao-do-pcc-no-df-funciona-ha-14-anos-e-tem-ate-cooperativa-de-credito>. Access on 31 Jul. 2019.

[63]   VICTORIO, Diorgeres. **Plan "(c)anticrime" and isolation of "leaders" of the pcc. 2019.** Available at: <https://www.sifuspesp.org.br/noticia/colunas/coluna-do-diorgeres/6439-plano-c-anticrime-e-isolamento-de-lideres-do-pcc#deny>. Access on June 7. 2019.

[64]   BARBIERI, Gaius. From the government to the opposition, df politicians repudiate marcola's coming. **Metropolises.** 2019. Available at: <https://www.metropoles.com/distrito-federal/politica-df/do-governo-a-oposicao-politicos-do-df-repudiam-vinda-de-marcola>. Accessed 29 Jul. 2019.

[65]   CARONE, Carlos. PINE, Mirelle. Branching of the PCC in df works for 14 years and even has credit union. **Metropolises.** 2015. Available at: <https://www.metropoles.com/distrito-federal/seguranca-df/ramificacao-do-pcc-no-df-funciona-ha-14-anos-e-tem-ate-cooperativa-de-credito>. Access on 31 Jul. 2019.

[66]   The arrest of some amazonian drug lords and the transfer of these to federal prisons in the early 2000s was the starting point for the installation of organized crime in the state, driving away the family mercancia, because the first factions emerged, namely: the Northern Family - FDN and the First Command of the Capital - PCC. A series of murders rocked the struggle for territories of the two preponderant factions. CAVALCANTI JUNIOR, Jose Divanilson; SOARES, Lúcia Dídia Lima (2016). Organized crime: a new struggle for the dominance of territoriality. **Journal of Sociology, Anthropology and Legal**Culture. *On line.* Florianópolis: CONPEDI, 2016. Available from: <https://www.conpedi.org.br/publicacoes/y0ii48h0/i80k5078/UJfP3FG170knvMgh.pdf>. (Cached). Accessed On Apr. 4, 2019, pp. 201-202.

[67]   According to the report of the Federal Police, "The northern family - FDN was born from the union of Gelson Lima, federal police regional superintendence in the amazon DRE - Police Of Repression of Narcotics 20 carnaúba, alias "G" and JOSÉ ROBERTO FERNANDES BARBOSA, alias "Z", "MESSI" and / or "PERTUBA", known criminals of the State of Amazonas, who after spending a season serving time in federal prisons, returned to Manaus determined (or oriented) to structure themselves as a criminal faction". They have created a "STATUTE [...] containing rules and rigid pillars of hierarchy and discipline, for dissemination through extreme violence to inmates of the Amazonian prison system." FEDERAL POLICE. **Final report IPL 222 of 2014 DRE** -Operation**la muralla.** Pdf. Available at :<http://politica.estadao.com.br/blogs/fausto-macedo/wp-ontent/uploads/sites/41/2017/01/Relat%C3%B3rio-final-IPL-222-de-2014-DRE-opera%c3%87%c3%83o-la-muralla.pdf >. Accessed on March 02, 2019.

[68]   TEIXEIRA, Sergio William Domingues. **High walls and rivers of blood:** the federal prison system and the expansion of criminal factions. Doctoral thesis. Porto Alegre: UFRGS, 2018, Available at: <https://lume.ufrgs.br/handle/10183/193205>. Access: 31 Jul. 2019, p. 60.

[69]   OLD, Gilberto. Violence, reciprocity and inequality: an anthropological perspective. *In*: VELHO, Gilberto & Alvito, Marcos (Orgs.). **Violence and citizenship.** Rio de Janeiro, Ufrj/Editora FGV, 1996, p. 290-304.

[70]   TEIXEIRA, Sergio William Domingues. **High walls and rivers of blood:** the federal prison system and the expansion of criminal factions. Doctoral thesis. Porto Alegre: UFRGS, 2018. Available from: <https://lume.ufrgs.br/handle/10183/193205>. Access: 31 Jul. 2019, p. 60.

[71]   ARRUDA, Élcio. Federal prisons. **Revista CEJ,** Brasília, Ano XIV, n. 50, p. 52-61, Jul./Sept. 2010.

[72]   As Teixeira points out, there would be a challenge about the "idea of labeling, that is, who will be labeled as more dangerous, more violent, more perverse, or even as effectively identifying the behavior that should be addressed to disabling policies". For the author, "punishment, as well as crime, is within normal limits, and is therefore acceptable." TEIXEIRA, Sergio William Domingues. **High walls and rivers of blood:** the federal prison system and the expansion of criminal factions. Doctoral thesis. Porto Alegre: UFRGS, 2018. Available from: <https://lume.ufrgs.br/handle/10183/193205>. Access: 31 Jul. 2019, p. 37.

[73]   DIAS, Camila Caldeira Nunes. PCC: **Hegemony in prisons and monopoly of violence**. São Paulo, Saraiva, 2013, p. 186.

[74]   MANSO, Bruno Paes; DIAS, Camila Nunes. PCC, Prison system and management of the world of crime in Brazil. **Brazilian Journal of Public Safety**. São Paulo, v. 11, nº 2, 10-29, Aug/Sep 2017, p. 16.

[75]   Crimes such as: "Arms smuggling, trade in illicit goods, gambling, loan sharking, kidnapping, extortion, counterfeiting of goods, bank bonds and financial papers, mercenary killings, prostitution, human organ trade, sales of stolen goods, smuggling, money laundering and narcotics trafficking, then become part of modern organized crime." TEIXEIRA, Sergio William Domingues. **High walls and rivers of blood:** the federal prison system and the expansion of criminal factions. Doctoral thesis. Porto Alegre: UFRGS, 2018. Available from: <https://lume.ufrgs.br/handle/10183/193205>. Access: 31 Jul. 2019, p. 59.

[76]   TEIXEIRA, Sergio William Domingues. **High walls and rivers of blood:** the federal prison system and the expansion of criminal factions. Doctoral thesis. Porto Alegre: UFRGS, 2018. Available from: <https://lume.ufrgs.br/handle/10183/193205>. Access: 31 Jul. 2019, p. 124. In addition to support houses, other forms of communication and interaction between prisoners, family members, lawyers, who submit to assist organized crime, end up occurring, as reported by "A confidential report of the Federal Police of Mato Grosso reported that prisoners from Amazonas who were serving time in the federal prison of Campo Grande had had contact with the members of the group of 'mega drug trafficker' Luiz Fernando da Costa, the 'Fernandinho Beira-Mar'. That this would have received instructions on how to organize to face the actions of the police. Lawyers and relatives of the Amazon traffickers stayed together with the Beira-Mar group in a pension rented by the trafficker. For the prosecutor Fábio Monteiro the prisoners come back with their heads full of new ideas to invest in their criminal actions. SANTOS, Ana Paula Medeiros dos. **Northern Family: Case** study about a typically

Amazonian criminal organization. 2016. Master's thesis. Manaus: UEA/AM, 2016, p. 55.

[77]   The attitude of the legal operator, not only of the magistrate, must be aware of its tragic character, [...] always resisting punitive power. If punitive power is an 'irrational' force and criminal law must give way only to that part of it that less compromises the 'rationality' of the rule of law, the penal selection must be 'rational', to compensate – as far as it can – at selective ('irrational') violence from the punitive torrent. AMARAL, Augusto Jobim do. Essay on an agnostic theory of the penalty: boundaries between the political and the criminal law. **I'VE CONMANI.** Manaus. Available from: <http://www.publicadireito.com.br/conpedi/manaus/arquivos/anais/salvador/augusto_jobim_do_amaral.pdf>. Access on May 30. 1596, 2019.

[78]   "In some places in Latin America, homicide rates are stable or declining. In some cases, this is due to the presence of robust public institutions and the improvement of social and economic conditions. In others, however, it stems from the ability of organized crime to regulate the use of violence." GARZÓN-VERGARA, Juan Carlos. Regulation of organized crime violence and the reduction of homicides. *In* GARZÓN-VERGARA, Juan Carlos. What is the relationship between organized crime and homicides in Latin America? **Igarapé Institute.** 2016, p. 9. It is a fact that criminal organizations operate retaliation when arrests or deaths of their leaders occur. And on the other hand, they do not allow certain "minor" crimes to occur so as not to disrupt "business."

[79]   SOUZA, Arlen José Silva de. **Public policies to combat drugs in comparative law and the Brazilian public drug policy used in the Western Amazon, in the District of Porto Velho/RO.** Doctoral thesis. Porto Alegre: UFRGS, 2018. Available from: <https://www.lume.ufrgs.br/bitstream/handle/10183/189512/001088333.pdf?...1>. Access on 31 Jul. 2019, p. 149.

[80]   CF. FROTA, Hidemberg Alves da. Concrete need for the penalty and principle of proportionality. **Revista CEJ,** Brasília, Ano XII, n. 41, p. 24-32, Apr./Jun. 2008, p. 31.

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Comparative Study of the Contact Angle in Fabrics Treated with Plasma

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Abstract— Among the techniques of modifying the properties of the surfaces applied in the industry, plasma treatment is widely used. Several studies have been conducted, especially in the last decade, analyzing textile articles of different fibers regarding the improvement of functionalities. This work evaluated the effect of plasma (corona discharge) treatment on polyamide 6.6 fabrics with elastane, establishing a comparison of the contact angle between treated and untreated samples. A significant reduction in the contact angle value of the treated samples was observed, increasing the absorption capacity of the fabric.

I. INTRODUCTION

Studying the characteristics of fibers (physical and chemical properties) is fundamental to establish a relationship with the comfort properties of the finished product. The modification of surface properties creates unlimited possibilities for the development of new products for the textile industry, improving the comfort and functionality of the fabric. In physics and chemistry, plasma is considered a partially ionized gas containing electrons, positive and negative ions, radicals, atoms, and molecules. Ionization is caused by the introduction of energy in all gas through direct electric current, radiofrequency, or microwave energy sources (INAGAKI et al., 1997; INAGAKI et al., 1999). Concerning the thermal state of the gas, there are two types of plasma: hot and cold. Hot plasmas, characterized by an average temperature between 1500 and 3500ºC, are used in the

surface treatment of metallic materials to increase the hardness of metal alloys. Cold plasmas with a temperature below 100ºC are most often used in the treatment of materials with a low melting point. In polymeric materials, cold plasma is used to improve surface properties, such as wettability and adwe, through the interaction of reactive species with the surface (CAIAZZO, 1996). The effect of plasma treatment on a given material is characterized by the type of chemical reaction between its surface and the gases present in the plasma and the changes that occur on the surface depend on the chemical composition of the polymer and gases used (D'AGOSTINO, 1999). In general, the treatment of a polymer with plasma produces significant changes in wettability and adwe, due to changes in chemical composition, contact angle, molecular weight, and morphology of the surface layer. The effects of plasma treatment, even if the intensity of the activity of reactive species on the surface is high, affect only one

surface layer (approximately between 50 Å and 10 μm thick) (COOPES et. al, 1982). There are two processes of interest in plasma study, low pressure (approximately 1 torr) and atmospheric pressure. Plasma at atmospheric pressure has a typical example, the treatment by Corona Discharge (COOPES et. al, 1982). Corona Discharge in Atmospheric Air consists of positively charged ions, electrons, excited or metal-oxygen, and nitrogen species. The energies of the particles (1-20 eV) are sufficient to break C-C and C-H bonds (2.54 eV and 3.79 eV, respectively) and generate free radicals on the polymer surface, which can react with oxygen atoms and form polar groups, mainly CO, C=0, C-O (FRALEY and MEKA, 1994). In the present work, the samples were treated with corona discharge in atmospheric air. The contact angle represents an important factor in the absorption process, studying their behavior in mesh tissues after treatment with plásmatic discharge, possibly a better understanding of changes in surface properties.

II. MATERIALS

2.1 Circular knitting data

Table 1 shows the circular knitting data.

Table 1. Fabric sample data

Knitting	Single jersey
Composition	92% PA/8% Spandex
Machine (needles/inch)	38
Weight (g/m²)	180

III. METHODS

3.1 Equipment for measuring the dynamic contact angle. The device used to measure the dynamic contact angle was the FTA 1000 model.

3.2 Plasma equipment

The equipment used for the treatment of knitted fabrics was Plasma Labo, from the textile machine manufacturer Arioli (Figure 1).

Fig.1: Laboratory plasma equipment

Table 2 shows the general specifications of the equipment:

Table 2. Equipment specifications

Work speed (m/min)	5 to 30
Power (Kw)	1.5
Time cycle (ms)	50 to 2000
Frequency (Khz)	30 to 80

The fabric sample was treated with 1.5 kW. The area of the treated knitting was 25x60 cm².

IV. RESULTS

The following graphs show the values of the contact angle (°) of the drop deposited on the textile surface as a function of time (dynamic contact angle). The value of the table of the deposited drop represents the initial value of the contact angle.
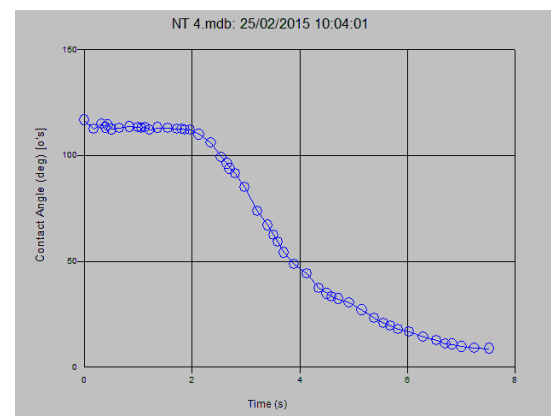
Fig.2: The contact angle of the untreated sample.
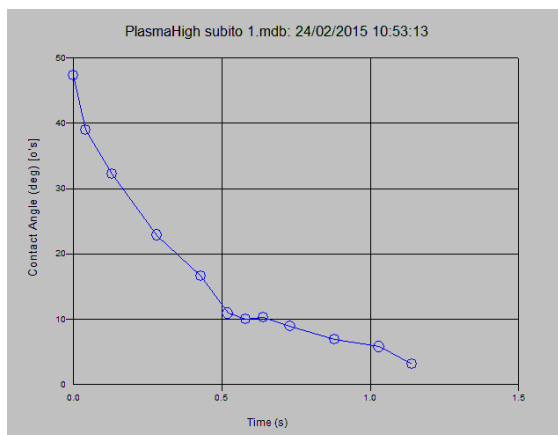
Fig.3: Dynamic contact angle measured right after treatment.
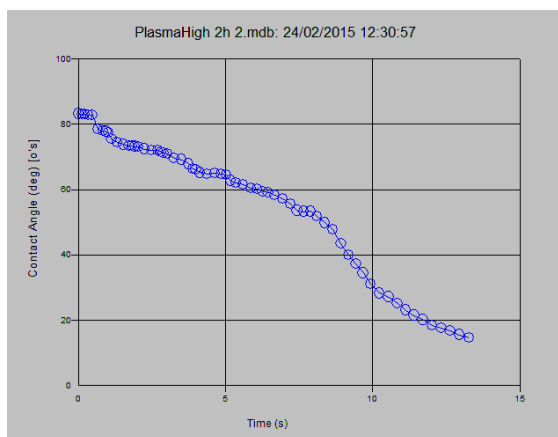
Fig.4: Dynamic contact angle measured two hours after treatment.
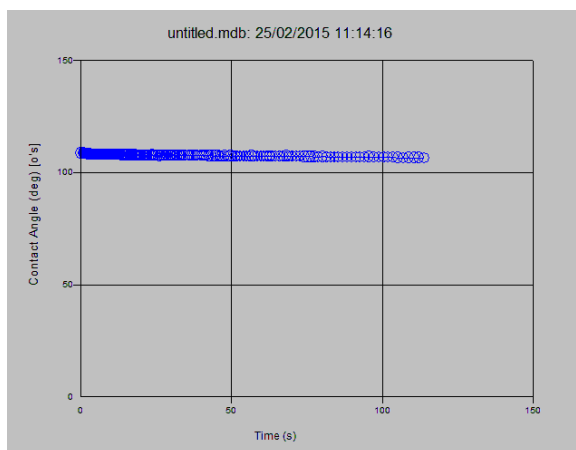
Fig.5: The contact angle of the sample was measured twenty-four hours after treatment.

V.   CONCLUSION

The plasma-treated sample shows a significant reduction in the contact angle; both static and dynamic. After

twenty-four hours, there is no difference in the value of the initial contact angle between the treated and untreated samples.

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Action to Combat the Environmental crime of the Brazilian Amazon: The case of the Integrated Operation of the "Ponta do Abunã"

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Abstract— *The objective of the study was to analyze the integrated inspection model of the Superintendencies of Ibama do Acre, Amazonas and Rondônia (integrated action) carried out in the Ponta do Abunã region as a more efficient and effective inspection model to be carried out in the State of Rondônia and in Western Amazon. Materials and Method: it's a case study. Two semi-structured instruments were applied with three subjective questions, comprising three axes: 1st Axis - characterization of the positive aspects; 2nd Axis - characterization of negative aspects; 3rd Axis - pointing out improvement measures to be integrated into the inspection model. The first instrument was applied to the Focus Group, consisting of the members who participated in the environmental inspection operation "Ponta do Abunã" and the second instrument applied to the Steering Group of the institutions that promote and execute environmental policies. Results: it was possible to perceive that the integrated inspection model has a greater protection of the environment in all spheres, given the improvement in the organization and the maximization of the use of resources. However, there is a lack of equipment and a logistics structure for the transportation and storage of seized goods. Thus, it could be perceived that there was an improvement in the State's capacity to prosecute violators, however, improvement actions are needed when dealing with the seized assets. Final considerations: it stands out as a positive point pointed out by the group the greater protection of the*

environment in all spheres, given the improvement in the organization and the maximization of the use of resources. The integration between the political and administrative entities allows inspection action of superior technical quality and with lower costs. In the perception of inspection agents, actions occur infrequently and this results in the loss of inspection effectiveness. According to the researched group, a more continuous inspection would bring better results.

I. INTRODUCTION

The history of deforestation and degradation of nature in Brazil has been a cause for concern and discussions aimed at promoting and adopting intervention measures aimed at eradicating it. It is known that at a global level, debates have been taking place in a fierce way, seeking to put an end to this situation. The political and economic development of the Amazon region and speculation of land along the roads, growth of cities, increase in cattle ranching, timber exploitation and family farming (more recently mechanized agriculture), mainly linked to the cultivation of soy and cotton, with this advancing in deforestation, has caused great losses of critical functions of the Amazon, requiring urgent measures of conservation and conscious use of its natural resources [1];[2]; [3].

Data from the Ministry of the Environment (MMA) point out that the deforestation process normally begins with the official or clandestine opening of roads that allow human expansion and the irregular occupation of land to the predatory exploitation of hardwoods. Subsequently, the exploited forest is converted into family farming and pastures for extensive cattle breeding, especially on large properties, this factor being responsible for about 80% of the deforested forests in the legal Amazon. But recently, pastures are giving way to mechanized agriculture linked mainly to soybean and cotton crops [4].

One of the great villains of the increase in deforestation rates in the Amazon and in Rondônia has been the increase in economic activities, making the situation increasingly critical, especially in recent years, which has caused, over the years, an intense struggle and in the search for solutions.

The understanding of the socio-environmental structure, as well as the historical aspects is of great relevance when planning environmental actions and activities, especially when it comes to the preservation of Amazonian forests, in which the forests of the State of Rondônia are inserted. In this context, it is necessary to understand the implementation and execution of environmental policy in the State of Rondônia so that it is possible to clarify, in a conscious and citizen way, to

express an opinion and intervene in projects that will certainly influence their lives and the community / society that has existed for a long time.

Within the scope of the Inspection Plan in Rondônia, the theme turns to control and access actions, mainly to protected areas, aiming to avoid the illegal occupation and extraction of wood around indigenous lands and conservation units. Although in the previous plan for the prevention and control of deforestation in Rondônia there was a zero rate predicted until 2015, it is worth mentioning that the main agents of deforestation continue to be small rural producers (settlers), migrants and landless, farmers, farmers, loggers, through of hidden deforestation.

With regard to inspection as an instrument to reduce degradation, the emphasis is on delegated responsibility to citizens and the State, to companies and institutions, duly supported by the Federal Constitution[5].However, it is noteworthy that it is up to the public authorities to ensure this inspection, using embargoes and measures that effectively combat deforestation. In this context, the Brazilian Institute for the Environment and Renewable Natural Resources (IBAMA) appears as an agency for action and combat, duly supported by legislation. In the state of Rondônia, the local peculiarities that require your intervention are challenging, and it is up to the partnership between the Union and the State to carry out actions aimed at protecting, preventing and fighting forest destruction.

In this sense, a way to achieve better results would be an option of integrated inspection between the different bodies responsible for the inspection and fight against deforestation, through the formation of teams composed of representatives of all the bodies, institutions and powers to face the difficulties and seek alternatives to remedy them, mainly through projects aimed at spreading human rights and protecting the environment.The research is justified since it offers subsidies for the awareness of the importance of popular participation in the defense of an ecologically balanced environment and promoter of healthy life through a joint inspection where partnerships are established between the federal and state governments, agencies and sectors responsible, among them IBAMA, so

that they assume a strong mobilization in favor of conservation and sustainable use.

In this context, IBAMA is responsible for executing an action plan that prioritizes the identification of problems and, in the face of them, search for alternatives that elucidate their implications, where control and monitoring, protected areas and territorial ordering are emphasized, encouraging sustainable activities so that inspection takes place effectively. The establishment of partnerships between the federal, state and municipal spheres, as well as the bodies with competence to act in the area, becomes a possible instrument for strengthening the application of the integrated action for the inspection of IBAMA, a fact observed in the case of the Operation Ponta do Abunã in Rondônia.

1.1 DESCRIPTION OF THE PROBLEM SITUATION

The efforts made by States, Municipalities and the Federal District to deal with the complexity that involves environmental issues require collective care from the whole organized society in favor of eradicating deforestation and environmental degradation. What underscores the extent of environmental damage and the emerging need for valuing, preserving, controlling and inspecting natural assets through attitudes that influence local and planetary sustainability.

Thus, actions such as training, educational campaigns, observation posts, patrolling and inspection, training of brigades, in addition to measures aimed at fighting fires, through a plan for preventing, controlling and fighting fires and investigating their causes, monitoring outbreaks via satellite and specific fire inspection operations have been developed by IBAMA in view of the initial policy adopted and the current reality of deforestation in the State of Rondônia.

In this context, the research was guided by the following problem: The actions developed by the State of Rondônia in the face of the problem of deforestation have observed the constitutional principles, adapting the inspection methods of IBAMA to local situations, and given an account of effective control and prevention of deforestation in the state through sustainable alternatives?

In this context and with the objective of further deepening the study on deforestation, the integrated action that took place in the Ponta do Abunã region, in the state of Rondônia, was chosen with representatives of the Brazilian Army, Federal Police (PF), Federal Highway Police (PRF), Military Police of the State of Rondônia (PMRO), National Police and IBAMA of the Superintendencies of Acre, Amazonas and Rondônia. When analyzing and discussing this situation and based on the knowledge of IBAMA's form of inspection, it is

intended to suggest the implementation of an integrated action plan, in which inspection strategies are carried out that include inspection based on environmental quality indicators, where the integrated action between IBAMA, governmental spheres and authorities of the various bodies responsible for the environment, is capable of preventing, controlling, inspecting and punishing those responsible for damages, contributing to the environment and, consequently, the quality of human life.

The panorama of deforestation in Rondônia requires a preventive character to face it in critical areas. In this sense, there is a need for guidelines to be established for sustainable development. Thus, the guarantee of a management area for sustainable development must be a concern of the government, since the current legislation allows the forest concession in public areas for the supply of raw material, with a view to this development. Following the national environmental policy, the environmental policy of the State of Rondônia presents actions that enable the execution of projects that provide for the selection and hiring of companies for sustainable exploitation through the forest management of the areas of the State Forests of Sustainable Income, with the commitment protecting and conserving your resources. Although there is an environmental policy duly supported by the current environmental legislation, with projects and actions aimed at sustainable yield, it must be admitted that the environmental inspection carried out in the State of Rondônia is not able to meet the great demand for illegal deforestation, corroborating for there to be greater incidence of illicit acts performed and less accountability of offenders.

The State of Rondônia requires the implementation of a policy consistent with regional needs, capable of monitoring deforestation, heat sources, natural regeneration, licensed properties, and a duly approved management plan, with accessibility via the Internet, therefore not meeting the scope of legality, prevention, inspection and control of the demands presented in the face of disorderly deforestation and the negative consequences that this deforestation brings to the State, to Brazil and to the world. Thus, this research aimed to analyze the integrated inspection model of the IBAMA Superintendencies of Acre, Amazonas and Rondônia (integrated action) carried out in the Ponta do Abunã region as a more efficient and effective model of inspection to be carried out in the State of Rondônia.

II.   MATERIALS AND METHODS

2.1 TYPE OF RESEARCH

The research is characterized primarily as to the means or according to the procedures for the collection of information as a Case Study. Regarding the use of results or their purpose, they can be classified as applied research, qualitative in terms of their nature or in terms of approach and descriptive in terms of purposes or objectives. Bruyne et al[6]affirm that the case studies allow the application of "techniques of collection of information equally varied (observations, interviews, documents)" to generate an analysis of an organization or to measure some performance. In Yin's [7]view, the case study type of research seeks to broaden and generalize theories based on theoretical analysis and not from a statistical perspective. Although the case study can also use quantitative methods to support the collection and treatment of information, in this research only the qualitative approach was used. For Godoy [8]even though, in essence, it has a qualitative character, case studies can also contain quantitative data to clarify some aspect of the question investigated. The study of a case allows the professional to observe, understand, analyze and describe a certain real situation, acquiring knowledge and experience that can be useful in decision making in the face of other situations. It is a method of investigation in which the professional has a great involvement and that includes as steps, the collection of information, a process of thought, constituted by data analysis and determination of solutions, and a process of judgment or evaluation [9]. The practical value of the case study and analysis is to provide an opportunity to examine a real life situation.

2.2 DATA AND INSTRUMENT COLLECTION TECHNIQUE

Gil [10]asserts that the data collection technique in a case study is used to: a) explore real-life situations whose limits are not clearly defined; b) describe the situation in the context in which a given investigation is being carried out; c) explain the causal variables of a given phenomenon in very complex situations that do not allow the use of surveys and experiments [11]; [12] and [13]. The present case study was carried out through the application of 2 semi-structured instruments, individually with the research subjects. As a data collection instrument, the interview previously prepared with open questions was used. The instrument is composed of three subjective questions comprising three axes: 1st Axis - characterization of the positive aspects adopted by the integrated inspection model; 2nd Axis - characterization of the negative aspects adopted by the integrated inspection model; 3rd Axis - pointing out improvement measures to be integrated into the inspection model. The first instrument for collecting data and information was applied to the Focal Group, made up of members who participated in the

environmental inspection operation "Ponta do Abunã". We opted for the use of the Focus Group technique in order to understand the perception and conception of environmental agents in relation to the "Ponta do Abunã" inspection model. To this end, a script of interviews was constructed to carry out the technique, placing questions that indicate the main positive, negative aspects and notes for the improvement of the inspection model. According to Prates et al [14] the Focal Group technique brings together the social actors that are linked from common perspectives, so it allows: […] the exchange of ideas, experiences, feelings, beliefs, behaviors and points of view, providing reflection and, even, the change of opinion or the reasoning of the initial position. With this technique, through group integration, it is possible to understand how the perceptions, daily practices, representations and symbologies of a certain group are constructed [15]; [16]; [17]. Through the technique, group discussions take place that allow us to understand the way individuals see the world and their different life experiences. The results, in turn, are obtained directly from the statements coming from the group's reports, at the moment when they describe their perceptions about the investigated theme. For the citations of the agents designated in this research, the acronym "P" was adopted, followed respectively by a number. Although it was not mandatory for the interviewees to be identified, only one of the nine interviewees did not identify. All team members who participated in the research are male, working with the inspection: 02 two years ago; 03 with experience varying between five and eight years; 01 to 19 years; 01 to 25 years; 01 to 36 years; and 01 that did not inform the time of experience, that punctuated the integrated inspection model according to the researched axes. The second instrument for collecting data and information was applied to the Steering Group, made up of the members who planned the environmental inspection operation "Ponta do Abunã".

2.3 SAMPLE SIZE AND SAMPLE SUBJECTS

A fraction of these individuals in the population, when studied in isolation, is called the sample. Sample corresponds to a subset of the population from which a value judgment is created regarding universal characteristics. Sample corresponds to a subset of the population from which a value judgment is created regarding universal characteristics. According to Kazmier [18], there is a random sample using "a procedure such that each member of the population has a known probability of being chosen and that does not have any known source of systematic error". The decision for the sample size was referenced in the Central Limit Theorem, presented by Kazmier (2008): "As the sample size

increases, the distribution of the average sample approaches the form of the normal distribution, whatever the form of population distribution". In this work, the limit reference adopted by Kazmier[18]was used, that is, a sample of 10 environmental agents, environmental police from the Military Police and environmental authorities was used, regardless of age and sex / gender and time of environmental inspection. In this sense, the sample granted for accessibility was a group formed by 10 agents (9.25%) of the total of environmental agents in a total universe of 108 subjects. The data and information collected were described as answered by the research subjects.

2.4 ETHICAL ASPECTS

The research subjects were informed about the objective, nature, risks and benefits of the study. It was only after signing the informed consent form that they were submitted to the application of the semi-structured instrument (questionnaire). Inclusion Criterion: All those who answered the instrument and returned it to the researcher. Exclusion Criterion: All subjects who received the instrument even after signing the informed consent form and did not return the instrument duly answered.

III.   RESEARCH RESULTS AND ANALYSIS

4.1 CASE STUDY: PONTA DO ABUNÃN OPERATION

The present research is the result of a case study, here the data obtained in the operation Ponta do Abunã adopted as an inspection model are presented, on which the following aspects are evidenced:

1. Regarding the Inspection Model: Corresponds to the permanent, shared and joint inspection action, between the IBAMA superintendencies in the states of Acre, Amazonas and Rondônia and, IBAMA Headquarters. The model was constructed from information from the intelligence services of the Brazilian army, federal police, federal highway police, ABIN, Funai, civil police, public agents selected by the superintendencies and employees infiltrated in business organizations and local society, in addition to information from municipal governments, ICMBio, MDA, INCRA, registry offices, municipal and state finance departments, among other employees. In this context, it is structured around a set of managers and civil servants active in the inspection, in its daily planning and execution process, and must be carried out with a concentration of efforts in large scale and visible actions, with objectivity, technical zeal for discipline [19]; [20]; [21]; [22].

2. Regarding the Study Area: The Ponta do Abunã region comprises the Vista Alegre do Abunã, Extrema and Nova Califórnia Districts that are part of the Municipality of Porto Velho. It also covers the southern part of the municipality of Lábrea, in the state of Amazonas, which connects with this region of Rondônia, through several branches that enter the territory of the state of Amazonas. These areas are close to the State of Acre, presenting relations regarding the main environmental illicit activities in the region. The main economic activities in the region are cattle ranching and logging, both with a ballast of illegality over the years, and with recent intensification, especially in illegal logging and fraudulent transactions in the control system (DOF). Over the past few years, the Ponta do Abunã region has been the target of major illegal deforestation aimed at the implantation of livestock activities, as well as the commercial exploitation of high-value forest species by timber companies. In addition to the activities of illegal logging and use of wood by the timber industries, there is also the occurrence of fraud with the DOF System, aiming at the acquisition of wood credits to "warm up" (legalize) them.

3. Regarding the Operation under Study: The objective of the operation was defined as that of combating illegal deforestation in areas of Amazonian forest, on indigenous lands, Conservation Units, Settlement Projects and private properties, as well as combating illegal logging. According to the Ministry of the Environment [19] and [20], the fight against illegal deforestation is at the center of the Brazilian strategy to face climate change. To this end, the country has already put in place specific plans to protect the forest and encourage sustainable activities in the Amazon and the Cerrado, including goals for reducing the loss of vegetation cover in both biomes. The main instrument of the Brazilian government to combat the problem is the Action Plan for the Prevention and Control of Deforestation in the Legal Amazon [4].

4. Regarding Deforestation in the region: Brazil has great vegetation cover, which favors deforestation. Very serious crimes, such as burning and deforestation, are devastating this Brazilian vegetation cover very quickly.

5. Regarding Combat Actions: To combat illegal deforestation, activities aimed at mapping deforestation polygons were adopted, as well as drawing up infraction notices and areas embargoes. In this case, information on the polygons inspected was issued by the Monitoring Centers (Geoprocessing), with the procedures being discussed and defined jointly by the respective Technical Divisions (DITEC), with the main and priority focus on the identification of the deforestation polygons in progress and still in the initial phase, for preventive combat, that is, before it happens or expands. Priority was given to environmental offenses identified within Indigenous

Lands, Conservation Units, Public Lands and, finally, private properties.

6. Regarding the Inspection Routes: The missions were daily, with the shortest possible routes, with three to six polygons, and if, after two days, a team had difficulty locating the violators, they should communicate with the operation coordinator, who could assign these calls to another team, then assess the situation.

7. Regarding the Executed Actions: Request for administrative processes related to the target projects, through official letter from IBAMA to the environmental agencies of the states of Amazonas and Rondônia; Field surveys carried out by a team of specialists, coordinated by an environmental analyst from one of the Superintendencies of the states of Acre, Amazon and Rondônia; Procedures for administrative assessments and embargoes, instruction and judgment of processes; Surveys of illegal companies that work to buy and sell virtual wood credits in SISDOF, as well as surveys of companies that have a large volume of wood in the yard; Supervisão, transporte e armazenamento de madeira no pátio das empresas; Permanent guard of the seized wood and equipment until its undoing; Preparation of inspection reports, infraction notices, seizure terms, deposit terms and embargo terms; Open administrative procedures with the SEI. Fixed and mobile barriers were also implemented in the main outlets for illegal timber aimed at combating the illegal transportation of timber from its origins to the beneficiation site, thus discouraging illegal exploitation. Barriers were set up on the main illegal wood outlets, as well as on interstate outlets (federal highway BR 364), which was under the responsibility of the Federal Highway Police.

8. Regularity: With regard to the activity of verifying the situation of regularity of the logging companies with the DOF System, this activity aimed to combat illegal companies, which operate with the sole purpose of generating fictitious credits in the DOF system for heating illegal wood.

9. Regarding the Collection of Data / Information: The information for carrying out these activities was provided by COINF / DIPRO / IBAMA-SEDE, which was filtered by NUINT / AC and NUCOFIS / AC, in order to determine the targets.

10. As for the Inspection Targets: The inspection targets were defined by the Intelligence Nucleus of the entities involved and by the Monitoring and Information Nucleus of the respective Superintendencies and the action procedures were discussed and defined jointly by their Technical Divisions and by the representatives of the command or control bodies participating in the operation.

11. Regarding the Hierarchical Organization: The higher authority was exercised hierarchically by the Presidency of IBAMA, the Director of DIPRO and the General Inspection Coordinator. This instance has the role of ratifying the Operational Plan and providing the necessary resources and means to carry out the Operation, being able to decide on any point of the Operational Plan, aiming at the achievement of institutional goals and objectives. The general coordination exercised in a collegial manner by the Superintendents of the Superintendencies of Acre, Amazonas and Rondônia, has the role of approving the Operational Plan and submitting it to the higher authority for approval, defining the general guidelines, supervising, monitoring and guiding the coordination actions executive and the execution of activities.

12. As for the sharing of responsibilities: Knowledge about the progress of the work is shared in real time with the three Superintendencies, through their DITEC's and NUFIS, in addition to the intelligence services of the partner agencies. It was suggested the creation of a Specific Unit in the Document Management System of IBAMA (SEI), called "Ponta do Abunã Operational Unit", to accommodate the processes, reports, consolidated spreadsheets, images and data on the activities in execution, being that the generated processes are attributed to those responsible for field actions, as well as to DITEC's, Superintendents, COFIS and CGFIS. The role of the Superintendencies was to indicate the targets; appoint the coordinators of the work teams; establish the guidelines and procedures for the teams to act within the scope of the action lines; establish partnerships with institutions so that they can receive seized products, as well as for the development of actions in the field; establish the permanent communication channel with DIPRO and its Coordinations; provide the necessary logistics for the withdrawal and deposit of seized products and prepare management reports to be shared by DITEC and Offices. While the role of CGFIS (COFIS and COINF), it was determined that it should focus on providing the resources and means for the logistics necessary to carry out the activities listed in the lines of action; transfer of budgetary resources; availability of specialized teams and recruitment of federal environmental agents based in other units of the Federation.

13. Regarding the opening of Infringement, Instruction and Judgment Proceedings: The formalization of processes has followed the current legal parameters, in compliance with the provision contained in Instruction Normayiva 10/2012 of IBAMA that the processes will be opened, instructed and judged (if applicable) in the state of origin of the infraction. Thus, it is up to the inspection teams and the coordination of operations to forward the infraction notices

and terms for opening the processes to the respective superintendence, or, if possible, a special Unit must be registered in the SEI System so that the processes can be opened and instructed in the base itself.

14. Regarding the Destination of Seized Goods and Products: All available means must be used to collect the seized goods, and the destruction must occur only in extreme cases and when its removal is not proven to be possible, even in Indigenous Lands or Conservation Units. The vehicles and equipment will be entrusted to the faithful depositary, which may be the institution itself, where it can be reverted to the equity, or to local institutions, and the processes must obey the accelerated rite for judgment and forfeiture decision for donation on an urgent basis. The seized products are classified into four categories: durable: machines, vehicles, boats, equipment and live animals; non-durable: tools, utensils, equipment, weapons and ammunition, parts, lubricants and agricultural products in their original packaging, processed wood and forest products, packaged and stored in storage; consumption: general goods, parts, lubricants and agricultural products outside their original packaging; perishables: Meat, fish, slaughtered animals, wood and products of forest origin in natura, in its raw state subject to the weather.

15. Regarding the use of vehicles, expedient material, equipment: The use of vehicles, depending on the amount needed, must be shared between the superintendencies involved. A permanent fleet of 08 vehicles and one to serve the Operational Nucleus must be maintained at the Operations Base. Other vehicles may be requested as needed.

16. Regarding the Composition of the Workforce: The number of personnel to be used in the Operation's workforce consists of employees of the institution itself, partner institutions and support personnel to be hired for specific activities, which require specialized knowledge or operational support. For the safety and support of the teams in the field and at the Operational Base, the police force of the Military Police of the three States and Battalions of Environmental Police were used. And in the first three months of the Operation, it counted and / or can count on the reinforcement of other security agencies, such as PRF (Federal Highway Police), Federal Police, National Force and the Brazilian Army.

17. Regarding the Staff: It comprises a permanent and support team, in the following aspects (Table 1).

Table 1: IBAMA and Security personnel - Permanent team

Specification	Type	Amount	Total
Team Coordinator	AAF - Environmental analyst -IBAMA	1/team	09
Federal Environmental Agent	AAF – IBAMA	6/team	54
Agent Geo	Agent Geo – IBAMA	1/team	09
Administrative support	Technician – IBAMA	2/team	18
Safety	BPA/PM	12/team	108

Table 2: Support staff

Specification	Activity	Amount	Total
Truck driver	Removal of Seized Goods	2/ team	18
Machine operator	Yard loading and handling	1/ team	09
Botanical Identifier	Assistance in the Management Plans and sawmills yards	1/ team	09
Patio support	Measurement and movement of sawmill yard	3/ team	18

18. Regarding the Scale of Performance of the Superintendencies (Table 3).

Table 3: Performance of the Superintendencies

RESPONSIBLE		Mar	Abr	Mai	Jun	Jul	Ago	Set	Out	Nov
ACRE										
Coordination		01			01			01		
Agent Geo		01			01			01		
Administrative support		02			02			02		
Federal Environmental Agent		02	02	02	02	02	02	02	02	02
AMAZONAS										
Coordination				01			01			01
Agent Geo				01			01			01
Administrative support				02			02			02
Federal Environmental Agent		02	02	02	02	02	02	02	02	02
RONDÔNIA										
Coordination			01			01			01	
Agent Geo			01			01			01	
Administrative support			02			02			02	
Federal Environmental Agent		02	02	02	02	02	02	02	02	02

19. Regarding the Establishment of Partnerships: The operation can also count on the reinforcement of personnel from the Brazilian Army and the Federal Highway Police, in addition to other partnerships with the Federal Police, ANATEL, ANAC, FUNAI, ICMBIO, MDA, INCRA, SEFAZ and City Halls.

20. Regarding the Schedule of Activities: It presents itself with the following activities: Aiming of targets: from January to November; Elaboration of performance procedures: from January to February; Preparation of management reporting models: from January to February; Preparatory events: from January to March; Combating illegal deforestation: from February to November; Combat illegal logging and infractions in SISDOF: April and November; Preparation of management reports: from March to December.

4.2 PERFORMANCE AND RESULTS OBTAINED FROM THE PONTA DO ABUNÃ OPERATION

As for the line of action: Operation Ponta do Abunã was mainly aimed at combating illegal deforestation (polygons) and illegal and disordered logging. The latter encompassing Forest Management Plans, Exploration Plans, Forest Transport, Industries and wood deposits and infractions committed in SISDOF.

Regarding the Evaluation: When dealing with the assessment of individual performance, the plan foresaw the inclusion of an individual goal in the work plan of the Nuclei for Prevention and Assistance to Environmental Emergencies - NUPAEM, in the following terms: I - provide assistance to at least 50% of environmental emergencies of federal competence, according to art. 5 of the Internal Regulations for Environmental Emergencies (RIEMA); and II - execute the minimum number of shares listed in Attachment III. Single paragraph. Those responsible for the NUPAEM will be able to distribute the actions listed in Annex III to the Environmental Emergency Agents and other members of the NUPAEM of their unit, after hearing the head of the Technical-Environmental Division.

4.3 AS TO THE PRIMARY DATA OBTAINED FROM THE RESEARCH

Regarding the analysis of the data obtained from the quantitative aspects of the research, the support was given by the teachings of Bardin [23], using the interview as a non-directive research resource, as it consists of open questions.

As for the Characterization of the aspects considered positive adopted by the integrated inspection model. The interviewee was asked to point out at least 3 aspects considered positive, adopted by the integrated inspection system. In view of the item presented, the following aspects stand out: Of the group interviewed, 66% pointed out as the main positive aspect the greater protection of the environment in all spheres, given the improvement in the organization and the maximization of the use of resources; 44% the number of professionals in the inspected regions; 33% the largest coverage in the supervised area; 33% of the group said that the knowledge of those involved in the inspection activity is also a positive point to be considered; 22% pointed out the highest number of assessments made; also, 22% said that concurrent administrative support with support for inspection personnel; for 11% of the group, another positive point is the integration between police and state and federal agencies; and 11% also understood that the detection of other crimes is a positive point.

It can be seen from the interviews that the Ponta do Abunã operation has contributed significantly to the control of deforestation and, consequently, of the consequences that it can cause due to the greater protection of the environment and, also, as pointed out in the positive aspects, evidenced by the interviewees, has contemplated the actions of PNAPA. The social responsibility delegated to the environmental protection agencies stands out, with the integrated action being a mechanism to ensure the aforementioned process of control, prevention, inspection, evaluation and dissemination of an environmental policy aimed at environmental quality, the forest management for multiple use in family properties, as well as the certification of production units.

Among the aspects considered positive adopted by the integrated inspection model, the following aspects stood out: 1. Support from the partnerships of the Superintendencies: Rondônia, Acre and Amazonas, which enabled interaction within the inspection operation plan. 2. Coordination performance that, even with equipment difficulties, did not measure efforts in the execution of activities. 3. Dynamics of administrative support, through the intensification of work in the preparation of consolidated reports and opening of processes.

As for the characterization of the negative aspects adopted by the integrated inspection model. Each interviewee was asked to point out at least 3 aspects considered negative, adopted by the integrated inspection system. In view of the item presented, the following aspects are highlighted (table 4).

Table 4: Negative aspects

Negative aspects	Percent
Lack of vehicle, trucks to transport seized goods and their logistics	55%
Lack of storage space for seized goods	33%
Almost no exchange of information	22%
Lack of SEI system integration for process monitoring	22%
Lack of team training	22%
No counterpart from the federal agency to the state	11%
Existence of personal conflicts	11%
Conflict of competences between institutions	11%
Difficulties in organization and general control	11%
Lack of place for accommodation for all involved, without division of teams	11%
Shortage of inspection personnel, as well as inspectors with inspection ordinance	11%
Difficulties in identifying those responsible for properties with deforestation	11%
Project management authorization in areas bordering forest reserves	11%
Lack of support and immediate communication in emergencies	11%
Difficulty in identifying those responsible for environmental crimes	11%
Inconstancy regarding the inspection period in the area, in the year	11%
Collection of numerical results of fines and little concern with the quality of the	11%

assessments	
Unnecessary advertising with self-promotion by managers	11%
Appropriation of timber equipment, without proper analysis of documents	11%

The research shows that some aspects that need to be reviewed and better structured in the face of the problems experienced by the Superintendencies of Rondônia, Acre and Amazonas. In this sense, it is necessary to prioritize the identification of the problems raised, carrying out actions that clarify their implications, where the control and monitoring are highlighted, protected areas and territorial ordering, fostering sustainable activities so that the inspection takes place effectively. Thus, it is essential to establish partnerships between the federal, state and municipal spheres, as well as the bodies with competence to act in the area, in order to strengthen the application of the integrated action in the inspection of IBAMA.

Regarding the negative aspects adopted by the integrated inspection model, the team formed by members who acted in the Inspection of Operation Ponta do Abunã, made the following highlights: 1. Collection of numerical results, fines. Much concern with the numerical results, leaving the quality of inspection services to be desired. 2. Unnecessary advertising (media). 3. Appropriation of equipment used by loggers. The immediate seizure and removal of equipment with the support of the Brazilian army.

As for the improvement measures to be integrated into the inspection process, the following measures were pointed out to be integrated into the "Ponta do Abunã" inspection system (table 5).

Table 5: Improvement Measures to be Integrated

Improvement Measures to be Integrated	Percent
Acquisition of equipment and machinery for the logistics of withdrawing and transporting seized goods	55%
Intensify inspection (emphasis on the logging yard) and promote continuity of operations throughout the year	44%
Improvement in the value of the daily rates, as well as the unification of values for all	33%
Provision of a warehouse for the storage of seized goods	22%
Greater number of people to do bureaucratic work	22%
Installation of an Operational Base, with necessary logistics at Ponta do Abunã	11%
Investment in technology in the Environmental Police Battalion (BPA)	11%
Greater information sharing (total communication between IBAMA inspectors and security staff)	11%
Suitable vehicles with tires for hard to reach places, winches and better equipment	11%
Creation of an integrated system between the federal entity and the state	11%
Access to information from other entities involved in the environmental issue	11%

The relevance of inspection to combat deforestation is understood, and the context of the effectiveness of this operation runs through state, structural, organizational, legal and human aspects. Thus, working conditions must prioritize resources, equipment, accessibility, security, communicability and personal / professional enhancement. In this sense, the inspection team highlights the following improvement measures, necessary: 1. Logistics for transporting seized goods. 2. Office and computer equipment logistics. It is observed that there is a need for transportation, deposit for storage of seized goods and adequate / updated equipment for the development of inspection.

In this context, it is believed that a good integrated action to be adopted by IBAMA depends on the following criteria, according to the competencies of each governmental sphere: Revoke Ordinance No. 14/2017 - Internal Regulation of IBAMA, returning the legal powers to the State Superintendents, without ideological, partisan or doctrinal bias; Creation of the Advisory and Deliberative Council of IBAMA State Superintendencies; Creation of the Sectorial Chamber for the Amazon;

Creation of a privileged forum for discussion of environmental issues pertinent to the Amazon, minimally constituted by the governors of the Amazon, representatives of the Federal Public Ministry, Brazilian Army, Brazilian Navy, Aeronautics, ABIN, Federal Highway Police, IBAMA Superintendencies in the Amazon; Restructuring of all Superintendencies (SUPES) and the return of all commissioned positions that were removed from SUPES and transferred to IBAMA / Brasília, as a means of equipping the Institution; Repealing the Ordinance that nationally lists the servants considered fit to exercise inspection activities, this instrument reduced the number of servants involved in command and control activities, creating a pseudo elite in the inspection; That the Superintendencies have autonomy to enforce the purposes of IBAMA foreseen in Law nº 7.735 / 1989; Role definitions between the Ministry of the Environment (MMA) and IBAMA, respectively, who formulates and executes; Strengthening of the Environmental Control System; Strengthening of Formal and Non-Formal Environmental Education programs and projects; Articulated Implementation of PPCDAm; Implementation of the National Environmental Crime Prevention Program; Decentralization of the competences established in art. 3rd and subsequent of LC 140/2011, promoting actions such as reestablishing or creating municipal environment councils, restructuring / or structuring and organizing municipal environment departments, transferring expertise and technology to SEMAS, promoting and encouraging the transfer of resources to the agreed municipalities, permanent and interconnected performance with SEMAS and state environmental agencies, implementation of a management and monitoring system for the actions established in the fundamental objectives of LC 140/2011; Establish delegation of competence to state and municipal entities; Create mechanisms for temporary and permanent action in the base units established in the priority municipalities; Integration of IBAMA and command and control institutions with the participation of military institutions in the scenario of combating environmental crimes; Invest in the sustainable management of water resources, in the revitalization of river basins and in river decontamination, in protecting strategic aquifers and in rural and urban water tables; Creation and implementation of the decentralized and unbureaucratic Environmental Licensing program; Attribution to the Superintendencies the competence to license projects characterized as protected by the Union, within the limits of their technical capacities to do so and within the limits of their jurisdictions; Implementation of the Environmental Extension Program, aimed at the use, monitoring and surveillance of natural resources, involving small producers; Construction of a basic model of instruction and judgment of administrative processes, transparent and clear; Creation of a permanent nucleus of experts to resolve possible divergent interpretations, allowing greater speed of instruction, judgment and approval of processes in the administrative sphere; That SUPES, through a specialized chamber representative of the federative unit, can elaborate and define by means of Fines Conversion Notices, the services for the preservation, improvement and recovery of the quality of the environment, the actions, activities and works included in priority projects with their regional and local specificities; That IBAMA, through the conversion of fines and destination of seized goods, can support the States and Municipalities in the management of solid waste such as selective collection, recycling and the assembly of a mini processing industry for this raw material; Eradicate the irresponsible and criminal destruction of seized assets, guide them to be auctioned bringing resources to the Union or donated to institutions that need them, we understand that after the seizure of what was seized, it becomes the Union's property until the final judgment of the process.

IBAMA, ICMBio and the Brazilian Forest Service - SFB, are three institutions linked to the same Ministry that go through extreme fragility, mainly with regard to human and budgetary resources. It is necessary to promote and implement an investment program with resources from the Amazon Fund and the National Treasury, via BNDS, in the areas of territorial ordering (Economic Ecological Zoning - EEZ and Land Regularization) management of public forests and conservation units; environmental control (monitoring and inspection); economical alternatives with the use of sustainable production technologies; sustainable management of renewable natural resources (forest, fisheries and wildlife), recovery of altered areas; resumption of PPCDAm [24].

Consecrated authors discuss environmental issues, both from the point of view of environmental law, environmental licensing, environmental responsibility, environmental inspection, deforestation, assessment of environmental impacts, as well as topics such as a plan to prevent and combat deforestation. The following authors can be highlighted [25]; [26]; [27]; [28]; [29]; [30]; [31]; [32]; [33]; [34]; [35]; [36]; [37]; [38] and [39].

IV.   FINAL CONSIDERATIONS

It stands out as a positive point pointed out by the group the greater protection of the environment in all spheres, given the improvement in the organization and the maximization of the use of resources. It is important to emphasize that society requires government officials not

only to meet their needs, but that these needs are met in the best way and at the lowest cost. When assessing that in the perception of the agents, there was greater protection of the environment and with an improvement in the use of resources, it can be said that in producing greater protection for the environment the model was more efficient, while maximizing the use of resources demonstrates effectiveness.

The integration between political and administrative entities allows each one to act on what is most apt. This combination of competences allows specialists to act in their area, leading the operation to superior technical quality and lower costs.

On the other hand, the item most remembered as negative was the lack of vehicles, trucks for transporting seized goods and their logistics. The vehicles used by Ibama are rented and all are equipped with a tow truck. However, there are no vehicles with tires with studs suitable for roads with puddles. In addition, Ibama does not have tractors or trucks to transport seized goods, nor does it have an outsourcing contract for this type of service. It is evident that the timber inspection activity includes the service of apprehending logs and sawn wood, which requires the availability of machinery inspection bodies for this work. Due to this lack of equipment, many servers claim that without alternatives, what remains is to destroy the seized goods.

Even in integrated action, the State is deficient in the capacity to transport the seized goods, either due to the lack of appropriate equipment or the lack of adequate planning. An adjustment in this direction could prevent the destruction of goods and merchandise, as well as allowing the use of these materials for the benefit of society. It was found that the second point most negatively remembered is the lack of an appropriate place for the deposit of these goods. It is clear that both the logistics of transportation and that of warehouses should be studied more carefully, seeking to find alternatives that meet the need for inspection, which on the one hand is effective in assessing and seizing used products and fruits of illegal activities, on the other hand, it is unable to deal with the product of this inspection properly.

For the sake of logic and concatenation of reasoning, it should be emphasized that the same agents who answered the first axis also answered the second and third axes. When suggesting improvements to the inspection, it is clear that the group attacked the main negative point and was concerned with seeking a solution to this deficiency. Thus, the acquisition of equipment and machinery for the logistics of withdrawing and transporting the seized goods was the suggestion for

improvement most pointed out by the group. Then, it was also suggested, intensify the inspection (emphasis on the logging yard) and promote the continuity of operations throughout the year.

In the perception of inspection agents, actions occur infrequently and this results in the loss of inspection effectiveness. According to the researched group, a more continuous inspection would bring better results. In this research, not all the positive points, not all the negative points, nor all the suggestions for improvements were presented. A survey of this magnitude does not exhaust the subject, but it can serve as an aid to other research and as a source of information for those interested in the subject of inspection, especially in this rich and important region of the planet.

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Epistemological Assumptions of Perception of Sustainable Development through Environmental Sociology

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Abstract— The aim of this paper is to discuss the epistemological bases of sustainable development from the perspective of environmental sociology. This is a literature review, descriptive, qualitative, interdisciplinary, systemic and holistic study. The subject of interdisciplinarity is still not fully understood today because there is no consensus around the epistemological debate. The interdisciplinary view is accepted by some thinkers as a kind of neopositivism. Environmental sociology also emerged linked to the epistemological discussion of the process of changing the scientific approach in addressing complex problems that strengthen the interdisciplinary movement in the field of knowledge, and although there is no consensus on environmental sociology, it highlights its importance for the discussion of the role of man and his interface with nature, meanwhile sustainable development, finds in the socio-environmental variable one of the central axes of scientific discussion about the pragmatism of its positioning, which for some authors is characterized as utopian. Understanding and explaining the complexity around the theme of environmental sociology is, above all, an exercise of reflection on the ethics of man as an integrated social being and interconnected with the natural environment.

I.   INTRODUCTION

The basis in the conception of the history of science, as a constructive element of the holistic view of the epistemological parameters of scientific knowledge (Phase 1) corresponds to the period marked by the domain of philosophical knowledge in which the first essays of science can be seen from great philosophers as Pythagoras, Plato, Socrates and Aristotle. However, in the ancient and medieval ages, the plurality of sciences and methods made the construction of science live its most static period in its history. This phase extends until approximately the 15th century.

The scientific revolution, the industrial revolution and the French revolution, for some authors like Sell [1], form the main framework that led this movement of political, economic, social and cultural transformation that provoked profound changes in the attitudes of man in relation to nature (Phase II).

Castro and Dias [2] had already pointed out that the economic and social transformations that marked the first half of the 19th century and the development of the scientific method in other sectors of human knowledge, parallel to sociology, created, at that time, the practical and theoretical, historical and philosophical ways of organizing sociology as a discipline and, only in this context, linking intellectual evolution to the social conditions of the settlement of the "ancien régime" and the inauguration of the industrial era, it is possible to understand the historical moment when sociology began to stand out as a specialized knowledge sector, systematizing itself as science.

According to Zayas [3]it is only from the modern age that the autonomy of science begins to take its first steps, going against a long period where it remained uncertain in the scope of philosophy. In this sense, the works of Galileo (1564-1642), Kepler (1571-1630), René Descartes (1596-1650) and Newton (1642-1727) stood out to a large extent and were responsible for this revolution in science. Newton's mechanics, in particular, crystallized the reductionist view in science. René Descartes (1596-1650), in turn, planted modern thought by fragmenting the whole problem into as many simple and separate elements as possible, which caused a great revolution in thought and methodology based on his work "O Discurso do Method", in 1630. This reductionist-mechanistic view reached its peak with David Hume (1711-1776), according to Zayas [3]. But in general terms how to define empiricism?

Empiricism can be understood as a philosophical method based on the idea that the only valid form of knowledge is that obtained through the use of the senses. According to this view, if something cannot be observed, then it is useless to try to explain natural or any other phenomena. An empirical statement therefore describes observations or research based on concrete observations. It is thus distinct from something based only on mental and theoretical processes. Thus, it is clear that there is a clear attempt to move away from purely philosophical precepts to another conception that has observation as the main criterion for scientific validation.

In Phase III, empirical thinking comes to dominate the scientific world, mainly due to the advancement of natural sciences such as Newtonian physics and the whole context of change that occurred due to the great scientific discoveries that, taken as a whole, contributed to the crystallization of the positivist view both in epistemological and sociological fields. According to Videira [4], positivism sought to defend the thesis that only science would be in a position to provide progress for human societies. In Brazil, positivism had a great influence, starting with the Brazilian flag since the phrase "Ordem e Progresso" is a purely positivist thought. As opposed to philosophical thinking, one of the research strategies adopted by the positivists was inductivism. This phase extends from the 19th to the 20th century. According to Giddens [5], both the term "positivism" and the term "sociology" are due to August Comte (1798-1857).

The aim of this work is to discuss the epistemological bases of sustainable development from the perspective of environmental sociology. This is a literature review study, descriptive, qualitative, interdisciplinary, systemic and holistic.

II.   SOCIOLOGY AS SCIENCE: A BRIEF CONTEXT

In this process of building sociology as a science, that is, of the new philosophy within an epistemological view, Comte took as an example other sciences that already used positive methods in his researches by revealing that the positivity of the sciences appears in essays that go back to the XVII century. Regarding the superiority of the positive view over the one linked to theological power, Comte makes the following statement:

> For the new philosophy, order is constantly the fundamental condition of progress and, conversely, progress becomes the necessary goal of order, since in the animal mechanism balance and progression are mutually indispensable, as a foundation or destiny.

Specially considered, then, with regard to order, the positive spirit today presents, in its social extension, powerful direct guarantees, not only scientific but also logical, which may soon be judged to be far superior to the vain pretensions of a backward theology that more and more, for several centuries, it has degenerated into an active element of disagreement, individual or national, unable, from now on, to contain the subversive ramblings of its own adherents [6].

Thus, according to Quintaneiro [7], Positivism appears as a response to the metaphysical spirit of the "negative philosophy" that subtended to take society to a kind of political disorder. Therefore, the "positive philosophy" provided the scientific basis for the proper path of society towards regeneration and social organization. Thus, Positivism had some striking characteristics. Leff [8] showing some of them reveals that the positivist project sought to always be objective, universalist, reinterpreting and reifying. According to Outhwaite and Bottomore [9], Comte intended to strictly eliminate from the domain of rational thought the metaphysical conception and sought to establish a unified science through the logical reduction of science to the terms of immediate experience. And with that, within a more general conception, the standardization of scientific procedures in the sciences can be considered as one of its main objectives. Using Cohen's work [10], it can be seen that Newton's powerful laws, so referenced by positivists, created in the scientific world a kind of heuristic around Newtonian theory that placed the postulates of physics at a level of almost benevolence both in the field of knowledge of the so-called natural sciences and in the field of social sciences that started to use them in the process of construction and scientific validation.

Comte's ideas were, between the years 1923 to 1936, defended by a group of philosophers, mathematicians and scientists like Moritz Shalick, Ernest Mach, Rudolf Carnap, Carl Hemper and Otto Neurath who together formed what was conventionally called the Circle of Vienna [9]. Therefore, the judgment of a knowledge as scientific or non-scientific started to depend on the endorsement of its peers, that is, on a group of people directly linked to the specific knowledge area that seeks validation of which, based on pre-established molds of

science, led the entire decision-making process. It can be seen that the structuring of positivism reached basically two dimensions: a philosophical dimension that involves science as the only legitimate knowledge through a "science model" and a sociological dimension that places "sociology" as a "natural" science of society since he considered the natural sciences more mature and developed. Thus, sociology, from an epistemological point of view, arises from the 19th century [11]; [1]. According to Giddens [5], it is due to Augusto Comte (1798-1857), considered the father of "positivism", for the designation of this new field of human knowledge. Understanding the historical process that alludes to the emergence of sociology is, above all, a fundamental exercise for a holistic view of the space-time framework in which this phase took place, thus showing the importance of major revolutions in the design of new habits, new patterns of human relations that together marked the emergence of this science.

From a methodological point of view Sell [1] reveals that Comte understood sociology from two essential fields: static, which studies the constant conditions of society or order; and a dynamic, which studies the laws of historical development of any society, that is, progress. It is clear, therefore, that the positivist foundation arises with the processes of changes that occurred in industrial societies in the 19th century from the consolidation of modern capitalism, which gave rise to what was conventionally called modernity. Modernity is restricted to a certain historical period, to a certain cultural, socioeconomic organization and to certain customs and lifestyles that emerged in Europe around the 17th century and that extends to the middle of the 20th century, whose influences were unfolding and going global. One of the consequences of modernity is the process of globalization that, among other things, generates uneven development both from an economic and a social point of view [12]; [13]. According to Sodré [13], this aspect was the great European model that found reason and progress as its main obsession. And within this rational logic, social life would find the essential mechanisms for the organization of the whole society.

Therefore, it is based on the paradigm of modernity that positivism is structured as a stream of sociological thought that sought in the linear progress of society and in the exclusive and absolute power of reason a rational way to know reality and, with that, proceed from a subjective approach to the elaboration of objective natural laws, whose representative considered most important was Émile Durkheim (1858-1917).

According to Vidal [14], the positivist perspective was based on Durkheim's classic definition of research

strategy, when defining social phenomena as "things" external to the individual in his work "The Rules of the Sociological Method". In this work, Durkheim establishes a methodology to facilitate the work of the social scientist in determining his object of study by associating social facts as "things", in the sense of constituting a perfectly determined and external unit to the individual. For Durkheim, the understanding of what is a social fact is fundamental to differentiate the object of study of the social scientist from that which identifies with other areas of knowledge [11].

According to Quaresma [15] throughout Durkheim's work, he always tried to establish causal relationships between two phenomena. For this classic, Sociology was intended not only to explain society but also to find remedies for social life. It is within this political-social aspect that many countries begin to adopt positivist principles as management strategies. Brazil with the motto "order and progress" inscribed on the central part of the Brazilian flag was one of those countries that tried to find in the positivist conceptions the remedies for the country's internal problems. This positivist stance can be evidenced during the First World Conference on Environment and Development that took place in Stockholm, Sweden, in 1972, due to the worsening of the environmental conditions that were increasingly expanded at a global level that started to significantly threaten life on earth.

At this Conference, it was necessary to reconcile two currents of interest. On the one hand, the Malthusian current, defended by some developed countries participating in the event, which had the discourse of freezing the growth of the global population and industrial capital due to the strong influence of the report "Limits to Growth" prepared by a team of researchers led by Dennis L. Meadows and that motivated great discussions in this Conference. On the other hand, the current vehemently defended by underdeveloped countries led by Brazil who wanted progress at any cost. The defenders of this trend believed that pollution and other social problems observed among developed countries were indicators of progress and, therefore, considered them "welcome". During the 1970s, Brazil was one of the main recipients of polluting industries in developed nations, due to the advance of environmental awareness in these countries. In the 1970s and 1980s, Brazil experimented with development policies rooted in positivist conceptions of progress and which later proved to be highly disastrous from the social and environmental point of view. As classic examples of policies in this direction are the major colonization projects in the northern region of the country that had the goal of "integrating not to deliver" with a view to promoting progress in a region that, despite having experienced golden periods of economic prosperity, after the decay, were isolated and susceptible to disorder, mainly in the border areas with the other South American countries. In summary and according to Videira [4] positivism sought to defend the thesis that only science would be in a position to provide progress for human societies.

In epistemological terms, the positivist conception began to suffer criticism and, with that, enabled the emergence of theories that sought to break with the rigidity of the Vienna Circle. In this sense, Kuhn [16] clarifies that the scientific community started to be characterized by its highly disciplinary, limited and closed posture, that is, marked by a scientific specialty, by a common theoretical formation, by the abundant circulation of information within the group and by the unanimity of judgment in professional matters. According to this same author, science is not developed through strict obedience to methodological canons, but through the realization of a convergent and unified research practice, made possible by the acquisition of a paradigm. In other words, Kuhn's work caused profound upheavals in the epistemological conception of science, which was characterized by inaugurating a discourse hitherto innovative, privileging the historical and sociological aspects to the detriment of the logical-methodological aspects rooted in the Popperian conception.

Thus, for Thomas Kuhn the existence of a science depends directly on the paradigmatic premises that without it, it would not exist. Lakatos, in his work entitled "The methodology of scientif research programs", appears, therefore, with the theory of research programs because he considers that both Popper and Kuhn failed to solve certain research problems. In this way, Lakatos reveals that there is a large dump of unresolved problems. For him, there are problems that the current premises cannot answer because they are considered increasingly complex. These unsolved problems would therefore be "thrown into the trash" of knowledge until a time when there would be new discoveries, which would provide answers to the problems of the trash, not in a revolutionary way, but through constant answers about the most complex phenomena. In this sense, by contextualizing the "blanks" left by both Popper and Kuhn, Lakatos formulates the theory of research programs that is based on the creation of a "hard core" and a heuristic.

The following is a representation of the main theories that sought to break with the concepts of verifiability of science in the Vienna Circle.
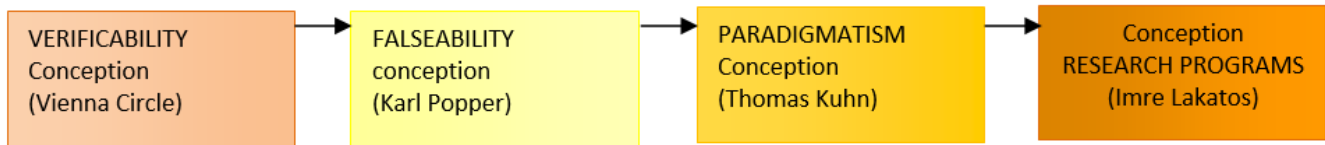
Fig.1: Schematic representation of the main theories against the positivist view.

Source: Own elaboration.

From there, a new way of thinking about the epistemology of science begins, based on the interdisciplinary approach (Phase IV), considered sine-qua-non in studies that address complex themes.

III. INTERDISCIPLINARITY

The fourth phase is related to the debate around the interdisciplinary concept that emerged at the end of the 20th century and which is considered a phenomenon of the 21st century. This new conception comes to be understood by some as a form of neo-positivism, but in reality, there is no consensus about it. For Santos [17] the time in which we live must be considered a time of transition between the paradigm of modern science and a new paradigm that he designates as postmodern science. According to Klein [18], it appears that the history of interdisciplinarity can be confused with the history of science, since for some, philosophers such as Plato, Aristotle, Rabelais, Kant, Hegel and others are considered to be the first. "Interdisciplinary thinkers".

From the work of Maturana [19], it can be observed that even criticizing the reductionist-mechanistic view of science defended by the positivists, logical rationalists such as Popper, Kuhn and Lakatos also ignored the problem of complexity. Furthermore, Von Bertalanffy [20] when mentioning one of the inconsistencies brought about by disciplinary pragmatism revealed that there are often cases in which identical principles were discovered several times because researchers working in one field were unaware that the required structure was already well developed in another field. According to Fazenda [21], the simple integration of contents is not enough to break the boundaries of the disciplines, it will become a precise attitude, that is, an interdisciplinary posture. In other words, interdisciplinarity is not achieved by the simple addition of disciplinary knowledge, that is, through multidisciplinary experience. First of all, there needs to be an interaction between them.

According to Gadotti [22], the concept of interdisciplinarity is not univocal, that is, there is still no consensus about it. This fact seems to strengthen the idea that interdisciplinarity is more linked to criteria of attitude than a new conception of scientific paradigm.

For Leff [23], interdisciplinarity arises with the purpose of reorienting professional training in search of a thought capable of apprehending the unity of reality to solve the complex problems generated by the dominant social, economic and technological rationality. Thus, interdisciplinarity seeks to build a multifaceted, yet homogeneous reality, whose perspectives are the reflections of the lights that project different disciplinary approaches on it [24]. Interdisciplinarity started to take shape in educational institutions, mainly in the United States, from the 1980s onwards due to basically three factors as described by Klein [18]: a) answering complex questions; b) solve problems that are beyond the reach of some disciplines; and c) reach units of knowledge, whether in limited proportions or on a large scale.

In Brazil, according to Gadotti [22], the concept of interdisciplinarity first arrived with the work of Georges Gusdorf and, later, with Piaget who together were largely responsible for the influence of interdisciplinary conception in the country, both in the epistemological and educational fields. Current discussions about environmental crises and the worrying quest to reverse the degradation stage of natural resources and their effects worldwide is not a simple issue that can be resolved in the light of a single discipline, such as the environmental disasters that tend to afflicting the modern world.Disasters can occur as a result of the impact of a natural risk or caused by human activities. Natural hazards include phenomena such as earthquakes, volcanic activity, landslides, tidal waves, tropical cyclones and other intense storms, tornadoes and strong winds, fluvial and coastal floods, forest fires and the mist that forms drought, sand and dust storms and infestations. Therefore, environmental disasters can be understood as a serious interruption of the functioning of a society, causing human, material or environmental losses that exceed the capacity of the affected society to deal with such consequences with its own resources [25].

The social and economic costs of disasters vary widely and are difficult to calculate globally. However, studies show that there is a growing trend in the intensity of these

phenomena as a result of human activities that tend to increase financial costs in the regions and / or countries where they occur. According to Munich Re [26] the number of major catastrophic events in the last decade has reached an impressive level by tripling its occurrence compared to the 1960s, in the same way as the rate of economic losses by showing an increase of almost nine times during the same period.

In summary and according to Cozetti [27], recent data from the United Nations Development Program (UNDP) show that the world is consuming 40% beyond the capacity to replace the biosphere (energy, food, natural resources). As Moon's [28] work shows when quoting other authors, the United States despite having only 5% of the world population consume 40% of the available resources. If the 7 billion people enjoyed the same standard of living as the 270 million Americans, 6 planets would be needed. Thus, for Capra [29] it is necessary to take an ecological perspective, differently from the mechanistic worldview of Descartes and Newton, since according to this same author, we live in a globally interconnected world, in which biological, psychological, social and environmental phenomena are all interdependent.

This thought is also shared by Viola [30] who found that during the last decades, in most branches of science and technology, the analytical-reductionist approach that fails to take into account the interconnection of living phenomena has been intensified. In the scientific community, according to this same author, this approach remains hegemonic, which has been triggering an increasingly fragmented process of knowledge, characteristic of the specialized disciplines of the modern world. In this sense, Santos [31] states that it is well known that modern science in general and social sciences in particular are currently experiencing a deep crisis of epistemological confidence. For Ferreira [32] the difficulties to know the truth is a problem that the social sciences are obliged to face in this century, not because of a calendar issue, but because of the critical awareness of the difficulty of disciplinary knowledge in the face of complex society. It is within this new form of approach that the newest branch of sociology, called environmental sociology, has also been structured. Below we present the origins and contributions to the discussion of sustainable development.

IV.   THE ENVIRONMENTAL SOCIOLOGY

Environmental sociology can be understood according to Mora [33] as a discipline applied to the studio of the system of relationships, spatially and temporally established, between society and the environment, emphasizing in social participation and transdisciplinary studies, as goal y context for the development of this specialty. In this sense, we cannot fail to recognize that in postmodernity, which was established in the middle of the 20th century, humanity is going through a new civilization that tends to unveil some of the incredible mysteries of the universe, however, with a tendency to increase the threat to the very existence of life on the planet. Giddens [12]considers that we are reaching a period in which the consequences of modernity are becoming more radicalized and universalized than before, this author prefers to work with the concept of high modernity.

According to Ferreira [32], environmental sociology, as a scientific and academic production, emerged in the wake of the social contestation movements that emerged in the early 1960s and the verification of the emergency situation of degradation of natural resources and the development of industrialism. For Hannigan [34], what we had were isolated works within the subarea of rural sociology, however, to understand the emergence of environmental sociology, it is necessary to observe how the geographic and biological theories of social development lost strength when sociology emerged, in the beginning of the 20th century, as a distinct discipline.

The pioneers of classical environmental sociology, Durkheim, Marx and Weber had approached the issue in a tangential way; moreover, isolated works in rural sociology only rarely appeared, without, however, promoting a considerable accumulation of knowledge that would allow the creation of a theoretical field or subfield [32];[35]. Ferreira [32] raises two explanations for the fact that sociologists marginalize the environmental issue in their theoretical endeavors. The first would be related to the failures of geographic and biological determinism, and his conservative view on understanding social changes and conflicts. The second would be related to the current thinking that, in the middle of the 20th century, emphasized the sociological literature of modernization. Thus, according to the author, what is currently identified as an environmental concern would be seen as a delay and an obstacle to development, to progress. Certainly there were critics of the developmentalist paradigm, like Marxist sociologists; but, they tended to see the environmental issue as a departure from the crucial issues of humanism.

According to Buttel [36], sociologists began to assimilate the importance of environmental sociology studies as a result of the recognition of divergences and conflicts over nature and the causes and extent of environmental problems. It is in the United States that the theme of environmental sociology took shape, dominating studies at a global level between the years of the 1980s and

1990s. However, according to Buttel [37], the American environmental sociological theory originally developed in reaction to the lack of attention of the dominant sociology with biophysical phenomena; thus, he emphasized strong, if not intrinsic, trends in modern societies to the degradation of the environment, and tended to minimize the theorization of environmental improvement processes. As the same author explains, the American environmental sociological culture tended to simplify the processes of environmental mobilization and to exaggerate the coherence of environmentalism.

For Ferreira [32], the institutionalization process of environmental sociology within sociology was not a homogeneous process. According to this same author, the political-institutional trajectory of the sub-discipline in the United States began in the 1970s, however with the influence of the 1960s that there was already a non-systematic, but interesting production, which approached the issue from from a more radical perspective, both in the United States and in Europe. Despite the initial repercussion of the increasingly serious environmental conditions worldwide, in the United States during this phase that marks the 1970s, it did not prosper in terms of objective accumulation of efforts that would motivate the practice of scientific research and investigation, on the subject, on the contrary, according to Dunlap [38] there was a reduction in the number of researchers. However, according to Ferreira [32], based on new undesirable events from the environmental point of view, such as the great contamination verified in accidents such as those at the Chernobyl nuclear plant in 1986, again intensified the clash over the topic that started to enter definitely on the agenda of political and scientific discussions.

From an epistemological point of view, Buttel [39], states that the theoretical-methodological perspective can be explained from three distinct moments: a) moment of formation that involves the combination and contribution of other specific sociologies; b) moment of constitution of a specific theoretical nucleus and with a more consensual profile; and c) a moment of diversification and greater incorporation in the theoretical field of sociology in general. The moment of formation for that author is more related to the contribution of rural sociology, although other specific sociologies have in some degree influenced environmental sociology, such as the sociology of communities, of development, among others.. In this sense, Ferreira [32] states that environmental sociology did not emerge as a new discipline, but within the existing disciplines, it tried to cover theoretical gaps in the classical tradition regarding environmental issues, creating an institutional locus for the development of the new theme. Buttel [37] when referring to the theoretical gap considers that the tendency of classical sociology was to create theories that, implicitly, assume that societies and human groups are independent or isolated from biophysical processes. For him, sociology, in search of liberating social thought from reductionisms, prejudices and the conservative view of the beginning of human ecology, exaggerated in promoting the separation between the social process and the natural world.

According to Ferreira [32], the moment of constitution of a theoretical nucleus was converged by the production of some environmental sociologists such as Catton, Dunlap, Schanaiberg, Buttel, Redclift, Harteley, Chapman, Yearley, Hannigan, among others. Still referring to Ferreira [32], he reveals that the third moment in the intellectual trajectory of environmental sociology, which was clearer at the turn of the 1980s, was characterized by greater theoretical diversity and by a certain incorporation of classical sociological theory. According to the same author, it is possible to register, from that moment, the contributions of prominent sociologists, who emphasize the importance of the issue in the context of high modern societies, such as Beck, Giddens, Touraine, Castells, Habermas, among others. Thus, for Ferreira [32] an environmental problem is socially constructed, that is, environmental problems would be similar to other social problems and the action of the different actors would be the main object of analysis.

When using the work of Buttel [37], practically three currents of thought in environmental sociology are evidenced: a) the current of the risk society; b) the current of ecological modernization; and c) the current of reflexive modernization. The first stream defends a context of risk society, in which environmental and technological risks are placed as central to understanding the society of high modernity. According to Rigotto [40], humanity has always lived with risks, but the specificity of the current ones derives from what Giddens calls "manufactured uncertainty" because the risks are different with regard to sources and scope, that is, uncertainties are created by the development of science and technology, and nothing indicates that more knowledge means more control. The risks appear with an irreducible character, without guarantees, without certainties, with global, invisible and, sometimes, irreversible effects, with long-term consequences, in general, unknown, and which are difficult to be accurately evaluated. It is not the risks that have a source external to modern society, but they are the results of human activity. It covers all people, crossing national or social class borders, which would give pollution a democratic character [41].

The current of ecological modernization, according to Buttel [37], grew out of social research, the

involvement of the environmental movement and ecological research on practical, non-utopian means of achieving environmental improvement. According to Rigotto [40], this current considers that human choices are not structurally determined by the master forces of capitalism, industrialization, etc; and that the solutions to environmental problems lie in progressive modernization, and not in demodernization, as advocated by radical environmentalism, that is, they argue that technology will bring solutions to environmental problems. The current of reflexive modernization believes that modernization has led to a series of misfortunes and risks. These conditions end up threatening the current generations, their quality of life and possibly the very conditions of survival of future generations, characterizing the environmental issue. The growing public recognition of these hazards and risks is one of the main factors that precipitate reflexive modernization and the risk society. Thus, according to Buttel [37], citizen-actors are not just passive recipients of the arc of forces of modernity / modernization. A modernização pode se "voltar sobre si mesma", de forma a encarar os problemas que criou. Modernization can "turn on itself" in order to face the problems it has created.

For Buttel [37] both the theory of risk society and that of ecological modernization and also that of reflexive modernization have been criticized for being applied to very particular contexts, mainly in Europe. The risk society is strongly anchored in the notion of equal risk, that is, no matter the social class, no one escapes bad luck and large-scale risks, in view of the state of well-being, the leveling of living standards and the absence of residential and spatial segregation in northern Europe. Thus, for the author, equal risk simultaneously contributes to the fall of social class and facilitates new policies that cross traditional class lines. However, according to Rigotto [40], this equality does not apply in a context of social inequality such as that of the United States, let alone developing countries, where environmental inequality is more the rule than the exception. Although there is no consensus on environmental sociology, it makes evident its importance for the discussion of the role of man and his interface with nature, placing him as one of the elements that make up the planet's biodiversity and not as an external manipulative individual, using rationality as a selfish measure of the market game product: individual satisfaction and, as a consequence, the growing consumerism that plagues the planet as serious environmental externalities.

Environmental sociology is, therefore, a challenge to understand the complex relationship of man with the environment that allows explaining social relations from a point of view that transcends the limits of man as an individual to a plan of analysis that involves a systemic and interdependent with the environment. To understand this process is to take another significant step to understand the essential role of man as a social being to ensure for future generations the same standards of environmental satisfaction that nature tends to manifest in current generations, although with serious signs of resource drain natural.

V. THE COMPLEXITY OF SUSTAINABLE DEVELOPMENT

Sustainable development has been promoted throughout the planet as a more rational way of promoting an equitable and socially just quality of life. The concept of sustainable development is based on the principle of sustainability. The negative environmental impact generated by economic activities was the main starting point for this mobilization around the discussion on sustainability. The demand for improvements in living conditions occurred when the negative environmental impacts, resulting from economic activities, began to transcend the territorial limits of a given country, taking the consequences of these actions to other peoples, often felt thousands of kilometers away. Your point. The origin. Environmental degradation, therefore, manifests itself as a symptom of a crisis of civilization, marked by the model of modernity governed by the predominance of the development of technological reason over the organization of nature. The environmental issue questions the very bases of production; points to the deconstruction of the economic paradigm of modernity and to the construction of possible futures, based on the limits of the laws of nature, ecological potentials, the production of social meanings and human creativity [24].

The environmental issue, despite being the precursor to this discussion, was not the only point in the process. According to Barbieri [42], it is a new way of perceiving solutions to global problems, which are not only reduced to the degradation of the physical and biological environment, but which incorporates social, political and cultural dimensions, such as poverty and social exclusion, it is what has been called sustainable development.

The concept of sustainable development, therefore, highlights the complexity of the environmental issue, as it highlights the need for an interface between society and the environment, which calls into question the Cartesian heuristic model that fragments and separates parts of the real to enable its understanding. In this sense, thinking about sustainability is not the task of just one scientific branch, much less of a single specific sector of society. It becomes necessary to break with the dominant conception

of development linked to the Western paradigm. Conforme Leff [24] o ambiente não é, pois o meio que circunda as espécies e as populações biológicas. According to Leff [24] the environment is not, as it is the environment that surrounds species and biological populations. It is a sociological category related to social rationality, configured by behaviors, values and knowledge, as well as by new productive potentials. In this sense and according to the same author, the interdisciplinary analysis of society-nature relations arises from the specificity of socioenvironmental processes as complex systems: on the one hand, it is a question of apprehending a multidimensional reality in which non-linear processes, of different levels of spatiality and temporality, with different forms of interdependence, from which new processes emerge that establish varied synergies and feedback, both positive and negative.

On the other hand, the environment questions the sciences to transform their traditional paradigms and incorporate complex knowledge. This emerging environmental knowledge is not univocal, nor is it already prepared to be absorbed by different disciplines.

Thus, according to Leff [24], the environmental issue in the field of development and interdisciplinarity in the field of knowledge arose with two contemporary issues in response to a crisis of the economic and theoretical rationality of modernity. Sustainable development, as an institutional objective of local, regional, national and international development programs and projects, finds in the socio-environmental variable one of the central axes of scientific discussion on the pragmatism of its position, which for many are characterized as utopian. Understanding and explaining the complexity surrounding the theme of environmental sociology is, above all, an exercise in ethical reflection of man as a social being integrated and interconnected with the natural environment. Although the ways to reach a common path in epistemological terms are quite arid, environmental sociology demonstrates that it is a movement that tends to contribute to the theme of sustainable development that, before having the intention of providing a strictly economic gain, seeks to contribute to improve the quality of life with respect to the environment, ethical and moral values and the parameters that strengthen the local identity. In this sense, there seems to be a wide fertile space for discussing the topic, mainly due to the serious environmental disasters that have occurred in different parts of the world and that is raising the level of concern in several governmental and non-governmental bodies on a global scale. Finally, we try to end this work with the work of Morin [43] by stating that knowledge needs to be aware of its biodegradability, since the belief in an absolute truth causes blindness in knowledge and rationalization. Therefore, in this new postmodern paradigm, there is an increasing saturation of this rational model.

VI. CONSIDERATIONS

The theme of interdisciplinarity, although it emerged at the end of the 20th century, is not fully understood today because there is no consensus around the epistemological debate of this movement that tends to be considered as the new paradigm of the 21st century.

The interdisciplinary view, although it may be understood by some as a new attempt to standardize science and, therefore, as a kind of neopositivism, is here understood as a movement that does not seek to reject any disciplinary practice in the sciences, on the contrary, applied it is precisely those problems that are considered complex, which, from the disciplinary point of view, are insufficient; but, on the other hand, for those linear problems, with a high degree of knowledge specialization, the disciplinary view reaches a high level of competence.

Environmental sociology has also emerged linked to the epistemological discussion of the process of changing the scientific focus in addressing complex problems that strengthen the interdisciplinary movement in the field of knowledge.

Although there is no consensus on environmental sociology, it makes evident its importance for the discussion of the role of man and his interface with nature, placing him as one of the elements that make up the planet's biodiversity and not as an external manipulative individual, using rationality as a selfish measure of the market game product: individual satisfaction and, as a consequence, growing consumerism with serious environmental externalities, worldwide.

Sustainable development, as an institutional objective of development programs and projects, finds in the socioenvironmental variable one of the central axes of scientific discussion on the pragmatism of its position, which for some authors are characterized as utopian.

Understanding and explaining the complexity surrounding the theme of environmental sociology is, above all, an exercise in reflection on the ethics of man as an integrated social being and interconnected with the natural environment.

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The Regulatory Framework of Organic Agriculture in Brazil and Sustainability

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Abstract— *This paper is a bibliographical review article about the regulatory framework of organic agriculture in Brazil (Law 10.831 of 2003) and its relationship with environmental sustainability. From a historical perspective of organic agriculture, it is shown that it arose from the organization of social movements characterized by concern for more sustainable agricultural models in relation to conventional agriculture. Organic agriculture is one of the aspects of agroecology that has as its mark the standardization of the norms and techniques of the agricultural production system, as well as the certification of food quality, which guarantees the consumer a food security.*

O Marco Regulatório da Agricultura Orgânica no Brasil E a Sustentabilidade

Resumo— *Este trabalho consiste num artigo de revisão bibliográfica acerca do marco regulatório da agricultura orgânica no Brasil (Lei 10.831 de 2003) e sua relação com a sustentabilidade ambiental. Dentro de uma perspectiva histórica da agricultura orgânica, mostra-se que esta surgiu a partir da organização dos movimentos sociais caracterizados pela preocupação com modelos de agricultura mais sustentáveis em relação à agricultura convencional. A agricultura orgânica é uma das vertentes da agroecologia que tem como marca a padronização das normas e técnicas do sistema agrícola de produção, além da certificação da qualidade dos alimentos, o que garante ao consumidor uma segurança alimentar.*

Palavras-chave— *Agroecologia; Sustentabilidade; Legislação agrícola.*

I.   INTRODUCTION

The cultivation of the land for the production of foods and other necessaries goods for human survival is a millennial activity and the agriculture is associated with life itself on the land. The anthropic impacts to the environment during the exercise of agriculture are multifaceted, may it be negative or positive. Thus, according to FAO (2012) throughout the centuries the agriculture contributed to the creation and conservation of semi natural *habitats* that shelter a big zoologic variety, however, on the other hand, there are productive processes that affect negatively the environment, for example, the intensive use of pesticides and fertilizers, incorrect drain practices and a high level of mechanization can harm the environment.

The importance of agriculture goes beyond the simple production of foods, since the inadequate agricole practices generate ambiental degradation, loss of biodiversity and affect human health direct and indirectly. (FAO, 2012)

It is not ignored that agriculture is a human activity potentially capable of causing damage to the environment, since it is provenient of the exploration of natural resources, however, the exploration of natural resources must be racional, in other to safeguard the rights of the current and future generations to an ecologically balanced environment, as recommended in the article 225 of the Federal Constitution of 1988.

Besides, it is imperative to observe that being the right to an ecologically balanced environment a principle of the Environmental Law it's correct to say that this endorses an ideal model of exploration of natural resources, an end to be pursued, but not always easy to be achieved, given the nuances of the real world, that many times leeds people to move away from the idealized model by the legislator. Thus, the task to harmonize the economic aspect of agriculture with the principle of environmental sustainability shows itself as a true challenge to the rural producer, on the other hand this mission cannot be lost sight of.

It is known that sustainability is a flexible concept, suffering different conceptions directly related to the view of each observer and to the observation angle, nevertheless, to look at what is sedimentary left around environmental sustainability in a global and local context and approach this ideal it is an imperative measure in the practice of agriculture.

With the attention on to the Law 10.831 of December 23 of 2003, that institutes organic agriculture in Brazil, this study seeks to analyze in what measure the model of agriculture outlined in that law approaches the ideal of sustainability in agriculture.

From a systematic analysis of the Law 10.831 of December 23 of 2003, it seeks to investigate whether the legally established criteria contribute to achieving sustainability in agriculture in the light of the systematic vision of the environment, by a perspective of Human Ecology, and, of course the notion of sustainability sedimented worldwide at the Conferences about the environment and in the brazilian positive legal system.

To face the question it is proposed a brief history of the agroecological currents, it's distinguished agroecology from organic agriculture, FAZ-SE ALUSÃO to the organic certification systems of Brazil, besides establishing the relation between the growth of organic agriculture in Brazil and its regulatory mark.

The objective of this revision article was to present a study around organic agriculture and its regulatory mark from the existing literature, with the purpose of presenting a panoramic vision of the subject and indicate, from collected studies, positive points of this model of agriculture, as well as justify the reasons why it becomes possible to affirm that the organic agriculture is a sustainable model of agriculture. The article is divided by the following topics: -Brief history of organic agriculture in Brazil; The agroecology and the organic agriculture; Systems of certification of organic agriculture in Brazil; The growth of organic agriculture in Brazil and the contribution of the regulatory mark; Final considerations.

II.   METHOD

The methodology adopted is a bibliographic revision through the search of articles with fulcrum on the role of agroecology and the search of models of sustainable agriculture, that pursue a harmonic relation between the elements that integrate it. We sought to situate organic agriculture inside the universe of agroecology, its emergence in Brazil and its collaboration to the conservation of the environment in all its dimensions.

For the achievement of the bibliographic research and compillations of the articles were applied as descriptors the terms "organic agriculture and sustainability", "agroecology in Brazil", "sustainable agriculture", "organic certification in Brazil". Were extracted the articles which had a greater relevance with the question of research and that answered the object of study.

Likewise, were collected data at official sources which have as objective the organic agriculture, for example the International Federation of Organic Agriculture Movements - IFOAM and the Food and Agriculture Organization of the United Nations - FAO.

In addition were collected the main legislatives sources about organic agriculture in Brazil, among which the Law 10.831 of December 23 of 2003, its respective regulatory decree and some normative instructions from the Ministry of Agriculture. It was equally explored the Law 7.794 of August 20 of 2012 - which instituted the National Politic of Agroecology, the Law 7.802 of July 11 of 1989 - which provides about pesticides, its components and such, as well as the Project of Law 6.299 of March 13 of 2002, which propose the alteration on the law of pesticides. The research did not have a time limit, but before that the concern was with the analysis of categories of research, history of organic agriculture in a more global context and especially in Brazil, relations between agroecology and organic agriculture, organic certification in Brazil and the growth of organic agriculture in Brazil.

It was also related statistic data informed on official pages in Brazil, such as InstitutoBrasileiro de Geografia e Estatística - IBGE and the Ministry of Agriculture, Livestock and Supply - MAPA, related to later dates to the publication regulatory framework of organic agriculture, with the scope of demonstrating its influence on the practice of organic agriculture and agroecology.

III. RESULTS AND DISCUSSION

BRIEF HISTORY OF ORGANIC AGRICULTURE IN BRAZIL

Throughout the history of agriculture in a global scenario, the conception of what is truly a sustainable agriculture has acquire different meanings, and, as it could not fail to be, the history of agriculture is permeated by the influence of the social context where such activity were practiced, so that agriculture went through different phases (EHLERS, 1994, p. 11).

According to Ehlers (1994, p. 10-23), the so called modern culture emerged from the century XVIII and XIX, occasion where the agricultural practices were marked by the rotation of culture and by the approach between agriculture and livestock, it's about the First Agricultural Revolution, phase characterised by alleviating hunger caused by food shortages in Europe. At the end of the century XIX and beginning of XX, occurs the Second Agricultural Revolution, characterised by various scientific and technological discoveries, usage of chemical fertilizers, genetic improvement of plants and the separation between agriculture and livestock. The model dictated by the Second Agricultural Revolution became present in practices of diverse farmers spread around the world, in such a way that it started to be called "conventional agriculture".

According to Siebeneichler (2018) the preoccupation with the environment, with the search of alternative models of agriculture, became part of the agenda for discussion in the countries from the second agricultural revolution (end of the XIX century and beginning of the XX century), due to the exhaustion of natural resources caused by the Green Revolution.

However, only at the end of the XX century a new phase is experienced in agriculture, a phase of reaction to the model then dominant, where there became an articulation between the countries, primarily among the developed countries like United States and Japan, in defense of the environment, with emphasis of the consequences of the anthropic activities about nature, getting into questioning the limits of economic growth.

Stresses Ehlers (1994, p. 57) that the alternative agriculture emerged between the decades of 1920 and 1930, as opposed to the installation of the chemical standard, moto-mechanic and genetic of modern agriculture, emerging with the denomination of "rebel movements", in which gave special importance to the productive process and vegetative soil. In the 1970s, rebel movements were strengthened, and coming to be called "alternative" agriculture to the conventional model.

In 1972 occurred the United Nations Conference in Stockholm (Sweden), that counted with 113 countries, among them Brazil, a historic milestone by alerting people to the preservation of the environment,, according to Dias (2017). Dias (2017) informs that the United Nations Conference in Stockholm was preceded by a report titled *"The limits to growth"*, based on a neomalathusian perspective which alerted around the risks of population growth over natural resources, having the potential to lead to the depletion of these resources. Thomas Malthus was a british economist that developed a famous theory around the demographic growth in which warned that the population grew in geometric progression, while the production of food grew in arithmetic progression, reason why the population growth would cause a great scarcity of food and, in consequence, hunger.

In 1983 ONU's general secretary invited the doctor Gro Harlem Brundtland to preside over the global commission about environment and development, and, in 1987 the commission led by Brundtland published an innovative report that brought to the world the concept of sustainable development. In 1992 occurred in Rio de Janeiro - Brazil the United Nations Conference about the environment; in 2002 the conference happened in South Africa ("Rio + 10"); in 2012, again in Rio de Janeiro - Brazil, occurred a new conference about the environment (Rio +20). Those

conferences defined a new objective to sustainable development (DIAS, 2017).

According to Santos & Monteiro (2004) the growth in demand for organic food results from the consciousness of consumers regarding the damage that residues from chemical fertilizers and pesticides can generate to health, including, such authors affirm that many pesticides considered indispensable for the conventional production are being seen as environment degraders and food contaminants.

According to Ehlers (1994, p. 40-55) agroecology stopped being seen merely as a scientific subject to become a practice, a "umbrella" concept that shelters various alternative tendencies.

Klug (2016) in an enlightening scientific article entitled *"The agricultural Brazil: the tortuous and difficult path to swidden"*, a work of bibliographical revision, concludes that since the colonial times Brazil served as agricultural enterprise for Portugal, in view of the lack of food autonomy of the last, since Portugal had no aptitude for agriculture and saw it as a less valuable and derogatory activity, resulting from this a huge contradiction on the part of the Brazilian peasants, that were reluctant to admit Brazil as a remarkably agricultural country, generating a true identity crisis. However, nevertheless the portuguese dependence related to brazilian agriculture, the author warns that Brazil did not employ agricultural techniques in land management, as the portuguese who were settled here did not dominate it, and absorbed the agricultural practices used by the natives who lived here.

In 1962, Brazil was strongly boosted with the publication of the book Silent Spring written by Rachel Carson, which stood out the necessity of respect towards the ecosystem for the protection of human health and environment.

Brazil's agroecological movement had its start in the decade of 1980 named alternative agriculture, since the movement emerged with the purpose of alternative models to conventional agriculture or the second phase of modern agriculture. (EHLERS, 1994, p.69-71).

In Brazil, the first regulations about organic products occurred in the decade of 1990 due to the rising number of production and commercialization in this sector, has especial spotlight the Normative Instruction nº 07/1999 by the Ministry of Agriculture, Livestock and Supply, that regularized the Organic System of Production and brought as newness the Certification by the Participative System of Guarantee, model that had been already used by Ecovida Network in Rio Grande do Sul. However, the Law that institutes the organic agriculture in Brazil was only published in 2003, it's about the Law nº 10.831 of

december of 2003, subsequently regulated by the Decret 6.323 of December 27 of 2007 (SILVA & SILVA, 2016).

Befits observe that the Normative Institutions n. 07/1999, the Law 10.831 of 2003 and the Decree 6.323 of 2007 have similar concepts of the Organic System of Production. Here's the concept presented in the Decree 6.323 of 2007:

> Organic system of agricultural production is everyone who adopts specific techniques, through the optimization of usage of natural resources and social economics available and the respect to the cultural integrity of the rural communities, having as an objective the economic and ecological sustainability, the maximization of social benefits, the minimization of the dependency on non-renewable energy, employing, always when possible, cultural, biologicals and mechanic methods, in contraposition to the use of synthetic materials, the elimination of the use of genetically modified organisms and ionizing radiation, in any phase of the production process, processing, storage, distribution and commercialization, and the protection of the environment (DECREE 6.323 of 2007, art. 2º., Inc. XVII).

In view of the foregoing, in accordance with art. 2º, inc. XVII of the Decree 6.323 of 2007, so there are and be observed the legal demands of the Organic System of Production. It mister the conjugation of all the factors listed on the law, whether, employment of specific techniques, optimisation of the usage of natural resources and socialeconomics available, as well as the respect to the cultural integrity of rural communities. Besides, the mentioned article also demands the elimination of synthetic materials, the elimination of the usage of genetically modified organisms and ionizing radiation.

Thereby, there is no doubt that organic agriculture is guided by the pursuit of ecological sustainability, preserving the biodiversity, the biological cycles and the plants' health, in line with the basic standards for the production and processing of organic foods edited by the

International Federation of Organic *Agriculture* Movements (IFOAM, 2014).

According to Oelofse*et al* (2010), organic agriculture is well-accepted by family-based farmers, those face it as a big opportunity of economic and social ascension, since the organic market is booming and the reduction in the use of external insum, as well as the additional value of the products promote an economic earn.

In the mid-1970s the theoretical emergence of "sustainable development" gets global attention, in this context happened the Stockholm's Conference by the United Nations in 1972, occasion which it was established the regulatory principles of sustainable development, but the theoretical framework of sustainable development emerge in mid-1980s, with the works of Victor Toledo and others in Mexico and Joan Martinez and other in Spain (GOMÉZ, 1996).

It is important to note that in the legislator's vision the observance of all those factors is a demand so the Organic System of Production exists, and it is a presupposition to achieve economic and ecological sustainability. The Brundtland Report, preparation for the United Nations Conference about the environment (ECO 92 - Rio de Janeiro - Brazil), addresses sustainable development as one capable of ensuring the needs of future generations.

AGROECOLOGY AND ORGANIC AGRICULTURE

Organic agriculture integrates a group of alternative agricultural currents to conventional agriculture, in between which biodynamics is inserted, natural agriculture and permaculture, that possesses traits which distinguish from one another, such as traits in common. Moreover, with the objective of encouraging agroecological soil management the second paragraph of the first article of the Law 10.831 of 2003 establishes that the organic system of agricultural production includes ecological, biodynamic, natural, regenerative, biological, agroecological, permaculture and other systems that attend to the agroecological principles, which is commendable, in view of that it brings some flexibility to the farmer.

It is good to clarify that according as sustains Ehlers (1994, p. 67) what is common between the agricultural currents mentioned above and the organic agriculture with regard to the recommended practices is that all of those defend the valorization of organic adubation, be it from vegetal or animal origin, of the consorced plantation, crop rotation and biological control of pests.

It's worth observing that organic agriculture, biodynamics, natural agriculture and permaculture should not be adopted

singly, but carry an idea of complementarity, being worth all the efforts on the search for the ecological balance, of an agriculture socially fair and viable. By the way, the laws of organic agriculture do not embrace only this mode of agriculture, as said before, but induct the notion of system, allowing all the measures aimed at seeking an ecologically sustainable agriculture. It is observed that Law 10.831 of 2003 and Decree 6.323 of 2007 do not define only organic agriculture, but define the "Organic System of Production", as art. 1º. of Law 10.831/2003 and art. 2º of Decree 6.323/2007, what reveals that the agroecological currents are not exclusionary from each other.

Too much more, it must be noted that the terms "agroecology" and "organic agriculture" are not synonyms, although many times being treated as such. However, as assert Altieri (1989) and Gliuessmam (1990) *apud* Abreu *et al* (2012) , while organic agriculture has its roots in soil science, agroecology is based on ecology's principles.

A. Wezel*et al* (2009) affirm that the term agroecology was used for the first time by a russian agronomist called Bensin between 1928 and 1930 that suggested the term "agroecology" to describe the usage of ecologic methods in searches about commercial plants. They say that up until today the term agroecology is used to refer to the application of ecology in agriculture.

To Assis (2002), agroecology is "a science that seeks the understanding of the functioning of complex agrosystems, as well as the different interactions present in theses". Exhibits the mentioned author that agroecology craves the conservation and enlargement of biodiversity, with views on obtaining self regulation and sustainability.

Assis (2002) emphasizes that soil has been recognized as an living entity, whose existing organisms do not depend only on physical and chemical conditions, but also influence this environment with a wide range of activities. Thus, the soil's biota is strongly influenced by the practices employed, such as crop rotations, fertilization and others.

A Wezel and collaborators (2009), when discussing the concept of agroecology inform that the term is present through time as science, social movement and as practice. Initially agroecology emerged as science around 1920 and 1930, from 1960 the term agroecology is used to head the social movements of protest to conventional agriculture, although in the 1990's and agroecology is presented as an agricultural practice.

Abreu and collaborators (2009) highlight agroecology as a practice when emphasizing that agriculture translates into the adoption of new practices, the emergence of new

systems of values and relations between producers and consumers. Agroecology is also presented as a complex interdisciplinary science, according Floriani and Floriani (2010).

Moreover, despite the multiplicity of factors around agroecology the theme deserved a minimum systematization, task achieved by the editing of Decree 7,794 of August 20 of 2012, that institutes the National Policies of Agroecology and Organic Production (PNAPO), created with the objective of "integrate, articulate and to adequate policies, programs and inductive actions of agroecologic transitions and organic agriculture started to integrate the project of development of Brazil, living with the development policies of conventional agriculture.

Many countries in the world created legislations to regulate the organic production system, not being a tendency only in Brazil, so much so that it is true that in 1972 the International Federation of Movements for Organic Agriculture (IFOAM) was created, global institution that brings together different sectors involved with organic production, in which in 1980 established basic standards to define the organic productions in an international context, standards that undergo periodic reviews and guide the laws of countries on organic production (IFOAM, 2014).

Moreover, Siebeneichler (2018) asserts that the brazilian State acts via a regulatory framework of organics, however, in Europe the States work through a regulatory body, which evidence in Europe a politicization of consumption and a bigger participation of non-public actors.

In the light of Decree nº 6,323 of 2007, organic agriculture is a system of production that maintains the soil's biological activities, seeking to preserve the health of the environment and biodiversity. It prohibits the use of synthetic fertilisers, pesticides in general and growth regulators, as well as the employment of genetically modified or transgenic organisms. According to IFOAM (2014), the principles of organic agriculture are equity, health, ecology and justice.

The differential of organic agriculture, here understood as that which attends to the organic system of production, translates itself on its legal discipline and in the demands of certification of its products, allowing the traceability of food in all the steps of production, since the plantation until the transportation and delivery of food to the final consumer, having as goal to attend the demands of food safety and quality (IFOAM, 2014).

It is not ignored that there are standardizations of fixed agriculture by the market, noticeably in the market focused on exportation, where usually it's fixed the standards of quality and traceability of cultivated products, however, the differential of organic production system is that it applies to all of those who adopt, without any distinction between the recipients of the products put up for sale, which provides greater protection to the consumer.

To Silva & Silva (2016) the superiority of the nutrients in organic food is an advantage, to the extent that this type of agriculture maintains soil fertility and the general health of plants, animals and humans.

It is worth stressing, however, that some critics present organic agriculture as a niche market, and sustain that there is a certain detachment between organic agriculture and agroecology, what happens, for example, when the first admits the practice of monoculture, with the purpose of producing on a large scale to attend the foreign market. By the way, one of the determining factors in the institution of a regulatory framework in Brazil was to meet the requirements of the international market.

In this sense, Abreu (2012) considers that organic agriculture and agroecology can converge at some points and diverge in other and, by pointing out the divergent points maintains that an organic-based farmer can seek efficiency in its practices without redefining the productive system, working on a system of monoculture, which would not meet the dictatings of agroecology, for it doesn't value the diversity of cultures.

In the same direction Silva (2017), who points that in capitalism it's impossible the ethical coexistence between living beings, since capitalism goes through a global standard of coloniality, dictating norms to obtain captivated minds, cheap labor and abundant raw material, requiring a counter-hegemonic movement, to enable the application of the principles of agroecology and well-being.

However, if it's true that agroecology and organic agriculture are not exactly convergente expressions in all points and that on large-scaled organic agriculture there is practice of monoculture, then, it's undeniable that even on organic monoculture it imposes to observe the legal rules, with the management of more sustainable agricultural techniques, under penalty of not obtaining the certification of the products or establishing itself in the market as an agribusiness focused on exports. This way, the organic farmer must obey to the Law nº 10,831 of 2003, the Regulatory Decree nº 6,323 of 2007, and, yet attend the Normative Instruction 46 of 2011 of the Agriculture Ministry, focused on plant and animal production.

On the other hand, as maintain Silva & Silva (2016) organic agriculture has the aptitude to be developed by employers' producers, but its greater aptitude is to be

developed by small and medium producers, since the inception of those in a modern productive system and adapted to the reality of the markets causes there to be creation of jobs, as well as social and regional development.

Santo *et al* (2012) in an enlightening study around organic agriculture and sustainability, based on the teachings of Sir Albert Howard, that brought the theoretical embasement to organic agriculture, and, as base of studies to many authors, points that "organic agriculture relies on economic, social and environmental factors, that interconnected and interdependent form a dynamic balance, pattern of sustainability." Add, also, Santos *et al* (2012) that various are the advantages of organic agriculture, being seen that its activities do not contaminate the water, nor cause death of the fish and aquatic animals, as opposed to what happens when indiscriminately using mineral insums.

It should be noted that the Decree 6,323 of 2007, by regulating the organic system of production, impose the observance of tradition and culture, besides demanding the obedience to the labour laws, especially in relation to the norms of safety and hygiene of work, how it is insoffrom the articles 4º and 5º of the referred decree.

Given this, the law does not despise the traditional knowledge of agriculture, respects the cultural integrity of the producer and also excels for healthiness in the workspace, seeking to improve the quality of life of the employee. By the way, the quality of life to be pursued must reach not only the paid employees, but also the own rural producer, that, not rarely work alongside the other members of your family with minimum age of work under the family farming scheme.

This way, organic agriculture is much more advantageous than conventional agriculture and offers more reliability and preservation of the ecosystem as a whole.

CERTIFICATION SYSTEMS OF ORGANIC AGRICULTURE IN BRAZIL

With the advent of the Law 10,831 of december 2003 Brazil gave an important step into searching sustainability in agriculture with the standardization of production, transportation and commercialization techniques of products.

For a unity of production to be considered organic must go through a period of conversion, that varies according to the type of exploration and the previous usage of the unit. Before the period of conversion is complete with all its demands it is not possible to obtain the certification of the product as organic, and, the collected food during this

phase are called only "agroecological products" (art. 6º of Decree 6,323 of 2007).

In collating with conventional agriculture it's evidente even more the standardization of organic agriculture, in view of the fact that conventional agriculture does not enjoy legal rules, except in relation to the use of pesticides and chemical fertilizers, which, has legal limitations, besides the ones imposed by the market. However, even so, according to Silva & Silva (2016) Brazil presents itself as the biggest consumer in global scale of pesticides, add to it, yet, that the agricultural sense of the Brazilian Institute of Geography and Statistics - IBGE - performed in 2017, found an improvement of 20% on the usage of pesticides in relation to the year of 2006 (IBGE, 2019).

Santos & Monteiro (2004) underscore that the food production by the convencional system can bring residues of pesticides harmful to human health. They bring up research performed by the National Health Surveillance Agency (ANVISA) alongside with the Oswaldo Cruz Foundation (FIOCRUZ), in which showed that 22,17% of the fruits, greens and vegetables, produced on conventional system and sold in supermarkets of four brazilian states, showed levels of pesticides higher than allowed by the law and contained, including, non-authorized products.

Organic farming, on the other hand, goes through inspection during the conversion period of conventional agriculture to this model of cultive of the soil and at least once every year the units already certified are inspected, according demanded by the articles 55 and following of the Decree 6,323 of 2007, which regularize the institute law of organic agriculture.

In 2012 the Brazilian Association of Public Health - ABRASCO published a dossier in which affirmed that from the 50 pesticides most used on Brazil's crops, 22 are prohibited on the European Union, which evidences the necessity of stricter regulamentation and fiscalization of the country.

In Brazil the law which provides about the use of pesticides is the law nº 7,802, of July 11 of 1989, which provides also about research, experimentation, production, packing, among other subjects relating to pesticides, its components and others, the referred law is scoped minimize the risks of exposure to pesticides in differents steps of the process.

It is in the process on the National Congress the Bill 6,299 of March 13 of 2002, vulgarly called "Poison Package", which, if approved, will release even more the usage of pesticides in the country. On the other hand, it also is in the process on the National Congress the Bill 6,670 of December 13 of 2016, which institutes the National

Policies of Pesticides Reduction, aiming more protection to human health and to the ecosystem.

Organic Agriculture has as main instrument the certification of its products, for it lends credibility to the consumer about the quality of food and easy access to foreign market (SILVA & SILVA, 2016). In this procedure a Certifier, duly accredited by the Ministry of Agriculture, Livestock and Supply (MAPA) attests in writing that determined product meets the norms and practices of the model of organic production, attaching a seal to the label or packaging of the product.

Santos & Monteiro (2004) when discussing the requirements for the production of organic foods adduct that:

> For you to become an organic farmer, it is necessary that the candidate be subjected to a rigorous process of investigation of the environmental conditions of the agricultural facility and of the potentiality to produce. It is considered aspects as the not use of chemical fertilizers and pesticides in the last two years, the existence of vegetal barriers when there are neighbors that practice convencional agriculture, the quality of the water to be utilized on irrigation and washing of products, the conditions of work and the life of workers, the compliance with health legislation and the lack of garbage scattered throughout the facility. The producer must respect the norms during all the steps of production, since the preparation of the soil to the packaging of the food, always preserving the natural resources. The farmer signs a contract with a certifior which provides for the monitoring of its production, in a way to guarantee the trackability and the quality of the product to be available to the consumer.
>
> (SANTOS, Graciela Cristina dos. MONTEIRO, Magali. Organic System to Food Production. Alim. Nutr.Araraquara, v.15, n.1, p.82, 2004).

Thus, given the strictness of the conditions necessary to obtain the framing as organic producer it's visible the guarantee of quality of the products offered to the consumer.

As far as certifiators are concerned, underscore Santos & Monteiro (2004) that they should have their own rules and exert proper control over the usage of their licences, certifiers and certification labels. In addition, they should specify which products are authorized to use the certification label.

There are three types of classification for the organic products available to the consumer: *Audit Certification (OAC), Participatory Guarantee System* and *Social Control in Direct Selling (SANTOS et al, 2017).*

On Audit Certification, the granting of the system seal of organic production (SisOrg) is done by a public or private certifier, accredited by the Ministry of Agriculture. The conformity assessment body obeys the procedures and criteria recognized internationally and the technical requirements established by brazilian law about organic agriculture (*SANTOS et al, 2017*).

The Participative System of Guarantee is characterized by the collective responsibility of the members of the system, that might be producers, consumers, technicians and other stakeholders. To be legal, a SPG has to have a Participatory Conformity Assessment Body (Opac) legally constituted, which will be responsible for issuing the SisOrg*(SANTOS et al, 2017)*.

According to Santos *et al* (2017) the participative system of guarantee is peculiar in Brazil, which brought the possibility of participation of all the agents involved in the sector, allowing that the guarantee of quality of the product to be made in a relational or participative manner, being able to attest to the organic quality without the direct presence of the certifier, which allowed small producers access to the system.

In case of certifications by the participative system the producer must be linked to a group, attending to the periodic meetings. The own group guarantees the organic quality of its products, being that everyone supervises each other, and, in case of one producer not meeting the norms of the organic system of production, the group must exclude the producers, cancel the certify and inform the Ministry of Agriculture *(SANTOS et al, 2017)*.

According to Santos *et al* (2017) the participative system of guarantee is peculiar in Brazil, which brought the possibility of participation of all the agents involved in the

sector, allowing that the guarantee of quality of the product to be made in a relational or participative manner, being able to attest to the organic quality without the direct presence of the certifier, which allowed small producers access to the system.

The Social Control of Direct Selling is an exception to the obligatory of certification of organic products, destined to the farmer under familiar regime. However,accreditation is required in an organisation of social control (OCS) registered in an official supervisory body, because with that, the family-based agricultors start to be part of the National Register of Organic Producers. On this system the producers must ensure the consumers and the inspection body the trackability of the products, as well as the open access to the producing facilities *(SANTOS et al, 2017)*.

It is therefore verified that the certification system makes possible and also conducts the observance of rules legally instituted to the configuration of organic systems of production, which provides food and nutrition security for the consumer, since it does not present synthetic fertilizers and pesticides, besides not allowing the genetic modification of seeds. Add to that the rational use of natural resources, the generation of more balanced ecosystems and more generation of hand of work, as stresses Silva & Silva (2016). Another important factor, which is highlighted by the law 10,831 of 2003 and the regulatory decree is respect for the cultural environment and to the knowledge of traditional communities, since local agriculture is valued, inserting the producers into the productive system.

THE GROWTH OF ORGANIC AGRICULTURE IN BRAZIL AND THE CONTRIBUTION ON THE REGULATORY FRAMEWORK

According to the official website of the Ministry of Agriculture, in seven years tripled the number of registered organic producers and the quantity of units of production grew a percentage of 300% between 2010 and 2018. The number of rural producers of organic food units has presented a permanent growth, leaving the number of 5,406 units in 2010 to hit the number of 22,064 producer units in 2018.

In 2006 IBGE performed an agricultural census and identified 90,498 facilities of organic producers embedded in a total of 5 million agricultural facilities in Brazil, in a way that the organic production represented 1,75% of the brazilian production. However, in the world of organic producers only 5,64% were accredited by a certifying body registered in the MAPA (IBGE, 2006).

Siebeneichler (2018) sustains that the organic market in Brazil, as in other countries, is on the rise, although the European market has a much higher level of growth.

Thus, the number of producers that formally adopted organic agriculture in Brazil is increasing.

IV.   CONCLUSION

The preoccupation with world hunger generated a model of agriculture focused on large scale production, implementing itself on agriculture a model of industrial production, with large usage of machines instead of human hand work, usage of pesticides and exacerbated natural resources. As a reaction to the current model of agriculture, emerged the alternative model of agriculture, in which rescued principles of agroecology abandoned before by conventional agriculture.

In the beginning of the XX century the environment started to integrate the agenda of global conferences between the countries, emerging alternative models of agriculture. In Brazil, organic agriculture became notorious in the 1990's, especially after the environment global conference - ECO 92, held in Rio de Janeiro - Brazil.

Agroecology and organic agriculture are not convergent expressions, one might say that agroecology is a genre and organic agriculture is a species, agroecology is a wider term and englobes other models of agriculture, such as permaculture, biodynamics and biological agriculture. Moreover, the law 10,831/2003 brought the definition of "Organic Systems of Production" involving various models of agriculture, not only organic agriculture, and concludes that the models of agriculture complement each other.

The legal subject of organic system of production, as well as the demands to certify the organic foods, except for the prerogative of direct selling by small farmers registered on the Ministry of Agriculture, Supply and Livestock, allows more food safety and a bigger approach of sustainability ideas. In contraposition, conventional agriculture which has no rules, except with respect to the limitation of the use of pesticides and the natural market impositions.

However, although there are legislative limitations regarding the use of pesticides there are shortcomings on fiscalization, in a way that it's common that food produced by conventional system of agriculture presents levels of pesticides higher than allowed by law, and not forgetting to consider that there is often the use of the unauthorized chemical insums by law.

Thus, the objective of this study was to demonstrate that the legal framework of organic agriculture in Brazil - Law 10,831 of 2003, stimulated the adoption of a model of sustainable agriculture, that respects the productive capacity of the soil, promotes the use of rational natural resources, the preservations of the ecosystem, respect to the rural producer, its culture and also the consumer.

The objective was to demonstrate the legal standardization of organic agriculture, as well as the demands of certification of its products gives consumers greater credibility, ensuring them the much desired food security.

In Brazil it was observed a discrete growth in organic agriculture, however the growth of organic agriculture has shown itself as a global tendency, since the consumers are more aware and demanding.

ACKNOWLEDGMENT

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Path Analysis for Maize (*Zea mays*) Silage Cerrado-Amazon Ecotone

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Abstract— The management of nitrogen fertilization is of paramount importance for the increase of corn silage productivity, by directly participating in the processes of cell division and expansion.It is extremely important to identify the characteristics that are associated with the responsiveness of the use of nitrogen fertilization.Therefore, this study aims to identify the characteristics that most influence the total weight in maize silage production.Two trials were conducted, one with low nitrogen dosage (0 kg ha^{-1} of N in cover) and the other with a high dosage (120 kg ha^{-1} of N in cover), performed in the harvest 2017/18, in Sítio Vitória, in the municipalityof Santa Maria das Barreiras, State of Pará, located in the ecotone Cerrado-Amazon. The experimental design used was randomized blocks with eleven treatments and three replications.The treatments used were BRS 3046, M274, AG 8088, ANHEMBI, PR 27D28, P33-16, P32-11, P29-M12, P36-19, P40-8, and AG 1051. The base fertilization was performed in the groove manually supplying the needs of chemical and physical analysis. Whole plants of the useful plot were harvested and the characteristics were measured forplant height, insertion height of the first ear, culm diameter, the diameter of the ear, weight of the stem leaf, ear weight, and total plant weight. Track and variance analyses were performed through the Genes computer program. Variance analysis was performed for Low and High N, and track analyses for low N, high N, and average values conditions.

I. INTRODUCTION

The maize crop (*ZeaMays*L.) exerts great economic and social importance, due to its high adaptability to the most diverse climates, being cultivated to thousands of generations around the mute. This cereal is present in several everyday situations, from human food, as well as to animals, and more recently, as a form of biofuel [1].

In recent decades, culture has undergone profound changes, according to Contini et al. [2] from the 2000/01 crop to the 2017/18 harvest, the world's maize production increased from 591 million tons to 1.076 billion tons (representing an increase of 82%), mainly because of the use as animal feed for the production of chickens and pigs.

In Brazil, the increase in productivity occurred especially due to the decrease in the role of culture as a source of subsistence for small producers, and its improvement of the role in agricultural production.Contini et al. [2]point out that, although the Brazilian maize market has shown a sudden growth, the sector still needs to solve some obstacles that prevent greater dynamism. Among the obstacles, we highlight the lack of clarity in price formation; difficulties in achieving private funding; obstacles in marketing, especially in the process of flowing production; productivity observed in some regions.

During the last years the growing need in the exploitation of maize crop, aiming at the optimization of areas cultivated with the crop, in the search for more productive cultivars, mainly for animal feed purposes. The expected production for the crop in the 2020/21 crop is 23.6 million tons. In addition to the second and third harvests, total production could reach 105.5 million tons, 2.9% higher than in 2019/20. Brazil has stood out as the third-largest producer in the world of this cereal, second only to the USA and China respectively [3].

Grass silages have low protein content, limiting their use [4]. The production of green matter, dry matter, and grain production, both at the silage point and at maturity, are the factors that most affect the production and palatability in the digestion of the animal.

According to Paziani et al. [5], there was a certain difficulty in finding cultivars with productive efficiency in Brazil, because in many times the cost of silage production outside the profit of the animal, or was lower than the profit obtained by maize grain, so the improvement of maize focused on silage was poorly seen.

Ciappina[6] highlights that about 70% of maize production is used in animal feed, and can reach 85% in developed countries, mainly because it is a fundamental food in the diet of the animal in confinement. Being the most used grass in silage production due to high mass production, ease of fermentation inside the silo, good energy value, and high consumption by animals.

The characteristics that maize silage brings allows it to be an important food in rural cutting and milk properties. In addition to the versatility and high energy value, it is easy to manage production, storage, and supply to animals during periods of food shortages, it guarantees the maintenance of the profitability of producers [7].

A wide variety of corn hybrids with different characteristics can currently be found on the market. For silage production, the productive potentials of each hybrid should be considered, in addition to the agronomic characteristics of the plants, since they are factors that can interfere with the quality of the ensiled material [8].

The *Path analysis*, when using the unfolding in direct and indirect effects of the correlations between productivity and characters evaluated in plants, can be an important statistical methodology in genetic improvement to identify the primary and secondary characters that most contribute to productivity [9].

The success of the *Path analysis* is based on the most consistent formulation of the cause and effect factor among the variables, which leads several authors to use it in their articles in the most diverse areas of knowledge [10]. The correlation values are expressed, if positive, the response effect of productivity will have gained before the variable, if it is negative, the response effect will have a decrease in productivity [11].

In the agrarians sciences, the path analysis is used to measure the correlation of parameters for different cultures, such as canola [12], sunflower [13], jabuticaba fruit [14], soy [15], sorghum [16]. When it comes to silage, it can be highlighted in the maize crop [4, 17, 18], and other crops, such as sorghum, elephant grass, and soybeans [19, 20, 21, 16].

Therefore, the present study aims to analyze the attributes that best represent the total mass of maize silage under high and low nitrogen conditions, through the *Path analysis*, allowing to establish correlations between these variables, which are indicative of maize yield and quality.

II. MATERIALS AND METHOD

The tests were conducted in the 2017/18 crop harvest at Sítio Vitória, located (8°18'32"S 50°36'58") in the municipality of Santa Maria das Barreiras, Pará State region located in the Cerrado-Amazon ecotono. The climate of the region is type Aw according to the Köppen

classification, which indicates tropical climate with the dry season in winter [22].

The State of Pará has high rainfall variability, resulting from the performance of different atmospheric systems that act on the State. The identification of homogeneous areas of rainfall in Pará directly diverges to the environmental dynamics, where the delimitation of periods and areas of higher and lower rainfall concentration become important for the determination of good productivity [23].

Two competition trials of maize cultivars were installed, one installed under low nitrogen, with 0 kg ha^{-1} of N, and the other under high nitrogen, with 120 kg ha^{-1}of N, both in cover. The doses were determined according to the lowest and highest expected productivity for maize[24].

The experimental design used in each assay was randomized blocks with eleven treatments and three replications. The treatments used were BRS 3046, M 274, AG 8088, ANHEMBI, PR 27D28, P33-16, P32-11, P29-M12, P36-19, P40-8, and AG 1051.

The experimental plot used was composed of four rows of 5.0 m, spaced 0.9 m between rows. The useful area of the plot was only the two central rows, discarding 0.5 m from the ends of these rows.

The soil preparation was carried out with a gentler grill followed by the use of a leveling grid. The base fertilization was performed manually, using 300 kg ha^{-1}of N-P$_2$O$_5$-K$_2$O, formulation 5-25-15 + 0.5% Zn, based on the characteristics obtained in the chemical and physical analysis of the soil, expressed in Table 1 [24].

Table 1. Chemical and physical characteristics of the soil of the experimental area (Depth: 0–20 cm) at Sitio Vitória, in Santa Maria das Barreiras, Pará State, 2017/18.

Clay %	pH CaCl$_2$	O.M. dag kg^{-1}	P mg dm^{-3}	K$^+$ mg dm^{-3}	Ca^{2+} cmol$_c$ dm^{-3}	Mg^{2+} cmol$_c$ dm^{-3}	Al^{3+} cmol$_c$ dm^{-3}	CEC cmol$_c$ dm^{-3}
15	4,8	1,7	4,9	43	1,7	0,3	0,20	5,21

O.M.: Organic Matter. CEC: Cation Exchange Capability.

Sowing was performed on November 14, 2017, in a groove, manually. After emergence, thinning was performed leaving an average spacing of 0.2 m between plants, obtaining a population of 55,555 plants ha^{-1}.

The management for the control of weed plants, pests, and diseases was carried out according to the technical recommendations found in the literature for maize crops[25].

The cover fertilization was performed with 150 kg ha^{-1} of N in the Alto N assay. The source used was urea (45% N),totaling 333.33 kg ha^{-1} of urea, it was divided into two stages, the first in Stage V4 and the second in stage V8 (classification used in Brazil)[26].

The harvest was performed when the plants reached the ideal physiological stage (fifth stage of the reproductive phase) for silage yield with maximum nutritional efficiency. The whole plants of the useful plot were harvested and the characteristics were measured for Plant Height (PH), Insertion Height of the first ear (IH), Stem Diameter (SD), Ear Diameter (ED), Stem Leaf Weight (SLW), Ear Weight (EW) and Total Plant Weight (TPW) [17].

After data collection, variance analysis was performed for low N, high N, and both environments at the same time. Pearson's correlation coefficients were then estimated between the characters.Correlations with values of $R^2 \geq 0.6$ or $R^2 \leq -0.6$, derived from the methodology proposed by Dancey et al. [27], were significant, where R^2 above 0.6 is considered moderate to strong. Then, *path analysis* was performed, and correlations were unfolded in direct and indirect effects of the variables (independent variables) on the weight of the total plant (TPW) (Wright,1921).

The analyses were performed using the Computer Genes program, version 2007 [28].

III.   RESULTS AND ANALYSIS

The choice of the GENES program for the trail analyses took into account the intrinsic factor that the program brings to the variables the direct and indirect effects, positive and negative, between the characteristic taxed as main and those taxed as second-parents, besides being a genuinely Brazilian program[28].

Table 2. Analysis of variance for seven characteristics, in eleven maize genotypes in low and high N.

Source of variation	DF	PH	IH	SD	ED	SLW	EW	TPW
Low N					**Medium Squares**			
Block	2	18.39	0.48	0.24	6.78	611.39	17.45	843.76
Genotypes	10	426.41*	405.29*	8.14	63.57*	7016.62	6152.28*	23214.74*
Residue	20	15.06	17.12	0.57	2.85	363.23	116.42	839.96
Mean		182.24	87.85	15.36	43.17	216.88	131.55	348.42
CV (%)		2.13	4.71	4.93	3.91	8.79	8.20	8.32
High N					**Medium Squares**			
Block	2	0.21	6.39	0.12	1.05	348.09	20.82	493.30
Genotypes	10	320.42	364.94*	8.89*	50.28*	17472.02*	17576.52*	63276.33*
Residue	20	19.68	6.39	0.38	1.60	122.32	46.78	194.77
Mean		208.52	106.58	18.69	53.49	371.82	257.73	629.67
CV (%)		2.13	2.37	3.30	2.36	2.97	2.65	2.22

* significant at 5% probability, by f-test. DF: Degree of freedom. CV: Coefficient of variation

Nitrogen plays a fundamental role, being the element required in greater quantity because it constitutes many plant components in the plant, consequently contributes to the greatest effect on productivity, being evident in the analysis of variance (Table 2), where the coefficient of variation found for all variables studied is considered low. Due to the influence of nitrogen fertilization, the coefficient of variation found is considerably lower in High N, besides demonstrating more concise mean values among the eleven maize genotypes [26, 29].

The coefficient of determination (R^2), expressed in Tables 3, 4 and 5, revealed that the total plant weight (TPW) can be explained by the effect of the variables analyzed, which revealed that 99.99% of the determination of total weight can be explained by the other variables. Being higher than that obtained by other authors [5, 18, 20, 30].

The effect of the residual variable for low N, high N, and the medium was 0.9%, 0.5%, and 0.21%, respectively, which reaffirms the high degree of reliability of the data obtained from the model for silage yield.

Table 3. Estimation of the direct and indirect effects involving the main variable, Total Plant Weight (TPW), and the explanatory effects, Plant Height (PH), Insertion Height of the first ear (IH), Stem Diameter (SD), Ear Diameter (ED), Stem Leaf Weight (SLW), Ear Weight (EW), for 11 maize genotypes, Low N.

Effects		PH	IH	SD	ED	SLW	EW
				Estimates of variables in Low N			
Direct	ViaTPW	0.0022	-0.0032	0.0026	0.0074	0.5479	0.5077
Indirect	Via PH	-	0.0017	0.0010	0.0008	0.0014	0.0007
	Via IH	-0.0025	-	-0.0016	-0.0014	-0.0018	-0.0007
	Via SD	0.0012	0.0013	-	0.0015	0.0008	0.0017
	Via ED	0.0028	0.0032	0.0044	-	0.0059	0.0068
	Via SLW	0.3498	0.2984	0.3869	0.4393	-	0.4188

	PH	IH	SD	ED	SLW	EW
Via EW	0.1560	0.1172	0.3236	0.4657	0.3881	-
Total	0.5094	0.4187	0.7169	0.9133	0.9434	0.9349
R²						0.9999
Effect of residual variable						0.0096

Under N (table 3), the weight of the stem leaf (SLW) and the ear weight (EW) showed high correlation and high direct effect, both positive, indicating a strong relationship between the variablesunder study, demonstrating that the correlation alone explained this relationship.In this case, SLW and EW can be used in indirect selection for grain production.

The stem diameter(SD)and the ear diameter (ED) showed high correlation and low and positive direct effect on the total plant weight, and the indirect effect via SLW and EW were responsible for the high correlation, which confirms theimportance of SLW and EW in the selection process aiming at increasing production under low N. Beleze et al. [31] highlights that plants with higher DS and ED tend to directly influence the content of green mass and dry mass.

The characteristics of plant height (PH) and ear (IH) showed correlations of low magnitude and negligible direct effect on TPW. Calonego et al. [32] and Kappes et al. [33] highlight that the height of the plant has great influence, where plants with high height have longer nodes, with smaller stem diameter (SD), which leads to undernutrition of the ear (< ED), consequently in the reduction of EW, the higher risk of bedtime.

The variables SLW and EWexerted a greater influence on the weight of the total plant since a well-developed stem will produce ears with higher protein content and higher weight for silage [26, 34, 35]. Besides, these variables are influenced by all the other variables and together constitute the total weight of the plant [26].

In conditions of high N (table 4), similar to that which occurred in low N, the weight of the stem leaf (SLW) and the ear weight (EW) showed a high correlation and high direct effect with silage productivity (TPW), indicating a strong relationship between the variables understudy, demonstrating that the correlation alone explained such relationship, Farinelli&Lemos[36] demonstrated that this relationship is intensified as the increase in nitrogen fertilization increased.

The stem diameter (SD) and the diameter of the ear (ED) also presented high correlation and low direct effect ViaTPW, this is due to the linear conditions provided by the increase of nitrogen fertilization, thus found by other authors [34, 35].

The indirect effect via SLW andEW those responsible for the high correlation, which confirms the importance of SLW and WS in the selection process aiming at increasing production under high N. Again, the characteristics of plant height (PH) and ear height (IH), presented correlations of low magnitude and negligible direct effect on TPW, a factor necessary for plants to develop more in diameter and consequently in green matter quality [1].

Table 4. Estimation of the direct and indirect effects involving the main variable, Total Plant Weight (TPW), and the explanatory effects, Plant Height (PH), Insertion Height of the first ear (IH), Stem Diameter (SD), Ear Diameter (ED), Stem Leaf Weight (SLW), Ear Weight (EW), for 11 maize genotypes, in High N.

Effects		Estimates of variables in High N					
		PH	IH	SD	ED	SLW	EW
Direct	Via TPW	-0.00095	-0.00019	0.00250	-0.00043	0.52517	0.52615
Indirect	Via PH	-	-0.00072	-0.00033	-0.00028	0.00015	0.00006
	Via IH	-0.00014	-	0.00001	0.00001	0.00006	0.00004
	Via SD	0.00087	-0.00011	-	0.00208	0.00126	0.00173
	Via ED	-0.00013	0.00003	-0.00036	-	-0.00022	-0.00027
	Via SLW	-0.08198	-0.16301	0.26374	0.26411	-	0.42229
	Via EW	-0.03067	-0.11270	0.36310	0.32732	0.42308	-
Total		-0.1130	-0.2767	0.6287	0.5928	0.9495	0.9500

R²		0.99997
Effect of residual variable		0.0050

For the variables PH and IH to exert a positive influence on silage, thus improving its palatability, as the dose of N did not exceed the recommended for the crop, there is no exaggerated presentment of the stem, which guarantees main levels in the diameters of the stem and ear. For the total weight of the plant to rising, that is, it must be sought through the improvement of materials with such characteristics [31].

When the two environments (High and low N) (Table 5) were studied together, the correlations and direct effect of each variable about productivity were of similar magnitude and signal to those derived from low (table 3) and high N (table 4), confirming that the SLW and EW can be used in indirect selection for silage production.

Table 5. Estimation of direct and indirect effects involvingthe main variable, Total Plant Weight (TPW), and the explanatory effects, Plant Height (PH), Insertion Height of the first ear (IH), Stem Diameter (SD), Ear Diameter (ED), Stem Leaf Weight (SLW), Ear Weight (EW), for 11 maize genotypes.

Effects		Mean estimate of variables					
		PH	IH	SD	ED	SLW	EW
Direct	Via TPW	-0.00044	-0.00036	0.00174	0.00002	0.49820	0.53777
Indirect	Via PH	-	-0.00036	-0.00020	-0.00016	-0.00009	-0.00008
	Via IH	-0.00030	-	-0.00010	-0.00008	0.00000	0.00001
	Via SD	0.00078	0.00047	-	0.00144	0.00124	0.00132
	Via ED	0.00001	0.00000	0.00001	-	0.00001	0.00001
	Via SLW	0.10532	-0.00249	0.35427	0.37534	-	0.42775
	Via EW	0.09164	-0.01608	0.40650	0.42435	0.46173	-
Total		0.1970	-0.0188	0.7622	0.8009	0.9611	0.9668
R²							0.999996
Effect of residual variable							0.0021

IV.   CONCLUSIONS

1 Nitrogen doses did not influence the magnitude of phenotypic and genotypic correlations and direct and indirect effects on silage production.

2 The weight of the stem and the weight of the ears can be used in indirect selection for silage production.

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Unveiling the Consumers' Taste Attributed to Energy Efficient labelled Appliances: Evidence from Energy Efficiency 2019 Appliance Compliance Monitoring Report

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Abstract— In Ghana, standards and labelling (S&L) for appliances and the Rebate refrigerator initiative were implemented in 2011 and 2012 respectively to offer consumers the awareness they really need making well-informed decisions about monitored appliances when purchasing monitored appliances and then to encourage standards and labelling. The study assessed the consumers' compliance level for home energy saving initiatives based on the report from the Renewable Energy, Energy Efficiency & Climate Change Directorate of Ghana on Compliance Monitoring and Data Collection in December 2019. More precisely, the study looked at the compliance level of standards and labels with the Rating of Energy Labels (ERL) of the Ghanaian market appliances and the influence exerted on the consumers' taste for energy labelled appliances. In the Ghanaian distribution and the retail outlets throughout the regions, a total of 6739 appliances were surveyed including; 6198 refrigeration appliances together with 541 air-conditioners. The compliance level with the availability of its test report of all refrigerating appliances and air conditioners found on the market is 99.62% and 99.37% respectively. The standard of compliance for refrigerating equipment in all retail stores or shops is 97.34%, while that of air conditioners is 97.80%. The results of the report shows 99% compliance level for cooling appliances on the Ghanaian market. This study recommends the need to stimulate and enable Ghanaian importers and manufacturers to bring to the market more energy-efficient refrigerators and air- conditioners. Again, government must take into account national needs and to ensure that efficient energy products are accessible and desirable to enterprises in supplying the appliances.

I. INTRODUCTION

Energy efficiency has long been referred to as "a first fuel" because it is the only energy endowed resource that any country has in large quantities. In September 2015, Countries from all over the globe joined forces to decide on 17-Sustainable Development Goals (SDGs). Among the goals, SDG 7 proposes for a readily access to moderate, efficient, sustainable and advanced energy for all countries

in 2030 (International Energy Agency., 2016). Effective energy efficiency measures are critical to achieving the core energy stated goals of lowering energy costs, combating climate change and carbon emissions, enhancing energy protection, and expanding energy access (Nunoo, Mariwah, & Suleman, 2019). Household appliances use a lot of electricity and thus play an major function in improving energy efficiency, specifically in the residential sectors (Ramos, Gago, Labandeira, & Linares, 2015). According to countries that make up the membership of International Energy Agency (IEA), residential appliances or housing appliances, for example, account for about 19% of total energy usage in areas where data is readily available (International Energy Agency., 2016).

In Ghana's scenario in the year 1984, due to prolonged droughts that disrupted water inflows from the Volta River basin into the Akosombo Dam, Ghana began experiencing power shortfalls. In addition to these droughts, the increase in the energy consumption is due to population growth, citing more factories and increasing commercial operation, without the subsequent expansion of generation capacity, is among the causes of the Ghana's power deficits (Ministry of Energy Ghana., 2009). Household energy demand has also risen over the years and a large percentage of household demand is assumed to be wasted by the use of obsolete, faulty and inefficient refrigerating equipment imported into the country. Energy crisis seems to have become a recurrent development problem that is threatening the economic growths of Ghana and transformation (ISSER., 2005).

S&L promote competition to offer the most effective equipment to patrons as consumers are well educated. Equipment or appliance labelling facilitates implementation of requirements by helping regulators to identify irregularities whether un-labelled or mis-labelled are the controlled equipment (Ministry of Energy Ghana., 2009). The Rebate refrigerator program in 2012 allowed consumers, at a subsidized price, to swap their old refrigerating devices for modern more effective ones which are energy efficient. This market control and tracking of compliance has been part of the Energy Commission's key operations, which have contributed to some success in the restructuring of the Ghanaian appliance market. Market surveillance and regulatory reporting studies found that unreliable appliances were already making inroads into the Ghanaian market over the years from 2015-2016, thereby short-changing customers in various delivery and retail shops (Ghana Energy Commission., 2019).

Although there could be substantial potential motive for consumers to reduce their household energy usage, it would be important to learn more about the reasons motivating consumers to take those steps (Hwang, Park, & Kim, 2016; Struwig & Adendorff, 2018). Consumers are highly motivated by their environmental attitudes, preferences and purchases (Sarigollu, 2009). The consumers' energy saving behaviour is sourced from its natural environment orientation, ecological knowledge and environmental interest (M. M. Mostafa, 2007), and environmental values and beliefs, environmental rules and environmental knowledge are among the factors influencing the consumers' motives for reducing energy consumption (M. Mostafa, 2006). Consumers living in equilibrium with nature select goods that produce less pollution, which can recycle and reduce consumption. Consumers have a role to play in promoting the environmental energy efficiency (Ramanlal, 2015). The current change in efficiency, however, has been objectively catapulted by the dealings of inefficiencies caused by energy consumption including carbon emissions and biodiversity depletion (Barkenbus, 2006; Bird, Holt, & Levenstein, 2008; Goeschl, 2019; Schleich, Durand, & Brugger, 2021).

The primary objective of this research is, thus, to assess consumers' taste for energy labelled appliance on the Ghanaian market by reviewing the report from the Renewable Energy, Energy Efficiency & Climate Change Directorate of Ghana on Compliance Monitoring and Data Collection in December 2019. More precisely, the study reviewed the following headings; energy efficiency standards and labels (S&L), countries that have successfully implemented S&L, S&L in Ghana with the Rating of Energy Labels (ERL) for cooling appliances (labelled, Un-labelled or mis-labelled), compliance and monitoring reports for cooling appliances (refrigerators and air-conditioners) found on the Ghanaian markets as well as the Compliance Level trend in Ghana and Concluded by making some useful suggestions to the government, manufacturers, distributors, retailers and consumers.

II.   LITERATURE REVIEW

2.1 Theoretical Review

2.1.1 Energy Efficiency Standards and Labels

Energy efficiency standards is or are collection of rules and policies which specify the minimum or less energy efficiency required of manufactured goods (Essam, 2009; Mernier A., 2009; Weil & McMahon, 2003). Standards define a minimum level of efficiency for an appliance manufacturers to meet to enable them to sell their products (Masjuki, Mahlia, Choudhury, & R., 2000). The term "standards" has two explanations: firstly, well-stated guidelines (or laboratory test processes) for obtaining an adequately accurate evaluation of a product's energy performance as being used usually, or at least a comparative

rating over the product's energy performance relative to other models. Secondly, the limits set for energy performance (normally maximum or minimal usable energy) (McMahon & Turiel, 1997; Weil & McMahon, 2003). Efficiency standards, like that of government safety standards, have important and common benefits, including goods innovation and huge amount of money in consumer energy savings, and a major fall in carbon emissions (Hampton, Okpala, Perez-Reyes, Roycroft, & Sowards, 2017). Standards for energy efficiency are mechanisms for market transformation (Stadelmann, 2020).

Energy-efficiency labeling are descriptive labeling attached to goods manufactured that clarify the product's energy performance (specifically in terms of energy usage, efficiency, or cost). These labeling offer consumers the necessary awareness needed in making well-informed purchasing decisions (Weil & McMahon, 2003). Energy labeling can be applied in two ways: mandatory or voluntary. Distributors and manufacturers are mandated by law to provide and display energy labels on all air conditioning appliances being sold or produced. Distributors and manufacturers will be charged to use the energy labels properly as defined by policymakers, while policymakers will be charged to supply the appropriate labeling for various appliances (Stadelmann, 2020). Of course, the appropriate authority will have to impose the required energy label. Labels allow manufacturers to prioritize performance in their marketing strategies, as well as enable them to introduce efficiency into their sales campaigns (Masjuki et al., 2000).

In markets across the world, energy labeling is becoming more prominent (Weil & McMahon, 2003). Two major forms of energy labels are identified on the market: the "seal-of-approval" and the "report card" (Banerjee & Solomon, 2003). Stickers of Seal-of-approval, such as the Energy Rating labels (ERL), are commonly identified confirming one or more well-defined measures have been carried out by the product and guarantee greater environmental results than the normal goods of that group (Hwang et al., 2016). These labels are in most cases controlled by a third party. Meanwhile, like that of the Energy Guide label, 'Report card' labels have comparable test results for the individual commodity and compare it to items with a similar standard (Goeschl, 2019).

2.1.2 Standards and Label System in Ghana

Ghana has enacted a Mandatory Appliance or Equipment Standards and Labeling system, which allows importers and Ghanaian retailers of room air-conditioners to import only and sell made products that meet the Ghana Standards Board's Minimum Performance and Efficiency Standards. S&L for appliances and the Rebate refrigerator

initiative were implemented in 2011 and 2012 respectively to enable consumers to specifically make well-informed decisions when purchasing monitored appliances and then to encourage S&L to improve on the Ghana's energy efficiency (Ghana Energy Commission., 2019).

Only appliances meeting the minimum energy performance (MEPs) requirements are permitted on the Ghanaian market, as per the regulations of Energy Standards and Labels Program (Nunoo et al., 2019). Appliance manufacturers or producers who have been exporting to Ghana likewise marketers selling mostly in the country are required to show a label representing the energy efficiency rating of the appliance prior to its first retail sale under the regulations of the Energy-Efficiency Standards and Labeling (Non-ducted Air-Conditioners) Regulations, 2005 (LI1815) (Ministry of Energy Ghana., 2020).

2.1.3 Standards and Labels for refrigerating appliances of Ghana

Paucity of regulatory policies to limit importation and selling of inefficient used cooling appliances, the refrigerating appliance industry of Ghana previously consisted primarily of used refrigerating appliances. Used and refurbished appliances is a vital source of high energy usage, health risks, and CO_2 emissions. As a result of the implementation and strict enforcement of Legislative Instruments of government (LI 1815, 1958, and 1932) in 2012, the appliance market has been improved (Ministry of Energy Ghana., 2020).

The energy performance of all refrigerating appliances are gauged and defined per the energy-efficiency-index (EEI). This EEI estimates the annual or yearly energy consumption (AC) relatively to the consumption of reference focused on the storage capacity and the refrigerating appliance model. The lower or less the EEI, the energy efficiency of the appliance would be higher and thus consumes less. The EEI of different refrigeration appliances sizes are categorized into star ratings. The appliance is more energy efficient when the star rating is higher (Ministry of Energy Ghana., 2009; Nunoo et al., 2019).

Moreover, in 2008, the Ghana Standards Board proposed that European Standards: IEC 62552: 2007 for the classification and evaluating of consumer refrigerating appliances be adopted. Definitions at the product and standard levels in the European Union, as specified by European Council Directives 92/2/EC and 2003/66/EC (Schleich et al., 2021). Imports of only ST and T class refrigerating appliances should then be permitted. For ST class refrigerating appliances, the Ghana one-star, two-star, three-star, four-star, and five-star levels must be set to be equal to European levels C, B, A, A+, and A++, and for T

class refrigerating appliances, European levels D, C, B, A, and A+. However, T class appliances are permitted to use energy more because they are operated at a higher temperature (32 degrees C) than ST class appliances (which are tested at 25 degrees C) (Ministry of Energy Ghana., 2009).

2.1.4 Standards and Labels for Air-Conditioners

In Ghana, an Energy-Efficiency-Ratio (EER) of 2.8 watts of cooling or freezing per watt of electricity or power input is the minimum acceptable energy efficiency level for air conditioners. 9.55 BTU/Watt is the equivalent. (In Canada and United States, the imperial unit for calculating energy efficiency is used). On the market, there are air conditioners with 3.5 EER and higher. The EER of a product shows how effective it is. The manufacturer, brand, and energy efficiency star-rating (thus, one to five stars, with the increasing number of stars indicating a greater energy-efficiency-ratio) are all described on the Energy Guide label attached to the product (Ministry of Energy Ghana., 2020; Nunoo et al., 2019).

2.1.5 Benefits of Energy Efficiency Standards and Labels

Most countries worldwide have effectively implemented energy standards and energy labeling. Records show that, existed 81 countries worldwide as of the year 2013 have standards and labeling systems, and air-conditionings becoming second highest frequently used appliances among the number of 73 countries that have implemented few other types of energy standards and labeling policies. Standards and labels are clear and efficient method for offering advice to residential consumers when purchasing household appliance (Abas & Mahlia, 2018; Harrington & Brown, 2014).

The implementation of energy standards and labels decrease the need for extra power plants minimizing overall energy consumption in the process of generating electricity (Sarigollu, 2009). As a result, there are economic benefits (for example, capital can be freed up to invest in non-energy social amenities such as schools, bridges, and hospitals) as well as benefitting environmentally (e.g., reducing carbon emissions) (Schleich et al., 2021). The evidence from the United States S&L programs, for example, clearly shows the tremendous economic benefits. As of the year 2020, efficiency standards would have prevented 20% of the States' projected new power generation, saving over $100 billion and providing a net savings of $1000 per US households (Meyers & et al., 2003).

Similarly, Australia's appliance energy management policy (basically, standards and labels) expected to generate $4.8 billion in economic benefits by 2030. Moreover,

substantial greenhouse gas emission reductions will be realized, resulting in greenhouse gas emission reduction nearly 204 million tonnes of CO_2 low business as normal within 2005 and 2030, according to recent projections (Abas & Mahlia, 2018; NAEEP, 2007). A recent study of Harrington sales data (2013) has shown that in the previous 13 years of Australia labeling, household cooler systems have improved their efficiency by over 30%. These cost savings are based on a net present value minus $23/tonnes of CO_2: In a way of buying more energy-efficient product outlined by the policy, Australians save money. On top of the direct effect on household and company electricity costs, the advantages of more energy friendly goods are numerous. Peak demand reduction increases grid stability, allowing marginal consumers to have more and more reliable energy (Harrington & Brown, 2014).

Appliances, equipment and lighting items that are energy labeled help to increase total energy efficiency (Schleich et al., 2021). First of the assessment of the effects of the new European Union (EU) labelling program for refrigerators, machines for washing, and lamps, for example, revealed a number of change in sales of extra efficient appliances (Schleich et al., 2021). Around 1992, just before the scheme was implemented, and late 1999, the sales-weighted proportionate energy efficiency of refrigerators increased by 26%. Minimum efficiency standards are believed to be responsible for 16 percent of the effect, while labeling is responsible for 10% the year 2000 (Bertoldi, 2000; Schleich et al., 2021). For example, performance of energy for washing machinery has increased from an average of 0.30 kWh/kg (Class C/D) in 1993 to 0.24 kWh/kg (Class B) in 1998, and to 0.18 kWh/kg (A/A+) in 2006, which represents a 40% reduction in energy consumption. For refrigerators, from an average of 102 (E) in 1992 to 79 (Class C) in 1999 and to 42, (A+) in 2006, an average energy efficiency index was increased, representing a total decrease of almost 60 percent of the particular consumption of energy (Bertoldi, 2000).

Standards for energy efficiency are strategies for market transformation. Models on the market will steadily increase their average energy efficiency (Stadelmann, 2020). Market pull as well as market push are two market transformation techniques that work together. By getting rid of the low efficient models from the local market, the energy efficiency requirements "pushes" the market. Labels "pull" consumers to purchase or consume more of energy-efficient products, "pushing" manufacturers to make more of energy-efficient models. Standards and labels joined forces to "push" and "pull" markets to a region of higher energy efficiency depicting in the illustration below (Masjuki et al., 2000).
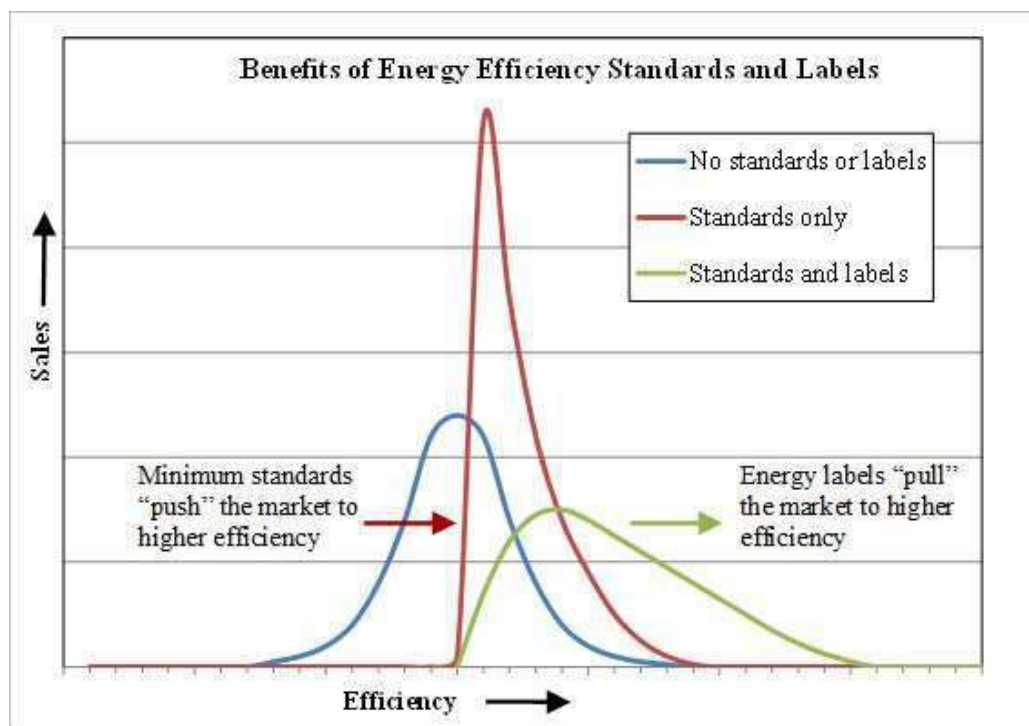
Fig.1: Standards and labels work together to "push" and "pull" markets to a region of greater energy efficiency,

[Clean Energy Solutions Center Webinar Series Presented by: McMahon and Buskirk, 2012]

2.2 Empirical Review

2.2.1 Environmental Concerns

In the area of energy conservation and environmental concern, there has been widespread studies. Household Consumers are highly environmentally conscious in their personal attitudes, tastes, and purchases (Sarigollu, 2009). Most consumers are ready to pay for extra environmentally efficient goods (Peattie, 2001; Sung-Yoon, Manseok, Jungwoo, & Seung-Hoon Y., 2019). Most especially, consumers' willingness-to-pay (WTP) for the substantial labeling e.g. (Aguilar & Vlosky, 2007; Bjørner, Hansen, & Russell, 2004; Blend & Ravenswaay, 1999; Loureiro, McCluskey, & Mittelhammer, 2002; Srinivasan & Blomquist, 2009); were of particular concern to this analysis in the evaluation of consumer responses to environmental labeling (or 'eco-labels') on appliances. The green revolution over the years has extended from the political science to consumer capitalism and extends from consumer capitalism to advertisement and manufacturing (Zimmer, Stafford, & Stafford, 1994). In several examples, environmental concern for a commodity with favorable environmental externalities has been shown to be favorably linked to respondents' preference or real WTP (Ahuja, Handa, & Jain, 2020; Krarup & Russell, 2005). For both green energies (Farhar & Houston, 1996; Roe, Teisl, Levy, & Russell, 2001; Souza, Filho, Bernardo, Silva, & Neto, 2018; Zarnikau, 2003) and environmentally sound food

goods, this pattern has been noticed (Balasubramanian & Moon, 2001; Wandel & Bugge, 1997).

Consumers' ability to pay a higher price for energy-efficient goods has been investigated in previous studies. (Wallander, 2008) looked at the price or payment premium available for Energy Star labels on residential (domestic) clothes washers and concluded that, upon the hedonic price feature, there is no substantial eco-label price premium (Liu, Chang, & Den, 2013) and positive at 10% but statistically insignificant price premium as per the quasi-experiment estimate. The findings indicate that the Energy Star initiative could have no impact on energy efficiency policy. (Fuerst & McAllister, 2009) looked into the influence of the LEED and associated Energy Star systems on US commercial office properties and discovered that eco-certified buildings had a 6% rental price premium.

Data on the effects of environmental concerns on buying of energy-use devices by consumers is limited. Ecological concern, however, was used as an explanatory vector to assess WTP for things such as quality of water (Cooper, Poe, & Bateman, 2004; Guilfoos, Hayden, Uchida, & Oyanedel-Craver, 2020), rainforest protection (Armstrong, 2014; Kramer & Mercer, 1997), and help for destroyed species (Abell, 2012; Kotchen & Reiling, 2000; Ojea & Loureiro, 2007). A contingent valuation study was undertaken by (Cooper et al., 2004) research on quality of water to find out the relationship between the specified environmental

concerns (EC) as well as WTP for the quality of water changes to a lake in the middle of the grounds of East Anglia University. To assess WTP, a vehicle payment was designed and environmental concerns (EC) were assessed by the responses of each person to a set of queries known as the New Ecological-Paradigm (EP) (Dunlap, Van Liere, Mertig, & Jones, 2000; López-Bonilla & López-Bonilla, 2015). The findings were consistent with the existed studies showing that WTP is associated with environmental concerns and altruism (Guilfoos et al., 2020; Takashima, 2016).

The current studies provide details on the impacts of eco-labels on the shopping habits of consumers (K. Govender & Govender, 2013; Hwang et al., 2016; Struwig & Adendorff, 2018). The proliferation of public interest about their daily environment has begun to hotshot their consuming habits and has triggered the creation of another market meeting - green consumers (K. Govender & Govender, 2013). The result of terrible environmental destruction and shifting consumer behavior, green production as well as its use are need specifically by this new century (P. Govender & Govender, 2016). In order to respond to, customer demand is a diverse factor; new systems and innovations are generated from the product piece to help in increasingly competitive markets (Sravani Chari, 2018; Won & Hong, 2014).

2.2.2 Energy Savings

There is limited past study also on forces energy labels have had on WTP (Ahuja et al., 2020). A meta-evaluation on five (5) energy labels conducted in the United States by (Banerjee & Solomon, 2003; Tunçel & Hammitt, 2014), two among the five are funded by the government (Energy Guide and Energy Star) and with the three being financed by private sponsors, that is, Scientific Certification System, Green Seal and Green-e. Consumer response, determined by perception, knowledge and attitude, and manufacturer/marketer response, were the metrics used to test these marks. The study found that in these terms, government-financed initiatives, specifically the Energy Star program, were more effective over private labeling programs. In addition, 54% of those respondents who were conscious of the Energy-Star labels and already bought energy appliances during last 12 months attested the label was very relevant in decisions for buying. An indication that consumers are in support of energy saving programs implemented by the government.

Research reveals that consumers appreciate energy saving initiatives (Ahuja et al., 2020; Banfi, Farsi, Filippini, & Jakob, 2008); however, the premium or price households want to pay for energy-efficient items in certain cases may not be as greater as economic theory would expect (Howarth

& Anderson, 1993). The disparity is simply termed as the "efficiency gap" (Howarth & Anderson, 1993). Imperfect data, liquidity limitations, and speculation regarding possible energy savings include potential reasons for the difference. The indications of an efficiency gap are uncertainly showing vast discount rates on equipment consuming energy (Howarth & Sanstad, 1995; Stadelmann, 2020). For instance, in their reported preferential research on refrigerators on a discount, loans, or no reward on high-efficiency units, (Revelt & Train, 1998) explored this difference. They found that on energy efficient refrigerators, customers willingly want to pay for an amount between $2.12 and $2.46 up front for $1 of the yearly energy savings. These WTP estimates suggest discount rates of between 46% and 39%, estimating a lifetime of 10 years.

A study of particular concern on the effect on Shanghai consumers of the Energy Efficiency labeling policy of China undertaken by Shen and Saijo. Although the actual objective of the Shen and Saijo research was to examine the effectiveness of the energy labeling systems in China, related procedures were also analyzed in their study as elucidated here (Shen & Saijo, 2009). A theoretical choice experiment was used through a web-based data collection and face-to-face interviews to assess customers' WTP for a single scale upgrade in the energy efficiency ratings on the China Energy Efficiency Label and also the cooling appliance sectors were assessed**.** Price or premium, energy efficiency rating, labels representing electrical bill savings, everyday power consumption, capacity, and low pollution were all factors considered in the refrigerator choice experiment. The first three characteristics, accompanied with per hour power usage, cooling space, and whether or not purification of air feature existed, were all the same for air conditioners. The 15 options were chosen based on their state and model source (exotic or local). In relation to state (used or new) and model source, the alternatives were fixed (foreign or domestic). Their finding showed a WTP for an each energy efficiency upgrade of $76-$89 for refrigerators and $35-$54 for air conditionings.

In comparison, in face-to-face interviews, their results revealed significantly higher WTP values than that of the web-based survey for cooling appliances. Similarly, as a survey tool assessing the relevance of the European Energy Label in consumers choices for buying (Sammer & Wüstenhagen, 2006; Schleich et al., 2021) published a discrete preference study. Again, to clearly understand energy savings effect on behavioral factors and to clarify the difference between the behaviors and orientations of consumers towards energy conservation and their real behaviour, energy and environmental consciousness has been studied (Liu et al., 2013; Sarigollu, 2009).

III.   METHODOLOGY

3.1 Data

The data used for the study was collected from a report by the Renewable Energy, Energy Efficiency & Climate Change Directorate of Ghana on Compliance Monitoring and Data Collection in December 2019. The objective of the exercise was to create the baseline market data for energy efficient appliances, which will facilitate the creation and accumulating of the energy efficient appliances database, most especially the upgrading of the existing air-conditioners and refrigerating appliances database with the appropriate application (Ministry of Energy Ghana., 2009, 2020). The country was divided into four parts, and every quarter of each zone was covered. In the different regions across the country, the group visited every distributor and retail outlet and shop owners were aided to download the app from Google Play Store and trained in the use of the modified app to help them validate appliances prior to importer acquisition. The southern Ghana is primary concentrated by refrigerating appliances sales and air-conditioners sales. The regions of Greater-Accra and Ashanti are the leading regions of refrigerator and air conditioner purchases followed by the provincial capitals likewise the border towns including Paga, Aflao, Elubo and Bawku with most of the appliance shops available (Ghana Energy Commission., 2019).

3.2 Features of Shops Visited

As per compliance with the scale and availability of the quantity of appliances on exhibition in the showroom, the appliance shops and retail outlets were classified. Shops with maximum appliances below 10 are classified as small,

10 to 20 are classified as intermediate, and stores with appliances over 20 are classified as large shops. Of the surveyed appliance stores, 37.62% were large, 30.03% were medium, and the remaining 32.34% were small stores. Twenty-five (25) new warehouse and retail centers were identified and the database captured and revised their demographics data. These new stores are focused primarily in the Ashanti region (Ghana Energy Commission., 2019).

3.3 Appliances on Sale

Fig. 1. A total of 6739 cooling appliances including 6198 refrigerating appliances and that of 541 air- conditioners were surveyed, 34.62 % of which came from the Greater Accra Region, making it the dominant market for appliances. The Ashanti Region accumulated 16.32%, making it the country's second leading appliance industry (Ghana Energy Commission., 2019).

IV.   RESULTS AND DISCUSSIONS

4.1 Compliance Level Analysis

For the 6198 total of the tested refrigerating appliances, 6177, representing 99.67%, had their test reports and 20, representing 0.33%, had no test reports, so it was not possible to check whether they follow the minimum requirements needed for refrigerating appliances on the Ghanaian market as shown in **Fig. 2**. The refrigerating appliances with no compliant test includes 10 exclusive brands and 18 distinct models (refer to **Table 1** and **Fig. 5** in the appendix). The above analysis shows that retailers or shops and distributors in Ghana have a test report of compliance level for most of the refrigerating appliances (Ghana Energy Commission., 2019).
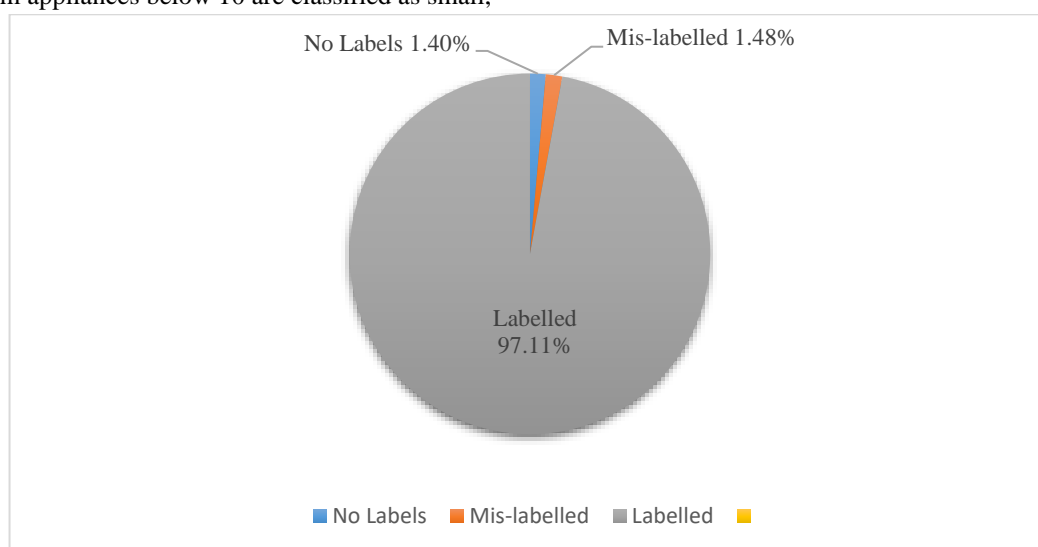
Fig.2: Test report and labeling compliance level for refrigerators.

[Source: Ghana Energy Commission (2019)]

The **Fig. 2** above represents the labelling compliance level for refrigerating models. Compliance with labeling plays a vital role in the modification of the appliance market, so critical attention is needed to identify irregularities in the information available on the labels shown on each appliance. Of the 6198 properly branded, 6019 refrigerating appliances representing 97.11% were properly labeled, 87 representing 1.4% had no labeling at all and 92 representing 1.48% were mislabeled (Ghana Energy Commission., 2019).

Of the 541 total air conditioners examined, 533, representing 98.52%, had test their reports and 8, representing 1.48%, had no test reports, so it is not possible to check whether they meet the minimum requirements needed for the Ghanaian market for refrigerating appliances. With reference to labelling, out of 541, 525 appliances were correctly branded, 11 representing 2.03% had no labeling at all and 5 representing 0.92% were mislabeled as shown in **Fig. 3** below.
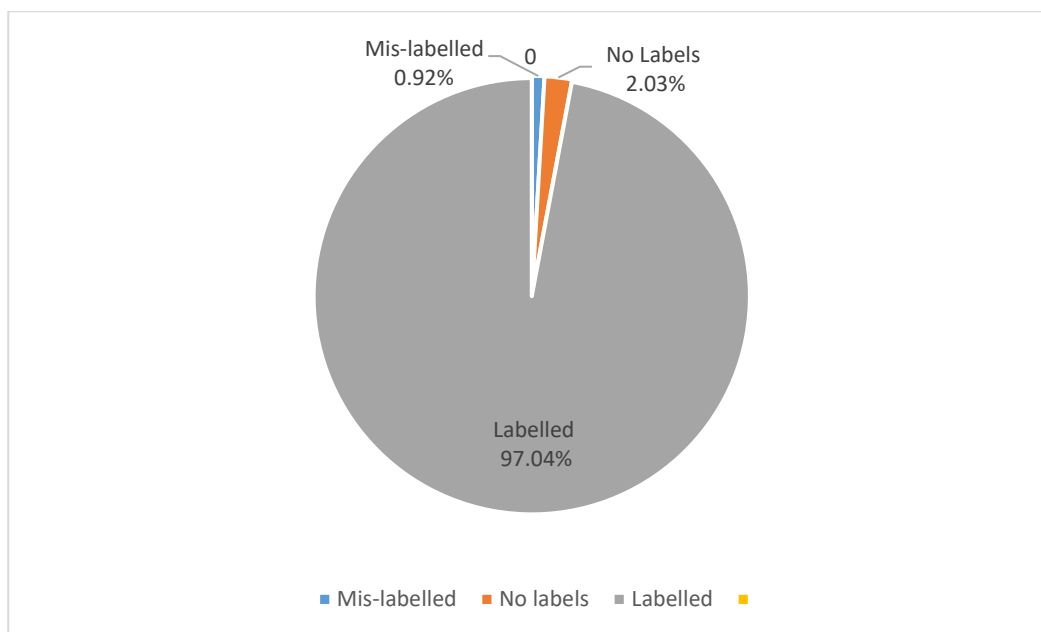
Fig. 3: Test report and compliance level for air conditioners.

[Source: Ghana Energy Commission (2019)]

Nationally, as seen in **Table 2**, a shop's total level of compliance is 98.51%. In all the countries, this phenomenon is well represented. None of the regions recorded a total compliance rating below 95%. As compliance with the test report was substantially high across the countries, the average output of shops was influenced by the marking of non-compliance amounts.

Six regions reported 100% compliance with the test report and 99% and above were recorded by the remaining 4. The appliance mislabeled were, for the most part, different in terms of star ratings and annual power ratings according to the evaluation results available to the Commission. As depicted in **Table 2** in the appendix, no shop dealing in refrigerating appliances recorded below 70% over all compliance (Ghana Energy Commission., 2019).

4.2 Test Report and labeling Compliance of Air Conditioners by Retail Shops

High compliance level in retail shops or outlets dealing in Air Conditioners was recorded in the similar vein as the refrigerating appliances. The overall compliance level

of a retail shop on a national level is 98.58%. It was quite impressive that about six regions recorded 100% overall compliance and the remaining 4 regions did not record below 94% overall compliance.

As shown in both **Table 3** in the appendix and **Fig. 3** above compliance level of a shop dealing in the market of air-conditioners is above 80% except Enderick Takoradi branch with compliance level of 37.5%.Again, results obtained from 2018 exercise recorded compliance level for refrigerating appliances of 90.24% and that of Air Conditioners was 33.11%. In 2019 however, compliance for refrigerating appliances was 99.68% and that of air conditioners to be 99.37% respectively (Ghana Energy Commission., 2019).

4.3 Compliance Level Trend for cooling appliances from 2015 to 2019

The **Fig.4** below shows the compliance level trend for both refrigerating appliances and air-conditioners. The compliance level for refrigerating appliances are 77.4% in 2015, 89.1% 2016, 91.6% in 2017, 94.0% in 2018,2019 was

98.5% associated with compliance level for air-conditioners 33.11% in 2018 and 98.58 in 2019. A significance increase over the sequential years for both refrigerating and air-conditioning appliances found on the Ghanaian markets and

more sense of awareness on the part of the distributors, retailers and consumers (Ghana Energy Commission., 2019; Ministry of Energy Ghana., 2020).
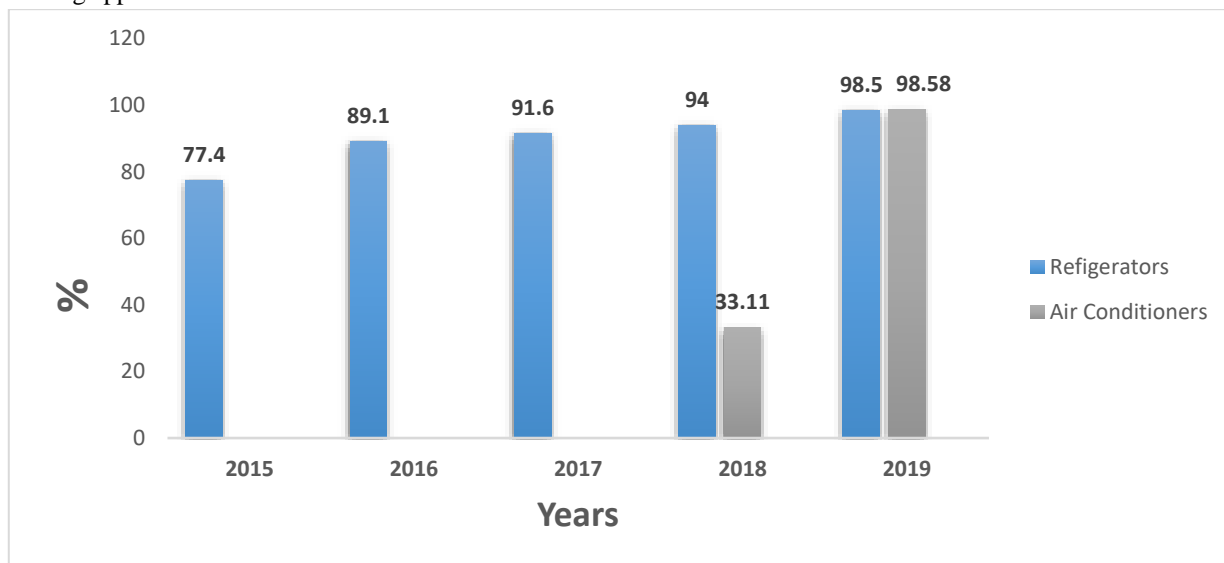
Fig.4: Compliance level trend for refrigerating appliances and ACs from 2015 to 2019

[Source: Ghana Energy Commission (2019)]

Home energy efficiency is based on energy efficient appliances being purchased and their efficiency. However, appliances being used in a manner that can increase or minimize both energy usage and energy bills (Ramos et al., 2015). To examine the consumers' taste for standard and labelled appliances most especially refrigerators and air-conditioners in Ghana, the reports on compliance monitoring appliances by Energy Efficiency of Ghana in 2019 reveals the households' taste for energy labels based on the proportion of the labelled appliances compared to non-labels and mis-labelled appliances on the Ghanaian market. The approval standard of the test report for a retail store is expressed as the number of appliances with approved test reports available as a percentage of the total appliances seen in the store. This measure is intended to improve consumer assurance in the patronization of appliances offered by shops with high availability of test results, labels and overall levels of compliance (Ghana Energy Commission., 2019).

On the basis of the labeling status of each refrigeration and air-conditioning appliance externally shown in the shop, the labelling compliance level was calculated. The total compliance of the appliance outlets or shop is measured by finding average rate of compliance with test reports and labelling. Mandatory environmental labelling or certification programs providing consumers with information on the environmental characteristics of one or more elements of the life span of a product have been

commonly embraced in one form or another around the globe (Shi, 2014; Ward, 2010). This study examined compliance with the Energy Star, energy labels and the influence they had on consumers' taste for cooling appliances as per the EE 2019 compliance monitoring report of Ghana. The overview and key results are listed below.

1. The data collection exercise included all 10 regions and involved 303 suppliers or distributors and retail outlets in 91 towns and cities.
2. The level of compliance with the availability of its test report of all refrigerating devices found on the market is 99.62%.
3. The level of compliance with the availability of the test report for all listed air conditioner models is 99.37%.
4. The standard of compliance for refrigerating equipment in all retail stores or shops is 97.34%, and then for air conditioners is 97.80%.
5. In all the regional distribution and retail outlets, a total of 6198 refrigeration appliances recorded and 541 air conditioners were surveyed.

The review of the reports shows that the 99% compliance level for cooling appliances (refrigerator and air-conditioners) is a strong indicator that Ghanaian customers have built a taste for energy-efficient appliances and even an increasing demand for energy-efficient air conditioning and refrigerating appliances. Compliance level of appliances on the market shows whether or not the

distributors, retailers and various shop owners in Ghana comply with the Energy Efficiency Policies implemented by the governmental boards to reduce energy consumption in the country are adhered and patronized. Any level below 50% depicts an extremely low patronage and support for energy saving policies and therefore, less taste for labelled appliances by the consumers. The 99% compliance level is an evidence of a higher compliance level which indicates the supports and confidence Ghanaians have in Standards and Labels as a means of ensuring energy savings. This would help to transform the market for appliances from expensive to more energy efficient appliances. S&L according to information obtained from retailers, customers have begun demanding for 3-star and probably 4-star quality ones for air conditioners, while the 1-star and 2-star ratings are the most known on the market.

The findings obtained from the report indicate substantial improvement in the transition of the appliance industry in Ghana. Compliance levels of monitored appliances have increased over the years and there has always been a full and changed demand for regulated appliances in 2019 (Refrigerating Appliances and Air Conditioners). There is therefore the need to stimulate and encourage importers and retailers to introduce higher energy efficient refrigerators and air conditioning appliances into the market.

It can also be deduced that households alternatively chooses labelled appliances over non-labelled or mis-labelled in the market which consciously promotes energy efficiency in urban Ghanaian homes. Often, Standards and Labelling promotes competition to offer the most effective equipment to households as consumers are well educated. Equipment labelling facilitates implementation of requirements by helping regulators to identify irregularities whether un-labelled or mis-labelled are the controlled devices.

V.   CONCLUSION AND RECOMMENDATIONS

The Consumers and shop owners in Ghana are strongly confident that modernizing appliance energy efficiency is profiting and supports efficiency standards and labels. The shops or retailers with compliance test reports are aware of efficiency standards implemented by the government and solemnly patronize them as per the 99% compliance level reported. The results show that the average shop owner, retailer and the final consumer in Ghana would choose labeled appliances over un-labeled or mis-labeled. Consumers patronizing labelled appliances show their taste for and willingness-to-pay extra for the product with assurance that no extra payment could be incurred with time in minimal energy bills, clearly that, they

will obviously save money. The household awareness of the significance of energy efficiency and patronage of efficiency across products and across time is consistent with much improvement in the appliance market in terms of conformity to standards and labeling. The consumers taste for labelled appliances on the Ghanaian market is thus revealed by their compliance level for energy appliances.

Moreover, for suppliers and government regulators, this study indicates that when purchasing a new appliance, the Energy Star label may play key role in the decision-making time of a customer. These effects, however, are focused primarily on refrigerators and could or could not be valid for other large home appliances. Therefore, there is a need to stimulate and enable Ghanaian importers and manufacturers to bring to the market more energy-efficient refrigerators and air-conditioners. It is recommended that recognition is given to importers who deal in very energy efficient appliances.

Finally, we recommend that, to determine the impact of standards on low-income groups, the government must take into account national needs and to ensure that efficient goods are accessible and desirable to enterprises in supplying the technology. Example; if consumers' payback on previous incremental energy efficiency investments for room air conditioners is less than 9 months, and consumers can save average US $64 million annually in Ghanaian low-income energy bills because they lack air conditioners, with little implications on the Ghanaian households' income. In Ghana, the wide demand for secondhand appliances exists for refrigerators/freezers, and this standard regulates new as well as used refrigerators and freezers, so the harmonization of products with Europe and other countries facilitates Europe-certified import products. A sponsored experiment on market change will help decide how Ghana's compliance and reward systems can be approached and designed. Further studies may be warranted on the influence of Energy Star labels having on similar appliances.

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Appendix

Table. 1: Regional breakdown of Appliances Surveyed

REGIONS	REFIGERATORS		AIR CONDITIONERS		TOTAL APPLIANCES	SHARES
	NUMBER OF SHOPS	TOTAL REFIGERATORS	NUMBER OF SHOPS	TOTAL AIRCONDITIONERS		
Ashanti	40	1022	23	78	1100	16.32
Brong Ahafo	45	609	7	16	625	9.27
Central	17	420	10	41	461	6.84
Eastern	40	597	4	16	613	9.10
Greater Accra	70	2101	47	232	2333	34.62
Northern	16	273	11	40	313	4.64
Upper East	14	272	6	13	285	4.23
Upper West	6	86	2	7	93	1.38
Volta	25	309	7	35	344	5.10
Western	30	509	20	63	572	8.49
Total	**303**	**6198**	**137**	**541**	**6739**	**100**

Source: EE, 2019 accessed 19 November, 2020

Table 2. National and Regional Retail Shops Labelling and Test Report Compliance.

Regions	Number Of Shops	Refrigerators	Average Compliance Level (%)		
			Test Report	Labelling	Overall
Ashanti	40	1022	100.00	96.77	98.38
BrongAhafo	45	609	99.53	98.81	99.17

Central	17	420	100.00	96.45	98.23
Eastern	40	597	100.00	98.29	99.14
Greater Accra	70	2101	99.24	96.84	98.04
Northern	16	273	99.69	97.79	98.74
Upper East	14	272	100.00	95.26	97.63
Upper West	6	86	100.00	99.02	99.51
Volta	25	309	100.00	98.91	99.46
Western	30	509	99.39	95.43	97.41
National	**303**	**6198**	**99.68**	**97.34**	**98.51**

Source: EE, 2019 accessed 19 November, 2020

Table 3. National and Regional Compliance Levels of Dealers of Air Conditioners.

Regions	Number Of Shops	Air Conditioners	Average Compliance Level (%)		
			Test Report	Labelling	Overall
Ashanti	23	78	100.00	100.00	100.00
Brong Ahafo	7	16	100.00	100.00	100.00
Central	10	41	100.00	100.00	100.00
Eastern	4	16	100.00	100.00	100.00
Greater Accra	47	232	99.39	100.00	98.16
Northern	11	40	997.98	96.94	98.23
Upper East	6	13	100.00	98.48	100.00
Upper West	2	7	100.00	100.00	100.00
Volta	7	35	98.48	97.22	97.85
Western	20	63	98.75	94.00	96.38
National	**137**	**541**	**99.37**	**97.80**	**98.58**

Source; EE, 2019 accessed 19 Nov 2020.
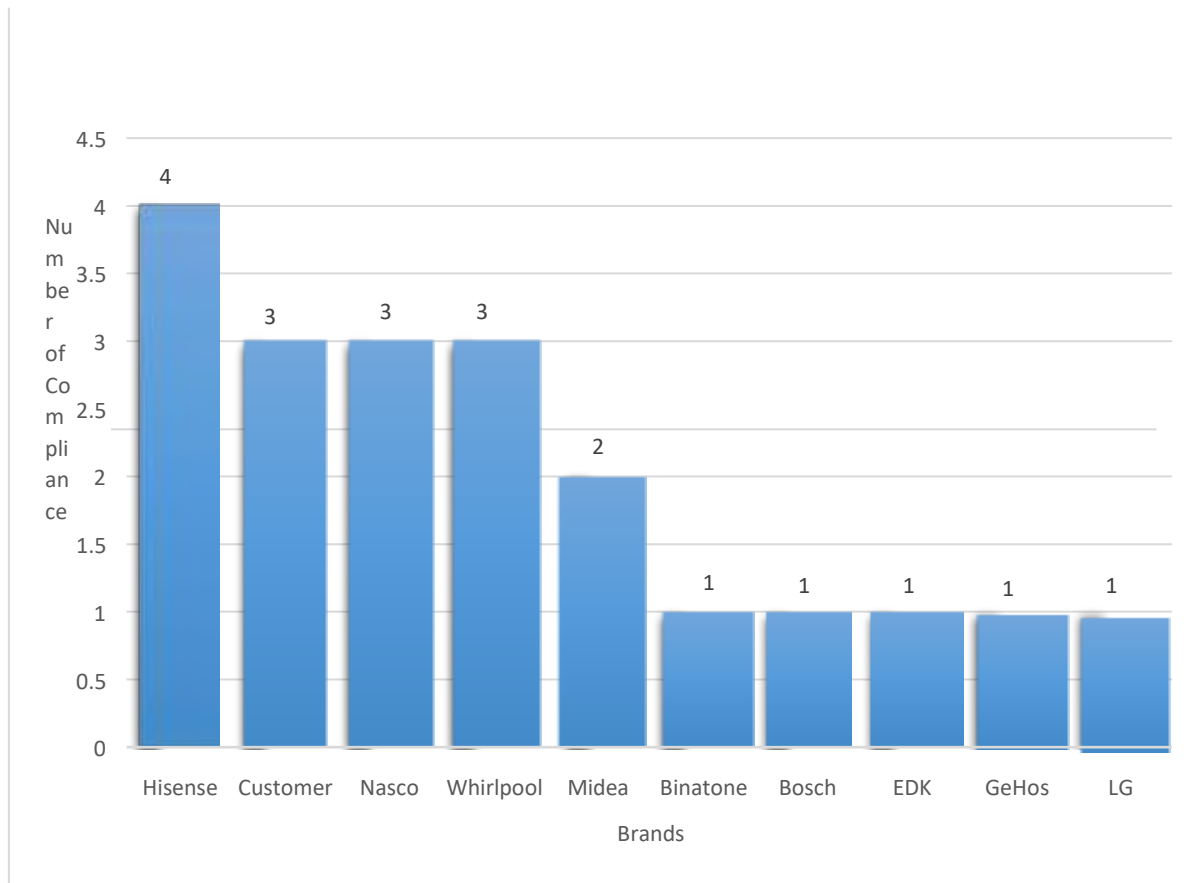
Fig. 5: Number of non-compliant refrigerator by Brand and Unique Models.

[Source: EE, 2019, accessed 19 November, 2020]
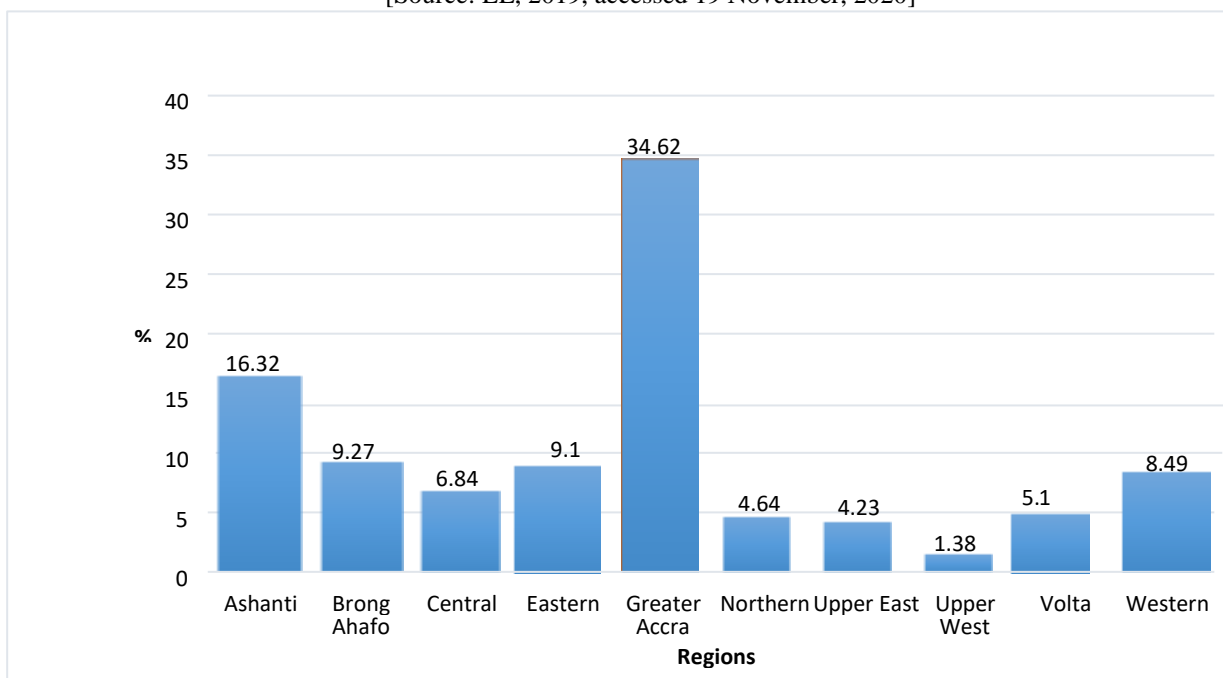
Fig. 6. Regional share of total Appliances surveyed.

[Source: EE, 2019, accessed 19 November, 2020]

Development of a Chatbot to Encourage the Use of Assistive Technologies and Reduce the Rate of Discontinuance

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Abstract— *Assistive Technology is an interdisciplinary group of tools that assists people with impairment. Even though 30% of people that use these discontinued using them, complicating their autonomy, quality of life, and social inclusion. For that, a prototype of Chatbot was developed to assist individuals with impairment to increase their adherence to Assistive Technologies. Chatbots are virtual assistants that interact with their users through messages, images, videos, and sounds, using an Artificial Intelligence tool named Natural Language Processing to simulate a person. It can be used in smartphones, computers, and other devices. This prototype was developed in the BLiP® platform, introducing a Knowledge Base with all the essential information about Assistive Technologies. The prototype assessment consisted of the White Box (Structural) and the Black Box (Functional) tests. The prototype was tested and presented a great flow of conversation and no errors in the structure. Besides the benefits provided, Chatbots cannot substitute a healthcare professional but only assist. Chatbots can be potential assistants that will increase and improve healthcare treatments.*

I. INTRODUCTION

Assistive technology (AT) is an interdisciplinary group of products, resources, methods, strategies, practices, laws, and services that assist individuals with special needs in achieving autonomy, independence, accessibility, quality of life, and social inclusion. [1, 2, 3]

These technologies aim at reducing or eliminating the limitations faced by the visually impaired so that they can better experience the different aspects of their lives, both professional and personal.[2]

ATs used for the visually impaired are divided into optical or non-optical resources, electronic resources, and software/applications. These resources are used mainly to improve reading, writing, manual work, mobility, professional activities, and leisure.[3]

Some examples of ATs worth mentioning are adjustable tilt desks, proper illumination for reading, writing, reading guides, glasses, magnifiers, telescopes, device cameras built into a cell phone or other devices to magnify objects, Windows® accessibility system, Braille system, blindness canes and guide dogs.[2, 3]

A literature review from 2015 concluded that 30% of those using any AT discontinued using it within the first five years of use, and some never even got to use it consistently. In 2018, Mission et al. demonstrated that the rate of AT discontinuance use is high, but it is hard to

determine the reasons since the discontinuance varies according to the AT type. [4, 5]

The principal reasons that lead to AT discontinuance are the appearance, ergonomic issues, design of the product, user's physical condition, lack of information and training, pain, functional limitations, preference for another AT or use of other remaining capabilities, heavy weight, changes in AT condition, trouble to use, discomfort, inadequacy, dissatisfaction and excessive noise.[3, 4]

Aiming to reduce the high rates of AT discontinuance, a prototype of a Chatbot was developed to assist patients undergoing ophthalmologic treatment. The goal is to increase the adherence of AT, either through reinforcing the importance of AT use or giving advice about adaptation to the technology.

Chatbots are virtual assistants that simulate a conversation using an Artificial Intelligence (AI) tool called Natural Language Processing (NLP), which identifies the morphological, semantic, syntactic, and pragmatic aspects of the language delivering a more human-like and objective conversation.[6]

The knowledge base of the chatbot has to be developed to provide answers that are coherent and objective. It consists of information available through the subject review and the knowledge acquired from previous interactions with its users.[6]

Chatbots in the medical field can be beneficial since it provides personalized assessment, 24/7 availability, less wait time in lines, decrease in unnecessary presential visits, increase in medical services reach to remote communities, scheduling, appointment or medication reminders, less cost, practicality and ability to answer to the most frequently asked questions quickly. [7, 8]

II. METHODS

2.1. DEVELOPMENT OF KNOWLEDGE BASE

The knowledge base was developed by collecting information from assistive technology in general and in ophthalmology too. Then, this information was fed into the prototype. We also inserted the fundamental questions that the users could ask, such as treatment, scheduling, and address. This phase did not involve any human beings, except for the developer, who came up with the possible questions.

2.2. CHATBOT DEVELOPMENT

Firstly, to develop a chatbot, it is necessary to produce a Specialist System (SS). SS is a system trained to solve problems that only the specialist in that field would solve.

Therefore, the knowledge base has to be developed from dense literature research and assessment of most commonly asked questions.

After developing the knowledge base, it will be loaded in the platform BLiP® to the prototype development. It is essential to evolve a friendly conversation on the chatbot to be more interesting for the users.

2.3. SOFTWARE VALIDATION TEST

For the software validation, the validation tests, known as the White Box test and the Black Box test, were selected.[9]

The White Box test is a structural test that developers use to access the development platform and verify every step to find possible errors and fix them. The Black Box test is a functional software test. In this test, developers act as a user to verify if the software is working by testing all possible functions and applications. It enables the assessment of expected answers or results.[9]

III. RESULTS

3.1. KNOWLEDGE BASE DEVELOPED

The prototype knowledge base was developed based on the literature review about visual rehabilitation, assistive technologies, and discontinuance causes. This review results in an extensive and reliable database. Therefore, the information offered by the chatbot is reliable and objective, making the prototype trustworthy.

Table 1 shows some examples of frequently questions asked by individuals with or at risk of visual impairment interested in using assistive technology and are undergoing ophthalmologic treatment. Additionally, questions were added in the chatbot setting to serve as examples.

Table.1: Examples of Frequently Asked Questions.

What is visual impairment?
What caused my visual impairment?
Am I under the risk of becoming blind?
What is assistive technology?
What is the rate of discontinuance of assistive technology?
What is assistive technology in ophthalmology?
Am I able to recover any vision from doing visual rehabilitation?
With these resources, am I going to see clearly again and be able to resume my daily activities, such as sewing, read books or the Bible, watch TV?
What are non-optical resources?

| What are the electronic resources? |
| What is software or application? |
| Where can I purchase this kind of technology? |
| How much does this technology cost? |
| Hello, did you use your assistive technology today? |
| Why did you not use it? |
| Can I help you? |
| Scheduling |
| What is the address? |
| What is the phone number for direct contact? |

3.2.   CHATBOT PROTOTYPE STRUCTURE

Figure 1 shows the prototype flowchart.

Initially, the main questions and answers were inserted in the prototype. To evolved it, the prototype interacted with different users to identify possible new interactions. If there were other questions, objective and trustworthy answers were formulated to increase the prototype knowledge base. Variations of the same expressions as "how are you?" or "are you doing well?" are recognized semantically the same due to an AI tool called NLP.

Figure 2 presents an example of the prototype conversation. In the figure, it is possible to recognize a personal conversation and not a formal one.
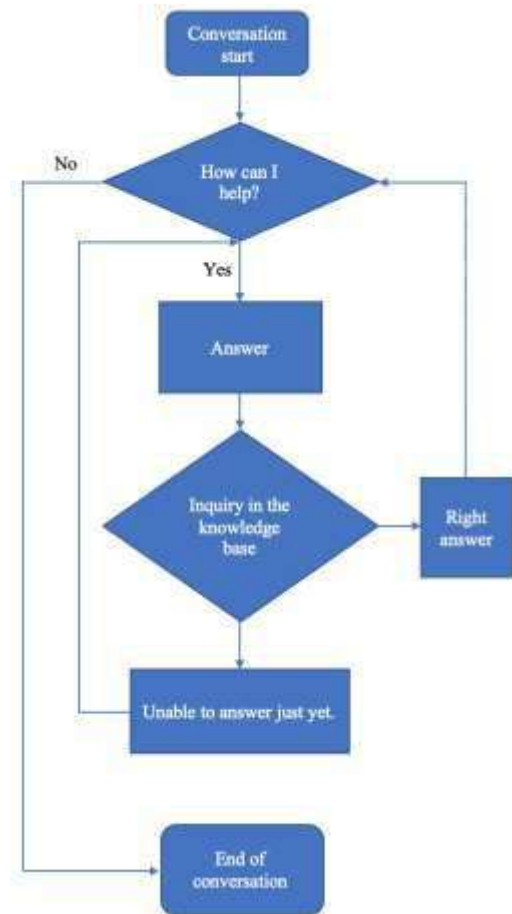
Fig.1: The Prototype Flowchart Structure.
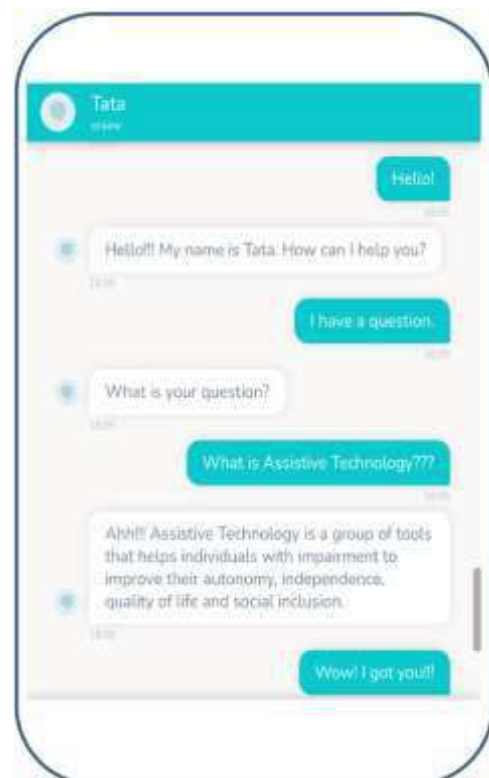
Fig.2. Example of Prototype Conversation.

3.3.   VALIDATION TEST

In the White Box text, the developer accessed the prototype's structure and code inside the BLiP® platform. All the steps during the prototype build-up were double-checked to identify possible flaws and enable corrections.

During the Black Box test, the developer acted as a user and interacted with the prototype multiple times to evaluate the functionality of all possible interactions.

The prototype did not present any errors or problems during the tests, but that does not preclude the need for periodical updates and tests with the chatbot.

IV.   DISCUSSION

The chatbot prototype is still in the initial phases of development, and for that reason, we did not test with final users. The initial phase consists of the software validation. Additionally, it is essential to verify the software's usefulness in healthcare assistance.[10]

Despite the amount of information loaded in the prototype knowledge base, it is necessary to periodically reevaluate, update and correct possible mistakes to keep the chatbot efficient in the environment in which it will be used.[11]

Since the chatbot prototype can be used 24/7, it would be a helpful tool to assist patients who need to ask questions or solve problems related to the assistive technology at any time, avoiding the unnecessary commute to health care units.[12]

Chatbots will not replace healthcare professionals. Chatbots can aid in the support and information services to patients, making them faster and readily available. Services like triage, frequently asked questions, and wait queue can be easily offered via chatbot.[13, 14]

V.   CONCLUSION

The results found in this study demonstrated that chatbots are a potential virtual assistant to increase and improve healthcare treatments and procedures.

For that, Chatbots can help 24 hours per day, do not have physical and emotional limits, avoid patients dislocating unnecessarily, and be accessed anywhere using a device.

Therefore, patients with any impairment can be helped using chatbots to increase their adherence to Assistive Technology, improving their quality of life, autonomy, and social inclusion.

Besides its benefits, chatbots cannot substitute healthcare professionals but only increase their performance and attendance.

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Domestic Violence and the Public Policy Need in Pandemic Time

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Abstract— The present work aims to analyze the need and usefulness of public policies during the Covid-19 pandemic. To this end, the present work deals with an analysis of domestic and family violence based on Law No. 11.340 / 06 - known as the Maria da Penha Law, as well as concepts and foundations pointed out in the best doctrine and jurisprudence.

I. INTRODUCTION

Over the years, the discussion about the condition of women in society and the guarantee of rights has been a construction that is based on a set of actions by organized civil society, social movements, government agencies and individual stories of people who have passed for different situations due to her condition of existence due to the fact of being a woman.

Various behaviors labeled as criminal offenses are constantly announced in the media, in which domestic and family violence figure as the most recurrent, because men and women are not affected in the same way by violence, because:

> […] They are affected by violence in a different way. While men tend to be victims of violence predominantly practiced in the public space, women daily suffer from a phenomenon that manifests within their own homes, most of the time practiced by their (ex) partners (BRASIL, 2019, s /for).

However, since the creation of Law 11.340 entitled "Lei Maria da Penha", there is a greater possibility for women to communicate to the competent authorities the various aggressions of which they are victims.

To this end, the State has created mechanisms and tools so that the aggressor does not fail to suffer the necessary reprimand. Allied to all this, the victims have been encouraged not only by official entities, but also by civil society organizations, non-governmental organizations and mainly by people who have some kind of close relationship.

Notably in the current context, due to the Covid-19 pandemic, women started to stay longer in their homes, where cases of aggression are more common. It should be noted that aggression is not only perpetrated in the marital relationship, but in any relationship in which there is an intimate relationship of affection. The family relationship that includes the partner, brother, parent, descendant also, in the event of any type of aggression on the part of these people, is subject to the provisions of Law No. 11.340.

The violence that affects women in the domestic and family environment often occurs through action or omission: through action, when it demands an active behavior from the aggressor, which can be: physical violence any act of aggression, with or without a weapon, that victimizes the person who is in a vulnerable state.

Sexual violence, in turn, occurs when the victim is forced to have sexual intercourse or any libidinous act is practiced without their consent through physical or psychological coercion.

Patrimonial violence, on the other hand, can occur when the victim's assets are subtracted or decreased; psychological violence that consists of emotional violence that causes psychological damage, which is often irreversible and with countless consequences for the rest of life. Such modality of violence occurs through serious threat, contempt, persecution, extortion and other means that cause dependence on the victim or low self-esteem; the moral violence that attributes facts that are untrue to taint your honor and reputation through slander, defamation and injury, and such offenses are currently very frequent when using social networks and communication channels.

The improper omission in this sense, occurs when someone, who could and should stop taking the action that the law determines, thus generating damage of equal gravity as if the fact had been practiced. Commonly, the omission is also related to a non-involvement of someone who is not obliged by law to do something, but for reasons of an intimate nature does not want to support or remedy the respective aggression, which can generate equal or even greater damage in relation to the possible action.

II. METHODOLOGICAL ASSUMPTIONS

This article demanded to use methodological procedures considered adequate to obtain answers to the questions and objectives presented, based on scientific articles and bibliographic survey of the specific literature related to the theme of domestic and family violence.

The research is qualitative and descriptive as pointed out by Gil (2010), as it seeks to conceptualize the main positions of the theme, as well as bibliographic, as it uses legislation, jurisprudence, doctrine as sources of research.

The present theme also requires a principled and humanitarian approach, considering that violence manifests itself in broad aspects and the protection for proper protection comes precisely from the Federal Constitution of Brazil, as well as from treaties and guidelines of international organizations.

III. LAW No. 11.340 AS A LEGAL INSTRUMENT INTENDED TO COMBAT DOMESTIC AND FAMILY VIOLENCE

Maria da Penha Maia Fernandes, Brazilian, from Ceará, born in the city of Fortaleza, daughter of a dentist father and mother teacher, entered the pharmacy course shortly before the age of eighteen. While at university, he married a journalist for the first time.

The marriage lasted a little less than four years because of his machismo and when he finished his higher education he went to the city of São Paulo to take his master's degree, and there he met the Colombian Marco Antônio Herédia Viveros where he married for the second time.

In the early years of his marriage, he was an extremely attentive and caring husband. Upon returning to his home city, Fortaleza, after completing his master's degree with his partner and his first daughter, he had two more daughters. At that moment he started showing signs of violence when he got his visa to stay here in Brazil. Then, psychological aggressions began and she could not stand that, she wanted the separation, but her partner did not accept the end of the relationship.

On the fateful dawn of the twenty-ninth of May, 1983, she woke up with a crash in her room and realized that she had been hit by something and thought that it was her companion from whom she did not take the shot, claiming it was thieves who entered her residence and victimized, stayed for a long time in hospital, underwent rehabilitation at the Sarah Kubitschek hospital from which he resumed the movements of his upper limbs and realized that he would stay for the rest of his days in a wheelchair, did his rehabilitation, returned to his hometown to her home where her husband put her with his three daughters in prison and once again victimized her with an electric shock in the bath; he altered the shower to give electric shocks and victimized her once more by being saved by his employees.

And she soon realized that things had been changed, she was in jail where she tried to escape from when her husband went on a trip and he did so. She managed with the support of her family from which she was struggling to get her divorce out, she soon realized that she had been hit by her husband, she fought made a complaint when the crime was almost prescribed and this was taken to a jury from which she was released, she left his conviction was mostly released after eight years. She fought for five more years and managed to get him to a jury from which he was released once again, was only put in prison after the third trial of which he was sentenced to eight years and spent only two years in prison. Marco Antônio, mocked the Brazilian criminal laws, implying that the acts of violence practiced would go unpunished.

Prior to this law, crimes against women were recognized as crimes of less offensive potential and were the responsibility of the Special Criminal Courts - Jecrim, if the maximum sentence imposed was up to two years, according to Art. 61. Of Law 9099/95, in verbis:

> Criminal offenses with less offensive potential are considered, for the purposes of this Law, criminal offenses and crimes to which the law imposes a maximum penalty of not more than 2 (two) years, cumulated or not with a fine.

The aggressor could be benefited by the decriminalizing institutes foreseen in the law 9099/95, such as criminal transaction and civil composition of the damages, even if it was labeled as domestic and family infraction.

After so much struggle Maria da Penha Maia Fernandes managed to get the OAS (Organization of American States) to condemn Brazil to recognize crimes against women, which had great worldwide repercussions as Maria da Penha herself mentions in her book.

Thus, a law was created that took the name of this woman, which also accompanied several measures and changes in legislation, such as: shelter, amendment to the Penal Code, domestic and family violence court - for the trial of criminal offenses involving victim of domestic violence, and so on. As a result of all her struggle, she also wrote in 1994 a book telling her story with the title "I survived and I can tell".

The Maria da penha law was published on August 8, 2006 and had a 45-day vacancy period and entered into force on September 22, 2006. According to art. 226 par. 8 of the Federal Constitution, the State has the duty to create mechanisms that will curb and prevent violence within the scope of family relationships. This constitutional provision is one of the foundations for the creation of the aforementioned law.

IV. LAW 11.340 / 06 AND ITS CHANGES IN VARIOUS NORMATIVE DIPLOMAS FOR THE BEST PROTECTION OF VICTIM WOMEN

Among the most important objects, law 11.340 / 06 seeks to curb and prevent domestic violence against women, considering that women have always been treated for many years as an object of patriarchal domination.

In addition, the law provided for the creation of courts for domestic and family violence, as well as defined assistance and protection measures for victims of domestic violence in a vulnerable state.

Despite so much struggle for more severe punishments for aggressors who commit domestic violence, the Maria da Penha law brought few changes to the penal code, among which added a general aggravating factor to art. 61 of the Penal Code in item II, item "f", transcribed below:

> Art. 61 - Circumstances that always aggravate the penalty, when they do not constitute or qualify the crime:
>
> II - the agent has committed the crime:
>
> f) with abuse of authority or taking advantage of domestic relations, cohabitation or hospitality, or with violence against women in the form of the specific law (Wording given by Law nº 11.340, of 2006).

Another important change was the modification of the penalty in art. 129 § 9 ° that although the maximum penalty has increased, the minimum penalty has also decreased, as shown below:

§ 9 If the injury is committed against the ascendant, descendant, brother, spouse or partner, or with whom he lives or has lived, or even if the agent of domestic relations, cohabitation or hospitality prevails: (Wording given by Law nº 11.340, of 2006).

 Penalty - imprisonment, from 3 (three) months to 3 (three) years.

Finally, the Maria da Penha law also included in the penal code a cause of increased penalty, which was § 11 to art. 129; this paragraph foresees an increase of 1/3 if the crime is committed against the ascendant, descendant, spouse or partner, or with those who live or have lived together, or even if the agent of domestic relations, cohabitation or hospitality prevails in the hypothesis that the victim is a person with a disability:

§ 11. In the case of § 9 of this article, the penalty will be increased by one third if the crime is committed against a person with a disability. (Included by Law 11.340, of 2006).

Despite the fact that alei brings this cause of increased penalty when the victim is a person with a disability, there is a loophole in the law, because in this case the cause of an increase in the "very serious injury" occurring in concomitance with the cause increase of the victim with a disability, the offending agent will focus on only one cause of increase when the victim is a person with a disability and the violence is practiced in the domestic sphere.

It is important to highlight that the crimes of bodily injury, light or culpable, in the Penal Code are public criminal action conditioned to the representation of the victim or his legal representative, however, if the injury is committed in the context of domestic and family violence,

the criminal action The public policy is unconditional, in accordance with the provisions of the Maria da Penha law.

Despite having been relevant changes made by the Maria da Penha law in the Penal Code, crimes in the domestic sphere have not decreased so that the result desired by the law has not been obtained, as each year the statistics indicate that such crimes only increase.

The most important change for the protection of the life of women victims was that which occurred with the figure of the so-called feminicide. Given the importance of the theme, it is necessary to conceptualize the term feminicide that was inserted through law No. 13.104 / 15 and contained in art. 121, VI, § 2ºA: "feminicide occurs when the agent acts with contempt or discrimination to the condition of woman, regardless of whether the author of the fact is a male or female person. The term feminicide is related to the death of a woman without the aforementioned conditions.

However, the law brought important measures to combat violence at home, including urgent protective measures aimed at protecting the victim of violence at the family, emotional and domestic levels.

In view of the increase in the number of victims, the public authorities created measures to prevent and combat this type of violence, among them, several Brazilian states formed specialized troops of the military police, known as the Maria da Penha round, aimed at preventing and combating violence against women. . It is an action of great importance, because when it is verified that the victim is no longer physically or emotionally able to remain in his affective context, he is sent to a shelter that constitutes shelters for women victims of domestic violence.

In addition, Specialized Police Departments for the Assistance of Women (DEAMs) were created by the states, which are specialized units of the Civil Police, aimed at the prevention, protection and investigation of crimes of domestic and sexual violence against women.

The media has also helped with the spread of prevention campaigns; schools have been promoting debates and educational prevention campaigns that aim to make the community aware of this problem; in addition, the topic has also started to be widely discussed in the academic sphere, with lectures, the production of opinion articles, conclusion papers in order to bring this discussion into the agenda for greater awareness on the topic. It is clear that all these measures and discussions seek greater effectiveness in laws to combat violence in this area.

V.   IMPORTANCE OF PUBLIC POLICIES TO COMBAT VIOLENCE IN THE NATIONAL PANDEMIC SCENARIO

Domestic violence in Brazil was already alarming, data prior to the pandemic indicate that every 2 minutes a new police report was registered with notification of violence against women at home. This situation was further aggravated by the need for isolation due to the covid-19 pandemic.

According to data from the Brazilian Public Security Forum (FBSP) in a study entitled "Domestic violence during the Covid-19 pandemic", cases of femicide grew by 22.2%, at the beginning of the pandemic decreed by WHO, specifically in the months of March and compared to the number of cases in 2019.

Faced with the covid-19 pandemic, people needing to remain in social isolation and staying in their homes caused something that has been recurring in our society for several decades to come to the fore, which is domestic violence, in which women are the group most likely to suffer from this modality. In other words, the pandemic was an unpredictable event that changed behaviors and the way people relate.

The existence of a structural paradox is perceived, since women, when they are in their homes in isolation due to the pandemic, should be feeling safe, but in reality it is not what happens in fact with many women, because for being in confinement with their possible aggressor, end up becoming more vulnerable to acts of violence.

With the covid-19 membership, the search for moments of leisure can make a potential aggressor come to the fore, with the excessive consumption of alcoholic drinks, a situation that society has been fighting for years has formed. This excessive consumption of alcohol is one of the factors that may be triggering violence against women in the period of the pandemic, and alcohol in line with the predisposition causes the loss of control over their acts, however, according to our penal code voluntary or culpable intoxication, does not exclude criminal imputability, and therefore aggressors must be held responsible for their actions.

Public policies developed to combat domestic violence during the pandemic are necessary for full assistance, even if remotely, to be provided to victims who suffer or are predisposed to suffer some type of violence.

Public policies are important for each and every society, especially with regard to public policies aimed at combating gender violence, since it is rooted in our sexist, patriarchal society.

The public authorities had already developed measures to combat domestic violence, but these measures needed to be expanded, rethought and others developed in the face of the pandemic scenario. These new policies are important, as they enable women who are victims of violence or a likely victim, so that they can ask for help and make the complaint safely to Organs competent bodies, since with social isolation women have had a harder time getting to the police stations. face-to-face and these policies emerge as a well-developed and comprehensive alternative.

It should be noted that not all women in our country are able to seek protection remotely, as many of them do not have access to the internet or are unaware of the policies aimed at protecting them.

In spite of everything, these policies are extremely important, as they demonstrate the government's view of the situation of this vulnerable group, especially during the covid-19 pandemic, seeking to combat this increase in the number of cases as well as to prevent the occurrence of crimes. fatalities practiced in this context.

VI.   FINAL CONSIDERATIONS

The aim of this study was to discuss domestic violence and the need for public policies at the time of the Covid-19 pandemic.

At first, it was necessary to talk a little about the whole history of law No. 11.340 / 06, mainly in the person of Maria da Penha, who gives the name to the law that combats domestic violence.

The various legislative changes that have occurred over the years since the enactment of Law No. 11.340 / 06 demonstrate that there is much to be done in relation to combating domestic violence.

Actions to combat domestic violence in relation to Covid-19 are important so that the victimized woman can use the various existing tools to denounce the possible aggressions suffered at all levels. It also helps the competent authorities to become aware of the acts of violence and thus be able to take the necessary legal measures.

All the experiences brought up to now, make it possible to affirm that the measures to combat are necessary and effective, even with the end of the pandemic situation. Any and all combat instruments can and should be used. The use of technology, through applications, for example, enables rapid interaction between authorities and the victim.

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Socioeconomic Profile of Distance Education Students: Relations with permanence

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Abstract— It was proposed in this work to outline the interfering factors of the permanence and non-permanence of the students of the Pedagogy Course of Distance Education, taking as reference the University of the State of Mato Grosso – Unemat. The objective of this study was to analyze the profile of beginner students and graduates of the Pedagogy Degree Course of the class 2014/1 at UAB / Unemat, seeking to understand the factors that interfere in the students permanence and non-permanence. To this end, we look for to map and to know the socioeconomic profile of beginners and graduates, using the socioeconomic questionnaire answered at the time of registration by the candidates, relating to the profile of the graduates. Thus, the results point out that the profile of beginners contrasted with that graduates showed that the students who remained are women (92.9%); browns and mulattos (59.5%); are over 30 years old (76%); are from families that have between one and four people (83.96%); the family income range is from 3 to 10 minimum wages (20.3%), that exercise paid activity on a part-time basis (up to 30 hours a week) (40.09%) and chose the course by identification (41.04%). It was also evident that the profile of students who gave up (did not remain) are men (7.1%), black (9.9%); under 30 years old (24%); live with 5 or more people (9.44%); the family income range is up to three minimum wages (79.2%); they work eventually or they don't work (22,65). Throughout this job, it was understood the needy to develop research with graduates of the UAB System to ascertain the quality of the distance education policy.

I. INTRODUCTION

Distance education (DE) is a model of teaching that has been implemented in the occidental world since 1980. In Brazil, the first distance graduation course was offered in 1995, by Federal University of Mato Grosso – UFMT. In 2006, by the Decreet n° 5800, of June 8th, 2006, the Brazil Open University System – UAB – was instituted, aimed at the development of the distance education, with the objective of expanding and interiorizing the offer of courses and programs of higher education in Brazil. It was the first great attempt of the Brazilian government in the

search for a bigger reach of higher education, as well as for the modernization and democratization of the models offered. This enlargement of spots and availability of poles in places of difficult access created opportunities for many people, but, at the same time, contributed for the increase of the evasion problem, that already reached education in all its levels. The data and references used in this study point distance education to be necessary in the process of expansion and democratization of higher education, however, they also indicate a high evasion level, as it is possible to observe in the Higher Education Census 2016

(44,76%) and also in Higher Education Census 2017 (34,65%). Distance education is among the modalities that present a high level of non-permanence.

In this context, this paper searched to outline the factors that interfere with permanence and non-permanence of students in the Pedagogy Course of Distance Education, taking as reference the State University of Mato Grosso (Unemat), which began the offer of distance courses in 1999, and, in 2010, through the Directory of Management of Distance Education (DEAD/Unemat), started offering distance education linked to the UAB system. Thus, the objective of this study was analyzing the profile of the students (beginners and graduates) of the course of bachelor degree in pedagogy of group 2014/1 from UAB/Unemat, searching to understand the factors that interfere with the permanence and non-permanence of students. For that, in the methodology, the aim has been mapping and getting to know the socioeconomic profile of beginners and graduates, using as instrument the socioeconomic questionnaire answered when the candidates enrolled in the course, relating it with the profile of the graduates, which was drawn through the socioeconomic questionnaire applied by the authors towards the students who were taking the last semester of the course, the aforementioned graduates. The number of students enrolled in the course of bachelor degree in pedagogy through e-learning in the first semester of 2014 was of 349 (three hundred forty-nine), which was the universe of this research. Among these, there were 212 (two hundred and twelve) graduate answers, that is, 60,74% of the enrolled students, which were the subject of this study.

The first questionnaire applied to the beginners was elaborated by the Entrance Exam Co-Ordinating (COVEST), answered by the candidate when applying for the exam; and the second questionnaire was elaborated by the authors and applied to the graduates with the objective of detailing personal and academic information and identifying the causes of permanence and non-permanence in the course, noticed by the answers of the active students that had access to the Virtual Learning Environment (VLE).

The questionnaire applied to the graduates was organized in two sections. The first one was made up by multiple-choice questions, that aimed at characterizing the profile of the students; for that, there were the variables gender, color, marital status, age, if they have children, who they live with, how many members there are in the family, income range, if the participant works in the education area, if they have another high education formation, city where they live, if they have internet access, if they were motivated by the professors to continue the course. The

second section was constituted by two open questions, with the objective of collecting their perception about positive and negative aspects of the course and gathering change suggestions, in order to analyze the reasons that took to permanence and non-permanence. The open questions offered the respondents the possibility of exposing their ideas. They were chosen with the intention of deepening the analysis about the factors that interfere with permanence.

This article is structured in three sections: in this first one (the introduction), we present the study problem and the methodology used; in the second one, we bring a contextualization of distance education in Brazil and in the State University of Mato Grosso (Unemat), without the intention of going too deep; and in the third section, we present the results and discussion, analyzing the profile of the beginners and graduates of the distance education pedagogy course – group 2014/1 – searching yet the voices of the students, so, at last, we could be able to unravel factors that interfere with permanence and non-permanence. We conclude, in final considerations, presenting the analytic synthesis of the results, evidencing the importance of mapping the socioeconomic profile of the students for the construction of programs and politics of permanence in higher education.

II.   DISTANCE EDUCATION: INITIAL CONTEXTS

Distance education emerges in the context of public politics in education, as a possibility of enlarging the board of enrollments through the expansion in the number of places in higher education, since the physical and structural limitations become less relevant, considering that a big part of the process of teaching and learning happens in places chosen by the students themselves to develop their courses. Distance education appears in the process of democratization of higher education as a strategy of expansion and enlargement of the number of places.

So as to have an idea of the size of the expansion that happened in the number of students beginning in distance education, we recurred to the higher education census, which presents the data of face-to-face and distance education. According to the census, in 2001, there were, in face-to-face education, 3.030.754 students enrolled. In the same year, in distance education, there were 5.359. In 2017, the census brings the following numbers: face-to-face enrollments – 6.529.681; distance education enrollments – 1.756.982. In the period of 2001 to 2017, the face-to-face education grew 215,45%, whereas distance education grew 32.785,6%. These surprising distance

education numbers demonstrate the strength that this modality won in the last years, despite little demonstrating the conditions with which the courses are offered, whether in infrastructure, professor hiring, or the conditions with which the pedagogical activities for the students happen.

In this context, it is necessary to understand the dimensions of the democratization of the access to higher education, but also analyzing the warrantee of quality education when it comes to distance modalities. In this search, we present, in table 1, the data of the census of graduation courses in distance higher education between 2005 and 2017, as well as the number of beginners and graduates and the percentage of success throughout theses years. We observe that the highest success rate was among the beginners of the year of 2006, which concluded in 2009, with percentage of 62,32%, being that the generation that started in 2008 had the smallest percentage (32,73%). By calculating the average of success between the years of 2005 and 2009, we found 49,31% and between 2010 and 2014, there was an average of 41,76%. If, on one hand, the number of beginners increased each year, the same did not occur with the success rate, therefore, there was a significant variation, below 50%, starting with the beginners of 2010, as it is possible to notice in table 1.

Table. 1 – Number of beginners and graduates by Generation in distance graduation courses in Brazil (2005-2017).

Year	Beginners	Year	Graduates	Success Rate
2005	127.014	2008	70.068	55,16%
2006	212.246	2009	132.269	62,32%
2007	329.271	2010	144.553	43,9%
2008	463.093	2011	151.552	32,73%
2009	332.469	2012	174.322	52,43%
2010	380.328	2013	161.072	42,35%
2011	431.597	2014	189.788	43,97%
2012	542.633	2015	233.704	43,07%
2013	515.405	2016	230.717	44,76%
2014	727.738	2017	252.163	34,65%

Source: elaborated by the authours from the data of the Higher Education Census (2005 -2017)

In the state of Mato Grosso, the teacher formation, considered as public politics, was expressed in the Institutional Program of Teacher Qualification, involving the State University of Mato Grosso (Unemat), Federal University of Mato Grosso (UFMT), State Secretary of Education (SEDUC), Municipal Secretaries of Education

and, yet, the Syndicate of Public Education Workers of Mato Grosso (SINTEP). It was from the effective participation in this program that the Distance Education Division (DEAD) of Unemat was created, aiming at accomplishing activities of a distance education program for working teachers, in order to improve the levels of productivity and the quality of the education offered.

Unemat searched, starting in March 1999, the approval of the merit of the "Political Administrative Project of the Distance Education Division (DEAD)", which defines the decisions for the organization, implantation, and implementation of infrastructure for offering courses in distance education modalities. This program gave origin to the course of Full Bachelor Degree in Basic Education, 1st to 4th grade, in distance modality, implanted in Unemat in 1999, opportunity in which was created an infrastructure for providing autonomy in managing distance courses. Offered in the campus of Nova Xavantina/Pedagogical Pole of Nova Xavantiva and in the campus of Pontes e Lacerda/Pedagogical Pole of Jauru, 424 and 491 places were offered, respectively, in the period of 2000-2004, for working teachers. The courses offered were both for teacher formation: Pedagogy Course: Bachelor Degree in Pedagogy – Basic Education – 1st to 4th grades (Resolutions 9 and 10/2005 – CONSUNI) and Full Bachelor Degree in Pedagogy: Teaching in Child Education (Resolution 011/2005 – CONSUNI), the latter offered through an interinstitutional partnership, firmed by consortium Pró-Formar.

In 2008, with the adhesion of Unemat to the Open University System of Brasil (UAB), the Co-Ordination of UAB-Unemat was created (Order of Regulation n° 379/2010 UAB-Unemat – 10/1/2008 to 10/2/2010), which restructured the distance modality at Unemat, since, when signing the Term of Technical Cooperation and Commitment with UAB/Capes, DEAD had to adequate to the exigences of the Federal Government Program, both in what concerned infrastructure and personal conditions, so it would receive financial resources to invest in equipment and furniture, as well as in the courses.

According to the data reported in the Management Report 2017-2021, DEAD/Unemat has a central administrative and pedagogical organization, destined to outlining politics, planning, follow-up, and execution of actions in the face-to-face support poles, located in strategic regions of the state, where face-to-face pedagogical activities are developed, being the place where the student meets up with tutors and professors and where they also have access to the library and labs, since, in the modality of teaching, the UAB pole is the physical reference of the institution.

Table 2 presents the number of enrollments in DE in the period of 2010/2 to 2014/1, showing a recurring enlargement in the expansion and success rate that came against the similar expansion aforementioned, in table 1, about the student flow in DE in Brazil. By analyzing these data, it is possible to say that the entrance was democratized with the implantation of the DE modality, but not the permanence and conclusion. Let us see:

Table 2 – Number of enrollments, level of conclusion, evasion, and retention of enrolled students 2010/2 to 2014/1.

Course/year	Enrollments	Conclusion	Evasion	Dead	Retention
Ba. Degree in Physics – 2010/2	291	10,31%	84,88%	00	4,81%
Biological Sciences – 2010/2	490	23,34%	18,39%	0,21%	58,06%
Ba. in Public Administration – 2010/2	378	34,92%	53,44%	O,26%	11,38%
Ba. in Public Administration – 2012/1	496	28,43%	53,64%	00	16,94%
Ba. in Public Administration – 2012/2	402	34,32%	43,29%	0,25%	22,14%
Ba. in Public Administration – 2014/1	148	12,73%	29.98%	00	57,29%
Letters – English – 2014/1	50	30%	70%	00	00
Letters – Spanish- 2014/1	98	38,78%	43,88%	00	17,34%
Ba. Degree in Pedagogy – 2014/1	349	48,14%	25,21%	00	22,64%

Source: elaborated by the authors from the research data.

When presenting the conclusion, evasion, dead, and retained rates by course, according to Table 2, it is possible to observe that, in the Bachelor Degree in Physics, starting in the second semester of 2010, there was an evasion rate of 84,88%. In the graduate percentage, it is possible to highlight the Bachelor Degree in Pedagogy 2014/1, with 48,70%. The course that presents the highest retention rate is Biological Sciences 2010/2, with 58,06%.

It is possible to verify that there were students that passed away: in the course of Biological Sciences, there was 1 beginner, in the second semester of 2010, and another one, who started in the second semester of 2012. Also draws our attention the course of Letters (English) 2014/1, in which there were 30% graduates and 70% evaded students and no retained students.

In the research conducted by Nodari (2016), there are average levels of face-to-face education at Unemat for beginners in 2009: conclusion 27%, evasion 37%, and retention 32%. These levels of face-to-face education, if compared to the ones of distance education courses of DEAD/Unemat, show a very similar reality. For example, we presented the data for the Baccalaureate in Public Administration 2012/1 face-to-face course, presented by Nodari (2016): up to the second semester of 2014, it was the course with the highest number of enrollments at

Unemat: 496, with conclusion levels of 28,43%, evasion of 53,64%, and retention of 16,94%. It is possible to observe that the average of conclusion of distance courses is equivalent to face-to-face education at Unemat, however, the number of evaded students is higher in distance education.

Considering the high expansion of offer of places by Unemat through the UAB system, in DE modality, and that this expansion happened with a bigger effervescence in the entrance exam of 2013, starting the courses in 2014/1, we searched, in the next section, to present indicators of the socioeconomic profile of the beginning students and the graduates of the Pedagogy course, group of 2014/1, and also to present the voices of the graduates with the object of analyzing the interferences of permamence and non-permanence in the course.

1. **Profile of beginning students and graduates of the Pedagogy DE Course – Group 2014/1: searching for factors that interfere with permanence**

In the boards and figures that follow, it is possible to see the common questions referring to questionnaires 1[1] and

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[1] Questionnaire answered at the moment of the inscription for the entrance exam.

2^2 and the profile of the students, answered by the academics of the DE Bachelor Degree Pedagogy Course at DEAD/Unemat – Group of 2014/1. The objective of comparing the two questionnaires consisted in the analysis of the profile of the beginners and in the relation of this with the profile of the graduates, observing the social, economic, and personal characteristics at the beginning of the course and at its end. This analysis has made possible to notice the profile of the students that remained and the profile of the students that quit, making it possible to outline the factors that probably influenced this situation.

2. Gender: women dominate the entrance and the conclusion

According to the Higher Education Census of 2014, year in which the data for this research started being collected, the enrollment for face-to-face courses and distance courses in Brazil are represented by 55,7% of female students, while male students represent 44,3%. Considering that the objective of the study are students that were approved in the specific entrance exam 2014/1 of the Bachelor Degree DE Pedagogy Course, it was verified that, in relation to the variable gender, 89,57% are female and 10,43% are male. Among the graduates, 92,9% are female and 7,1% are male, according to figure 1.
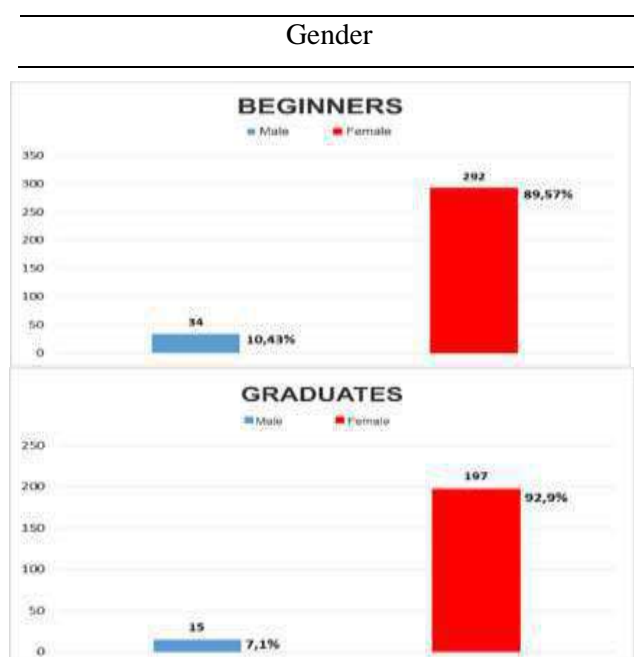
Fig.1 - Percentage of female and male students in the Bachelor Degree DE Pedagogy Course of DEAD/Unemat – Group of 2014/1

3. Color: black students own the smallest conclusion level

Unemat, in the specific edict 2014/1, with the politics of affirmative action, reserved 25% of the places in graduation courses for candidates who were self-declared black or mulatto, through the Ethnical-Racial Integration and Inclusion Program – PIIER. 40% of the places were destined for wide competition and 35% of the total amount of places were destined for candidates from public schools. It is possible to understand that 15,34% of black people entered the course and 9,9% of them concluded, indicating the giving up of black people. The percentage of people that considered themselves mulatto in the entrance exam was of 3,07% and, among the graduates, 1,04%. These data show that there was a higher percentage of giving up among black and mulatto people.
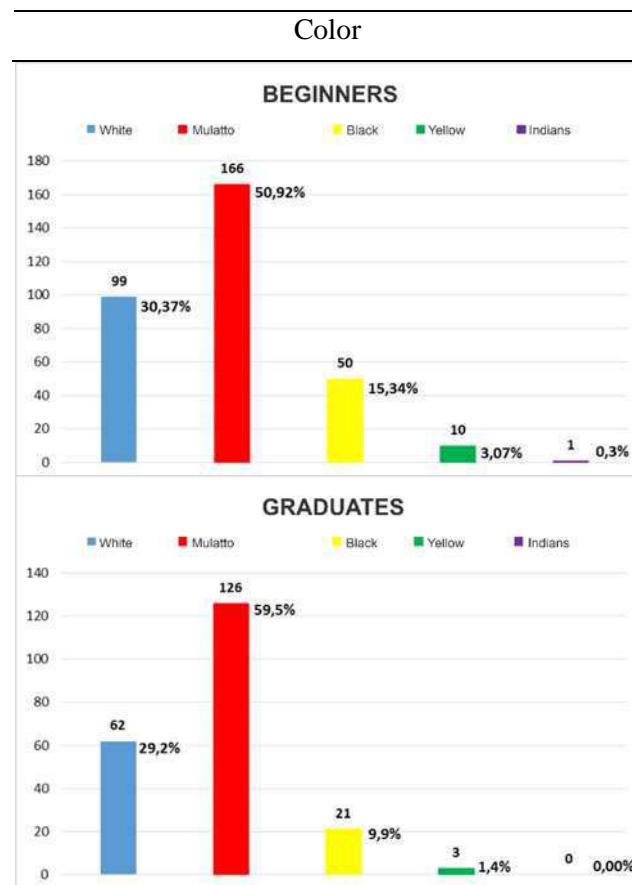
Fig.2 – Color of beginners and graduates.

According to the IBGE Census in 2010, black and mulatto people formed the biggest populational group in Brazil, with 50,7%, while 47,8% identify themselves as white people. For Ristoff (2014), Brazilian education as a whole is far for reflecting the populational profile, since, in percentual terms, the students in Brazil are 17% whiter than Brazilian society. In Mato Grosso, according to IBGE 2010, 60% of the population belongs to the group of black

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[2] Questionnaire Applied to the students, available at the VLE between 11/19/2017 and 1/5/2018.

and mulatto people and 37,5% identified themselves as white people.

In the studies conducted by Ristoff (2014), the whitest courses in Brazilian graduation are in the health area: veterinarian medicine, medicine, and odontology, with percentages of white people superior to 60%, while Brazilian population declared as white is, according to IBGE 2010, 48%. Thus, it is possible to understand that people considered mulatto and black in our country search for bachelor degree courses, while white people look for baccalaureate courses.

It is important to highlight that the research conducted at DEAD/Unemat meets up with what was said in Ristoff's paper (2014), since, for the bachelor degree course in pedagogy 2014/1, in the questionnaire answered by the graduates, the highest percentage of mulatto and black people, who are considered quota students, according to Resolution n° 200/2004 – CONEPE.

4. Age: young people over 30 have higher conclusion rates

When analyzing the variable "age" for beginners and graduates, according to Figure 3, we verify that the beginners who are over 30 years old correspond to 49,08%. On the other hand, graduates over 30 correspond to 76%. These data show that the people who evade the course are, in a large number, people who are 30 years old or less.
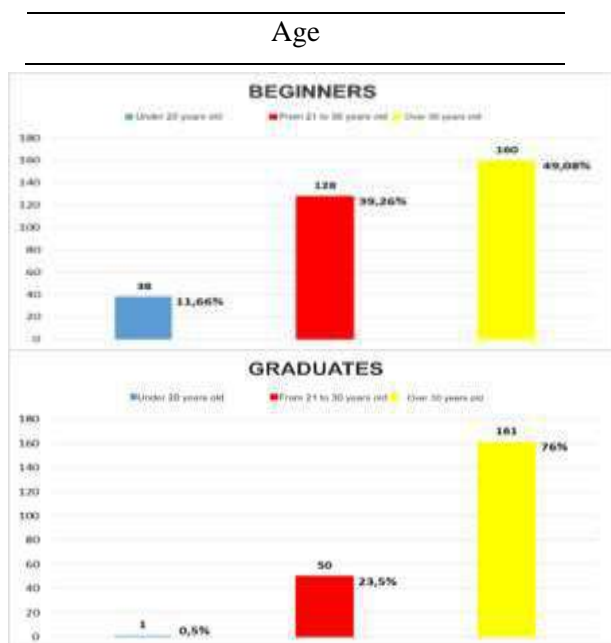
Fig.3 – Age of beginners and graduates

Source: elaborated by the authors according to data from the research.

Answers to Q2 confirm what was answered in Q1, since most respondents chose that they are over 30. In the pole of Comodore, there were 3,23% who chose the option "under 20". It is important to highlight the pole of Campo Verde, where 93,94% answered being over 30 years old. The smallest pole where respondents chose the option of being over 30 was Nova Xavantina's, with 57,89%. The rest of the students chose being between 21-30 years old, 29,63%. These data meet up with the Higher Education Census 2016, when affirming that the average of the graduates of distance education is 34 years old.

According to the Higher Education Census 2016, the average age of enrollment of face-to-face students is 21 years old, while the average age of distance education students is 28 years old. The entering age for face-to-face students is 18 years old, while for distance education it is 27 years old. When it comes to graduates of face-to-face education, the average is of 23 years old, and, for distance education, the average is 34 years old.

The DEAD/Unemat data correspond to the data of the Higher Education Census 2016 in all of the researched poles. The highest percentage of students approved in the bachelor degree in pedagogy DE course chose the option of being over 30.

5. Marital status: married students are the ones that most conclude the course

In relation to the general graph about the variable "marital status", 49,69% of the beginners of the course answered being single, 44,48% answered being married, the divorced ones are 4,91%, and the widowed ones are 0,92%. In relation to the graduates, 25,94% answered being single, the married ones are 64,62%, the divorced ones are 7,55%, and the widowed ones are 1,89%, as it is possible to verify in Figure 4.
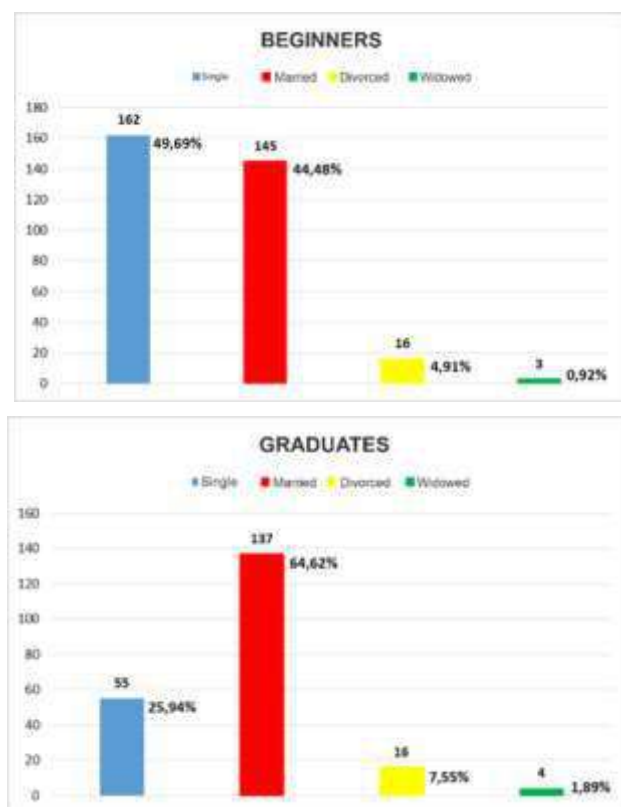
Fig.4 – Marital Status of the beginners and graduates.

Source: elaborated by the authors from data of the research.

In 2014/1, among the students approved for the bachelor degree DE course in pedagogy, a great majority identify itself as single, with highlight to the pole of Cáceres, in which 64% of the students approved identified as single. The highest percentage of married students was found in the pole of Campo Verde, with 57,69% of the approved students. The percentage of divorced students is higher in the pole of Comodoro, 10%. About the number of widowed students, there are 2% in Juína, 2% in Comodoro, and 3,8% in Campo Verde.

In the questionnaire answered by the graduates, in almost all of the poles, more than 50% chose the option "married", highlighting the pole of Cáceres, with 72,22%. The highest number of divorced students is in the pole of Juína, with 55,56%. There are 6,06% widowed students in Campo Verde, 3,22% in Comodoro and 2,78% in Sapezal. According to the data of PNAD/2014, in Mato Grosso, 47,3% of the population over 15 years old is married[3],

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[3] In this, are gathered all the people in the following situations: consensual union, civil union, religious union, civil and religious union, with different genders and of the same gender.

4,1% is divorced, disunited or legally separated, 3% is widowed and 45,6% consider themselves as single people.

6. Number of family members who live in the same house

In the answers of the beginners about how many people live with them, 58,6% answered that 3 or 4 people live with them. Among the graduates, the highest number live with 1 or 2 people, with 42,92%. Among the beginners, the number of people who live with more than 5 or 6 people was of 9,51% and with more than 6 people was of 3,98%. In conclusion, this percentage for 5 or 6 people was of 7,08% and, for more than six people, 2,36%, as demonstrated in Figure 5.

How many family members live with you
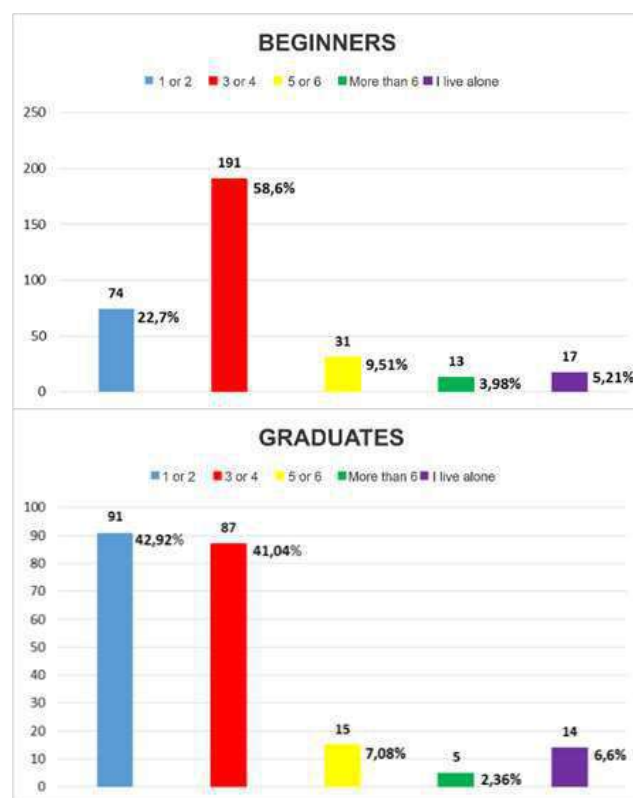
Fig.5 – General: number of family members who live with you.

Source: elaborated by the authors according to data from the research.

According to the data of IBGE (2016, p. 98), the average number of people per household in Brazil was of 3,5 in 2005, reducing to 3,0, in 2015. In Middle-West, the average, in 2015, was of 3,19 people per household.

7. Average monthly family income rage below 3 minimum wages

Among the graduates, the highest percentage, 84,58%, has an average income between 1 and 3 minimum wages. Among the graduates, for the income up to 3 minimum wages, the percentage is of 79,2%. The beginners who receive between 3 and 10 minimum wages are 14,72%. Among the graduates, the percentage is of 20,3%, as it is possible to verify in the following figure:

What is your family's income rate?
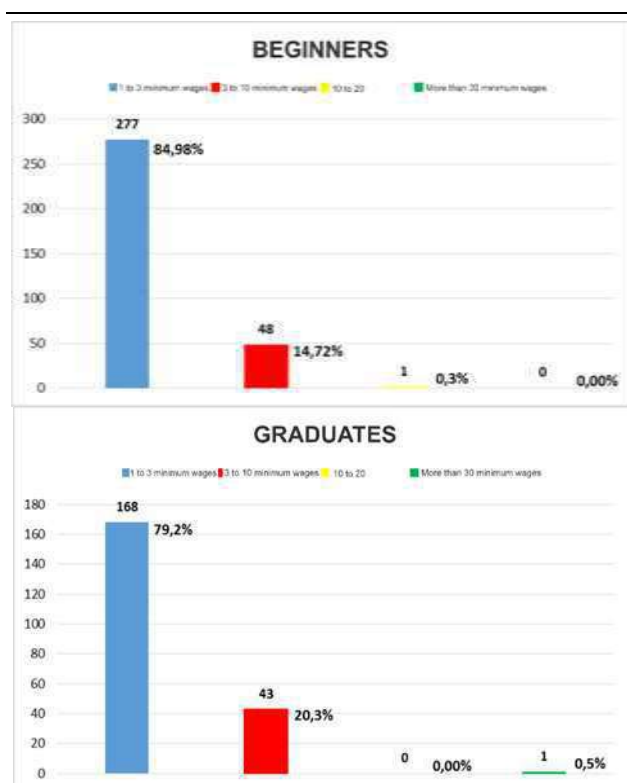
Fig.6 – General: income rate of your family.

Source: elaborated by the authors according to the research data.

According to the answers of Enade (2016), 47,6% of graduation students in Brazil have monthly family income of 1,5 to 4,5 minimum wages. In the studies conducted by Corbucci (2014), the income may be pointed as the main factor for academic performance and, when it comes to entrance, the income may constitute a barrier in continuing the studies for students who need to work.

8. Do you perform any kind of paid activity: students who work

About paid activities, 33,1% said that they perform part time (up to 30 hours). Among the graduates, this percentage is of 40,09%. The ones that work full time are 37,4% for beginners and 37,26% for graduates. The ones

who say that do not work are 22,8% of beginners and, for graduates, they correspond to 17,93%. Inside the aspect "paid activity", it is possible to say, according to Figure 7, that there was higher permanence of students who work part time (up to 30 hours a week).

Do you perform any paid activity?
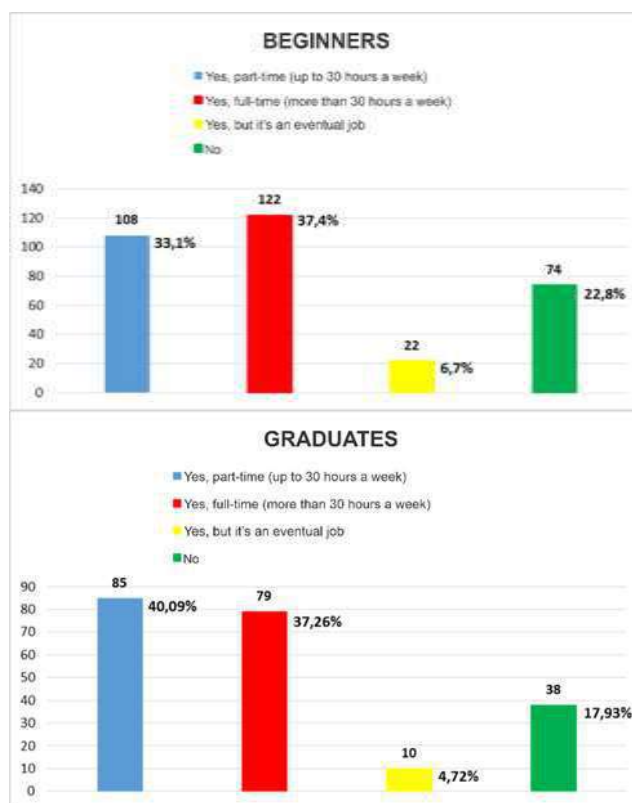
Fig.7 – Performance of paid activity.

Source: elaborated by the authors with the data from the research.

9. Reasons for choosing the course

About the variable "reason for choosing the course", 45,7% of beginners say that they chose the pedagogy DE course due to work market. On the other hand, graduates who chose this option were 26,42%. A factor that draws attention for beginners is that 25,2% of them chose the bachelor degree pedagogy course for improving an activity they already perform. This shows that this person already works in the education area and the course will help better develop the function.

I chose the course because
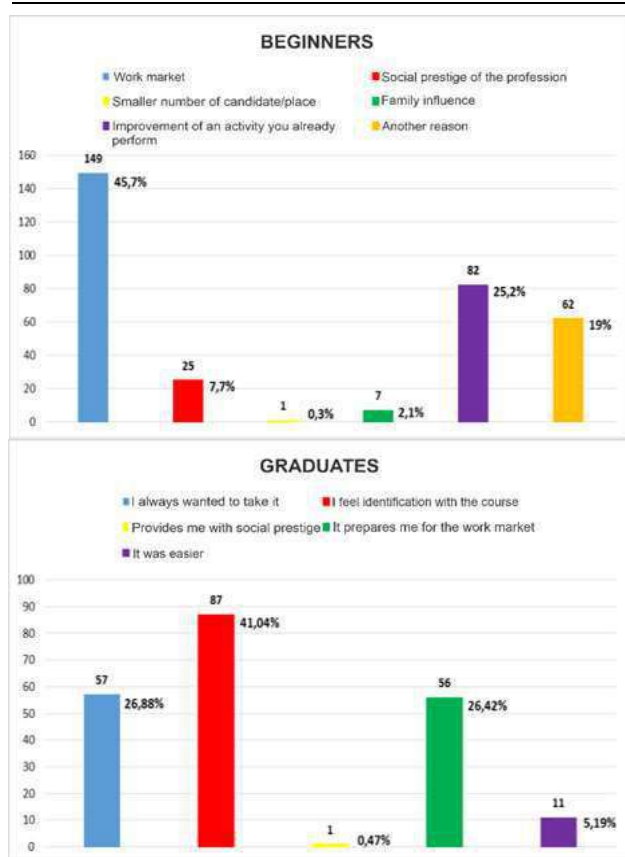
Fig.8 – Reasons for choosing the course.

Source: elaborated by the authors according to the data from the research.

Laham (2016), in his studies, has reached the following conclusion regarding the choice of students for the DE pedagogy course: in face of the manifestation of students and the frequency of answers that point the factors "time" and "autonomy for studies", it has been evidenced that the main factors to influence the choice for the course and modality are traversed by the rationality and pragmatism. These characteristics show the intention of effectively concluding the chosen course.

To sum up, the variables of the socioeconomic profile of beginners and graduate students indicate:

a) In relation to the variable gender, the highest giving-up rate was of men, who, in the entrance, represented 10,43% and, in the conclusion, this percentage fell to 7,1%;

b) In relation to color, the highest giving-up rate was of black people who, in the beginning, corresponded to 15,34% and, in the conclusion, this percentage was of only 9,9%.

c) In relation to the variable age, the ones that most remained were the ones over 30 years old. In the entrance,

they were 49,08% and, when concluding, the ones over 30 corresponded to 76%. On the other hand, the beginners under 20 years old corresponded to 11,66%. In the conclusion, this percentage corresponded to 0,5%.

d) In relation to marital status, the ones that most gave up were the single ones: in the beginning, they corresponded to 49,69% and when concluding, 25,94%;

e) In relation to family members, the ones that most gave up were the ones with the highest number of family members: the beginners with 3 or more people in the family were 58,6%. The ones with 5 or 6 members were 9,51% and with more than 6 members, 3,98%. Among the graduates, these percentages fell: 3 to 4 members, 41,04%, 5 or 6 members, 7,08%; more than 6 members, 2,36%;

f) In relation to family income, the one that most gave up are the ones that receive between 1 and 3 minimum wages. In the beginning, this group corresponded to 14,72% and, among the graduates, 20,3%.

g) In relation to paid activity, the ones that most remained were the ones that work part time (up to 30 hours a week). In the beginning, they corresponded to 33,1%; the graduates corresponded to 40,09%.

h) In relation to the reasons for choosing the course, the highest giving-up rate was for the ones who chose the course because of work market: in the beginning, they corresponded to 45,7% and among the graduates, 26,42%.

In order to go deeper into these results, we analyzed the sayings of the students, aiming at clarifying the factors that interfere with permanence. The answers were crossed with the result of the analysis of the profile of the beginners over the graduates, aiming at building the categories that indicate factors that interfere with permanence and non-permanence in the course.

The analysis of the sayings of the research subjects were, firstly, systematized, by using Nvivo 11[4] software, by Microsoft, which gives support to researches. It was used for the creation of word clouds, having the specificity of creating clouds with the 100 most expressed words in the discourse of the interviewees.

These clouds were created with reference to the "nodes"[5] created for the crossing of the data obtained through the questionnaire sent to the students of the bachelor degree DE pedagogy course enrolled in 2014/1.

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[4] The software was dowloaded as a trial version, with free license for 14 days. Available at: https://www.qsrinternational.com/nvivo/trial/trial-portuguese. Access in: July 2018.

[5] Term used in Nvivo 11 to name the interposition of the analysis of the crossed data.

The first question raised with the students was about the suggestions to improve the course in order to make permanence possible. From the graduate's answers, a cloud with the 100 most evident words was made.

Fig.9 – Map of the suggestions of the graduates for the bachelor degree DE pedagogy course aiming at permanence

Source: Cloud elaborated by the authors through Nvivo 11 software.

In order to understand the cloud, the words that had the most highlight were: face-to-face, classes, professors, tutors. Among the highlights, the conjunction "more" is always related to the enlargement of an aspect of the course, such as: more classes, faster answers, more interaction, clearer answers, as we can see on the following sayings:

Q1. "More face-to-face classes".

Q2. "For me, it is very good".

Q3. "We should have faster answers in order to clarify our doubts".

Q4. "Despite being a distance course, we should have more face-to-face classes, so we could have more access to the professors".

Q5. "Faster answers from the tutors, professors, and about the contents".

Q6. "Facilitating the communication between professors and students".

Q7. "I suggest the availability of a free phone line for clarifying the doubts of the academics immediately. The publicizing, since the beginning of the course, of complementary activities that will be accepted, since, in our course, we only had this information in the beginning

of the 8th semester and the time was short, because courses we had took with this purpose were disregarded.

Q8. "There should be more classes at the poles, because this is one of the moments in which we learn the most".

Q9. "More interaction of the professor/tutor with the students".

Q10. "Clearer and faster answers from distance professors".

Q11. "More face-to-face classes and more quickness in returning the posted assignments".

Q12. "I would like very much that there was printed material and that there could be more face-to-face classes".

In face of the suggestions mentioned above, it is noticeable that many students of the bachelor degree DE pedagogy course need more face-to-face meetings. Regarding the other question that they most suggested, faster answers from professors and tutors, it seems that the students' questions take a lot of time to be answered and, by their sayings, there are indications that this delay interferes with the learning, causing demotivation about the course and, consequently, leading to giving up. Let us see, as follows, the synthesis with the building of the categories that emerged about the factors that may interfere with permanence.

10. The building of the categories: the factors that interfere with permanence

Based on similarity criteria of content, logics, and pertinence, as oriented by the procedures of content analysis proposed by Bardin (1977), two categories emerged: the first one was "Reasons for permanence", highlighting flexibility of time for studying, good professional perspective, quality, and gratuitousness of the course; and the second category was "Reasons for non-permanence", highlighting the lack of fast answers by tutors and professors, the lack of face-to-face classes and the feeling of loneliness (interactivity).

In the category "Reasons for permanence", it was possible to observe that, for the students that remained, most (37,26%) presented that factor "time flexibility" as the main reason for permanence, followed by quality and gratuitousness of the course (34,91%). The evocations of the students evidence that the choice for the distance modality would be due to the freedom of choice of time for studies. However, during the verification of the answers presented, it was possible to understand that this reason was not determinant for all of the students.

According to the relates of the graduates and the analysis of the socioeconomic profiles, the time, or the lack of it, is

a determining factor both for permanence and non-permanence of students, who affirm that the responsibility of several things to do and the delay in the answers from some tutors and professors make it difficult, for the student, to plan and follow an organization of time for studying and they also say that conciliating studies with daily things to do is very difficult, and it takes a lot of discipline to prioritize time for studies.

The results about the socioeconomic profile of the beginners and graduates evidenced that 64,6% of participants declared being married, 85,4% affirmed having between 1 and 4 kids, and 77,4% perform paid activities from 30 to 40 hours a week, parallelly to their studies. Let us see the answers of the graduates about the difficulties they found to keep their studies, for example, Q2: "Sometimes, the answers from tutors and professors took too long, test were very difficult, and there were way too many assignments requested by the professors and not enough time to do them"; and Q3. "Professors took too long to give answers about an assignment; questionnaires with mistakes; delays in making grades for tests and assignments available".

According to Palloff and Pratt (2004), DE provides students with the possibility of studying anywhere anytime. This allows students to keep on working full time and give attention to their families. However, in researches conducted by Vargas (2004), Moura-Walter (2006), and Oliveira (2007), it has been demonstrated that conciliating studies, work, and family is still one of the greatest difficulties found by students.

Regarding the category "Reasons for non-permanence", the reasons that were most evidenced are related to the delay in answers from professors and tutors (39,23%); lack of face-to-face classes (22,10%); and the feeling of loneliness (13,81%). These subcategories may be presented as the factors that lead students to give up the DE pedagogy course.

The subcategory "feeling of loneliness" is also related to the matter of time and was related by 25 respondents, which corresponds to 13,81% of graduates: "studying alone, study time management". For Fávero and Franco (2006), the loneliness and the lack of interaction between professors and students and among students themselves may lead to a higher level of evasion. For Romão (2009), not all students have enough maturity to face by themselves and in loneliness a series of responsibilities that the distance studying embraces. The "lonely" hereby mentioned is not equivalent to the lack of companionship or to the brutal loneliness, but to the lack, for further than immediate contacts, of interaction, dialogue, and collaboration among the subjects involved in the process, missing interactivity (ROMÃO, 2009).

In this subcategory, the feeling of being lonely, let us look at the following answer of a student: Q7. "it takes a lot of reading and doing the activities mostly on your own, because that doubts that came up took a long time to be answered and there were a lot of subjects that barely opened, we barely had time to read the material posted, and the time was already expiring to post the activities". Let us see that "being lonely" means the difficulties of interaction with professors, tutors, and the colleagues themselves.

In the manifestations of the graduates, it was possible to evidence that, despite the use of interactive tools in the learning platform of the course and the face-to-face meetings in the poles, there is a feeling of loneliness, which may indicate that these interaction tools are not enough or do not work properly. For Palloff and Pratt (2004), the problem of the loneliness is caused by the quality of the interaction and a quality interaction is fundamental to avoid the students to give up the course. It is necessary a good interaction between colleagues of the course and between students and tutors for the formation of a virtual learning community and the proximity between tutors and students makes them (students) not feel lonely and increases the opportunity of success in the studies, decreasing the giving-up. About the construction of a learning community, Palloff and Pratt (2004) highlight that the bigger the attention there is for the development of a sense of community, the more the students tend to continue the course until the end. If the students believe that they "are in this together", the possibility of retention will increase, because the feeling of isolation will decrease, independently of how difficult the studied subject is. The students start having the feeling that there is someone who understands them.

In this same context, Mourão et al. (2014) day that there are behavioral actions that can be adopted by tutors and professors in order to minimize or eliminate the feeling of virtual loneliness in the learning environment, which may lead to discouragement and abandonment of the course by the student. The actions to which the authors refer relate to conduction and evaluation directresses for assessment activities in the course, stablishing a pattern of answer time and feedback for students within 24 hours.

According to the relates of Mourão et al. (2014), it is necessary to foment the presence of students in the discussion forums and other asynchronous interaction tools available in the learning platform, so that presence occurs. It is necessary agility from the tutors to give back feedbacks which would be a way to favor a more

individual and effective follow-up of the activities posted in the platform, minimizing the feeling of loneliness of the students.

III. FINAL CONSIDERATIONS: QUESTIONS FOR CONTINUITY

To sum up, the profile analysis of the beginners contrasted with the graduates' evidenced that the students that remained are women (92,9%); mulattos (59,5%); over 30 years old (76%); from families that have between one and four people (83,96%); with family income around 3 to 10 minimum wages (20,3%); who perform paid activity part time (up to 30 hours a week) (40,09%); and who chose the course by identification (41,04%). It was still evidenced that the profile of the students who gave up (did not remain) are men (7,1%); black people (9,9%); under 30 years old (24%); who live with 5 or more people (9,44%); the rate of the family income is up to three minimum wages (79,2%); work eventually or do not work (22,65%).

We highlight in the results of the profile of the students that did not remain the fact that black students give up more than white students; young people give up more, and the ones who do not work full time also give up more. There are no more answers for these questions in this study, which points at the need of continuity and deepening, but also indicates the need of elaborating politics and actions of permanence focused on theses publics.

The analysis of the voices of graduates evidenced that the factors that interfere with non-permanence of students are, in synthesis, related to the matter of time and feeling of loneliness in the studies, understood as the lack of interaction. Here, there is a contradiction that also opens up possibilities for new studies, since some of the factors that lead to entering a DE course in the lack of time and conditions to take the graduation course face-to-face; on the other hand, students say, in this study, that some factors that interfere with permanence are lack of time for dedicating to DE activities and the loneliness to study. According to the students, the lonely study, pointed by them as the lack or difficulty to interact with professors, tutors, and colleagues, causes discouragement. It is necessary encouragement from colleagues, professors, tutors, and, in this sense, the face-to-face meetings are of fundamental importance, reason that may have taken students to suggest more face-to-face classes.

In this study, it has been identified the importance of mapping the socioeconomic profile of beginning students and graduates, in order to make a follow-up of students at risk of non-permanence. This knowledge of the profile should contribute for the elaboration of politics focused on

making possible the permanence of students and should be directed at the group with the profile that presents the highest probability of giving up.

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CyberSix Learning: Development and systematization of a methodology for remote teaching

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Abstract—Rapid changes, especially due to the COVID-19 pandemics, are taking place in society. Accordingly, educational methods need to adapt, in order to follow the improvement of social complexity. Therefore, this research had the purpose of investigating the application of active learning methodologies, adapted for remote teaching, in the discipline of Work Organization in Production, a subject of a Production Engineering course, from the University of São Paulo. Also, this work aimed to analyze the development of socioemotional skills together with the assimilation of technical concepts; and to systematize a new methodology, which was denominated CyberSix Learning. The investigation had a qualitative approach, an applied nature, and an exploratory objective. The research method was the case study itself. In general, students considered that the experience added value in the construction of knowledge, especially concerning critical thinking and development of the ability to give feedbacks. Some difficulties were found, such as resistance to changes, ineffective communication, group distance, and cognitive obstacles.

I. INTRODUCTION

In Brazil, even in the last decade, the educational sector has been quite resistant to the adoption of new technologies and methodologies, being, in its great majority, structured from the industrial ideals coined in the Industrial Revolution, in which teaching occurs based on content repetition [1]. The rapid social changes, driven by globalization and high connectivity, highlight the consequences of a content-based learning ecosystem, dependent on the teacher, with little interactivity and use of creativity, in addition to the lack of autonomy of the learners [2]. In this case, the educational process becomes tiring and less productive.

Thus, as an alternative to equate the educational process with social changes, Active Methodologies emerged.They began to spread in Brazil at the end of the 20th century. As a basis, the student is considered a central figure in the learning process, and the teacher's role goes from transmitting knowledge to facilitating learning [3].

Concerning higher education in engineering, active learning methodologies might be undertaken in different ways and methods, in which the common denominators are: improvement of transversal skills, combined development between academic and professional training, procedural assessment, and greater articulation of the knowledge [4]. Besides, such methodologies are a means to train not only professionals for the job market but also dynamic, pragmatic, and active individuals capable of adapting to the constant innovations and transformations in the world [4].

Due to the COVID-19 pandemics, the world found itself immersed in a widespread crisis, unprecedented in recent global history. In this context, changes, which were already occurring rapidly, were even further accelerated. The term "liquid modernity" is used to describe the

transformations of the contemporary world, in which nothing is solid, and everything is diluted like water [5]. However, this analogy is no longer enough to represent the direction of society. The accurate definitions of the VUCA world (volatile, uncertain, complex, and ambiguous) transformed the liquidity social state definition to the gas sphere, in which everything seems to be adopting a more ethereal form, impossible to retain in the hands [6].

The compulsory closure of educational institutions in the pandemic, which forced them to use technological tools for remote education, may possibly mean a turning point in education's history [7]. The adaptation of active teaching methodologies to the online environment presents several challenges for both students and teachers, such as lack of time for preparation and adaptation to online modus operandi; teacher/student isolation (both should not feel that they are alone in the teaching and learning processes); and the urgency of new pedagogical approaches [8].

Based on the above considerations, the need to adapt the education system, regarding to social paradigm changes, is indisputable. This case study aimed to investigate the application of active learning methodologies adapted for remote teaching, in the discipline of Work Organization in Production; to analyze the development of socioemotional skills together with the assimilation of technical concepts; and to systematize a new methodology, called CyberSix Learning.

1.1 Contemporary Teaching Methodologies

Active methodologies emerged intending to integrate the multiple factors that influence the learning process, to place the student in the central role of learning itself. From this teaching strategy, linked to cognitive psychology, especially to metacognition (as a learning strategy), the importance of reflection and student autonomy in the educational process is emphasized, with the ability to know himself, learn to regulate and control the search for knowledge, seeking to be an autonomous manager of their learning [9].

Active methodologies offer students opportunities to build their knowledge through theoretical-practical activities, which instigate greater interaction between student, object, and study context, to bring academic education closer to professional performance [4]. As a general consequence, students develop transversal skills and a more active, proactive, communicative, and investigative role [10].

Among several methodological tools, some, which are already well known, as Case Study, PBL - Problem-Based Learning, PjBL - Project-Based Learning, Concept maps, Peer Instructions, Flipped Classroom, and Think Pair

Share. Other strategies and methodologies have also been developed in recent years and we address, below, those that supported the development of this work.

1.2 Self-Directed Learning (SDL)

Many terms similar to "self-directed learning" are used with the same meaning and context, such as self-regulated learning, autonomous learning, self-planned learning, self-teaching, and independent study. The differences between them are subtle, which has led to indistinct use by many researchers [11].

An initial definition of self-directed learning comes from Knowles [12], who described it as a process in which individuals take the initiative in the learning process itself and, with or without the help of others, can diagnose their needs, formulate goals, identify human and material resources to learn, choose and implement appropriate strategies and evaluate learning outcomes. The concept of self-direction for learning has undergone a careful reassessment in recent years. In this way, an important distinction emerged between the self-directed learning process and the notion of self-direction as a construction of personality [13]. To overcome the ambiguity of those two perspectives of the term "self-directed learning", Brockett and Hiemstra [13] coined the "Personal Responsibility Guidance" (PRO), a model where two related dimensions are connected in an umbrella concept: self-direction in learning. Schemed in Fig.1, it is observed that personal responsibility serves as a starting point, leading to self-direction in learning through characteristics of the teaching-learning transaction (self-directed learning) and characteristics of the learner (self-direction of the learner) [13].

Fig. 1: Personal Responsibility Orientation (PRO)

However, the PRO model has been reconfigured and adapted to convey the changes required by the transformation of time. Thus, the PPC (Person, Process, and Context) model emerged, illustrated in Fig.2.
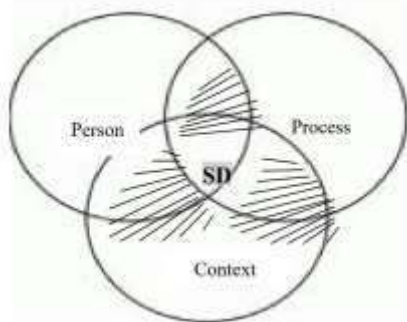
Fig. 2: Model "Person, Process and Context"

In the PPC model, the ideal situation for self-directed learning to be more effective is the one in which person, process, and context are in balance. That is, when the student is highly self-directed, the teaching-learning process is configured in a way that encourages students to take control of their own learning, and the socio-political context and the learning environment support the atmosphere for self-directed learning [14].

1.3 Diversix Methodology

Barreto [15] coined a methodology that integrates six pedagogical resources with an unusual skill used in teaching processes, which is humor. This method, called Diversix, enables the development of several skills and abilities, such as creativity, communication, capacity for analysis and synthesis, teamwork, leadership, transmission, reception and processing of information, and others.

According to this methodology, the classroom should be divided into groups of students, who are responsible for preparing presentations on topics related to the discipline. At least six pedagogical resources must be used, such as group dynamics, slide presentation, videos, cases, an individual scientific research summary about the topic, and evaluation of the entire classroom in the next class (includes preparation, application, and correction of an evaluative activity). After each presentation, the whole class and the teacher give systematic feedbacks to the responsible group [15].

1.4 Online Education

Online education is defined as the set of teaching-learning actions mediated by digital interfaces that enhance interactive and hyper textual communication practices [16]. It is not just an evolution of Distance Education, but also a phenomenon of cyber culture, term that names the socio-cultural development within the "cyberspace", where the information portrays the main characteristic of this organization and the network flow constitutes the basis of the social structure [16].

Some fundamental principles ought to beconsidered for educational success, which are the virtual learning environment resources, the interactivity and collaboration between students, and the role-played by the teacher (moving out from the center of the process) [17].

1.4.1 Distance Education

There are several concepts of Distance Education (DE). Fundamentally, distance education is defined when the teaching process occurs while the teacher and the student are separated [18]. In addition, distance education involves a particular educational project, with tutors, virtual environments, and the establishment of learning objectives [19]. However, each author highlights some specific trait in his conceptualization.

Dohmen [20] emphasizes that DE is a systematic self-study, in which the student learns from the material presented to him, with supervision by teachers through the media. Peters [21] states that distance education is an industrialized way of teaching and learning. Dias and Leite [22] highlight the physical separation and the mediation of the so-called ICT (Information and Communication Technologies) in the distance learning process.

According to Moore and Kearsley [23], technology and the media have pointed the innovative evolution of distance education over five generations, as proposed:

a) 1st. Generation (1850 - 1960) - correspondence;

b) 2nd. Generation (1960 - 1985) - broadcast by radio and TV;

c) 3rd. Generation (1980 - 1995) - open universities;

d) 4th. Generation (1995 - 2005) - conference call; and

e) 5th. Generation (2005 - until today/2020) - Internet.

It is important to highlight counterpoints to Distance Education, as it may hinder the learning process if not tackled. The virtual class does not encompass the intensity of a real class, as the teacher-student relationship must be essentially immediate, without intermediation [24]; and the ability of distance education to provide an ethical-political education for the student is also questionable, once it fails to provide the awareness of power relations present in social institutions, scientific knowledge, and professional practice [25].

1.4.2 Emergency Remote Teaching

Due to the COVID-19 pandemic, remote education has been applied on an emergency basis, since the educational projects of educational institutions and their respective courses were not planned for the distance education modality, which requires structuring the curriculum and processes to appropriate teaching methods. In this way,

teachers are using ICTs as a means of teaching, to virtualize the face-to-face model [26].

Emergency remote education is defined as a period of a sudden change from the form of educational instruction to an online model, due to some catastrophe. In this case, once the circumstances of the disaster recede, the teaching configuration will return to its original format [28].

1.5 A new strategy: CyberSix Learning

Following the methodologies and theoretical bases mentioned above, a new method was created to meet the specific needs of students, taking into account the social context triggered by the COVID-19 pandemics.

This new method is called CyberSix Learning and its authorship is equally shared between the teacher responsible for the discipline and a monitor student who had already taken the course in a previous year (2019), both authors of this article.

The pillars that underlie the construction of the methodology are:

a. Conceptual understanding of the subject

The theoretical concept of the discipline must be thoroughly worked on, to guarantee that technical apprehension occurs. In addition, the academic study should provide support for the student's development, in order to expand his knowledge and technical skills on the subject.

b. Student at the center of the learning process

The student has the autonomy to relate to the theoretical concepts of the discipline and to be actively involved in its development, in order to build knowledge, being guided by the teacher, and collaborating with the mentor, as well as the other apprentices. In this way, it presupposes and creates an environment in which there is a conscious intention to improve and learn.

c. Network interactivity and learning

In this case, the term network is a social trait, being understood as the whole flow and bundle of relationships between the subjects involved in the learning process, and the digital interfaces. The network allows students to share meanings while recognizing information and knowledge, becoming possible by the wide reach of the internet. Thus, learning occurs from teacher to student, between students, and in the student's contact within the cyberspace. Fig. 3 shows how the pillars elucidated are interrelated as elements of learning, and with the subjects of the educational process (student and teacher).

Legend:

Cyberspace

Personal choice of own development

Theoretical apprehension process proposed by the teacher

Network between students

Fig. 3 - Relational Scheme between the methodological pillars

II. METHODOLOGY

This study was carried out in the discipline of "Organization of Work in Production", given for the Production Engineering course at the Engineering School of Lorena campus (EEL), at the University of São Paulo. The class had 40 students, 36 from EEL and 4 from Polytechnic School (another campus of the University). Sinceit took place during the second semester of 2020, classes occurred remotely, due to the Coronavirus pandemic.

The investigation had a qualitative approach, concerned with the understanding of subjective concepts; an applied nature, proposing to investigate a specific case; and an exploratory objective, aiming to obtain greater proximity with the object of study [28].

The research method was a case study, which represents an empirical investigation and contains a comprehensive method, with the logic of data planning, collection, and analysis [29]. In addition, it allows the intense examination of an object of study in order to achieve the results [30].

Thus, the research was conducted into six stages. In the first one, the object of study was defined, concomitantly with the elucidation of the purpose of this research. Also, a bibliographic search was made about active teaching

methodologies, self-directed learning, the Diversix method, online education, and its variants.

In the second stage, based on the previous theoretical foundation, the fundamental methodology for this case study, CyberSix Learning, was coined with the planning of each class and activity.

During the third stage, the teaching strategy was applied. Thus, a Case Study was developed, using participant observation as an investigation technique, which consists of the researcher's real interaction with the object of study, in which the researcher joins the group and influences it [31].

The fourth stage happened concurrently with the third one, since data were collected and systematized as the teaching methodology became concrete.

Subsequently, in the fifth stage, there was an analysis of the data collected, made based on the Content Analysis technique [32].

The sixth step consisted of compiling the research findings and writing this article.

III. RESULTS

3.1 Before classes' start

First, a flexible schedule plan was developed to support the application of the method. The following themes to be worked on were defined, which were already part of the programmatic content of the discipline, grouped as follows: the needs of modern companies; new production models; work models of organization schools; socio-technical principles of work; group work; organization by processes; and organizational changes.

The execution strategies during classes were also planned, and the roles to be played by the teacher, monitor, and students were aligned.

Then, students received an invitation to be an active part of the discipline's learning process, by e-mail. The purpose of the invitation was to make room for the students' individual intention to commit to their own development, while studying the subject.

3.2 During classes

In the first class, an icebreaker activity was made to connect the students to each other, the teacher and the monitor as well. The chosen dynamic was an adaptation of a common game,in which the first person speaks the name of an object, and people need to show the object, as soon as possible, through the webcam. Also, whoever showed the object should also say something about themselves,

except for the following topics: age, course, city, and where they work.

The activity brought agility and interaction, in the first moment, besides promoting identification among the participants, undoing the initial tension of the unknown, and providing a less formal environment.

Continuing the class, theoretical concepts of the discipline were explained, and later the proposal for structuring the semester was placed:

a. The students could present topics that they would like to work on in the semester, but also connecting them with the mandatory menu;

b. Formation of ten groups, with four students in each;

c. Presentation of a seminar per group during the semester, lasting 1h50, and with weekly frequency. The classes had a total duration of 3h20.

Still in the first class, the groups were set up, and the additional topics, brought by the students, were discussed. The following topics were added: Industry 4.0/5.0; Agile Mindset; Duality of automation vs humanization; Non-Violent Communication; Time management; Firms of Endearment; Mental health at work; Diversity and inclusion. Subsequently, these themes were included in the discipline's schedule.

Concerning the requirements of the seminar, it should contain slides, videos, a case, dynamics, be presented by every participant of each group, and use humor. Both teacher and the monitor were available to answer questions and clarify what was necessary, but for that, the group of students would have to speak up. That is, if they needed or wanted, they could get in touch.

In the following classes, the groups presented the seminars, and, after each exhibition, a feedback session was held about the presentation with the whole class, pointing out positive aspects and aspects that needed to be improved.

For each presentation, the monitor, to enable future comparisons and support the analysis of the research procedures, wrote a descriptive record.

To end the semester, there was a lecture by an organizational designer covering the theme "Flexibility and Adaptation to Changes", aiming to bring students closer to the skills development need, due to major changes in the job market.

3.3 Perception of students

Throughout the classes, students' feedback about the discipline methodology and execution was collected, as well as a metric of individual perception of learning. The average answer of how much they consider they learned in

this subject, in comparison with other disciplines they took, whose methodology is traditional, was 4, on a scale from 1 to 5, where 5 means learning much more and 1 much less than the other disciplines.

In general, students considered the learning experience positive through the applied methodology. Some comments prove this idea:

"I would like to congratulate the teacher, who always complied with the agreement, and the monitor for her excellent work throughout the semester. I had never done a discipline with such a participative monitor, and this role of the monitor should be better explored in other subjects of the undergraduate courses at the university" [S1].

"The methodology applied was the best adaptation of the face-to-face classes for distance learning, in comparison with other subjects, this due to the interaction proposal between students in the classroom" [S2].

"This subject added me a lot, both in technical aspects of group work, as well as in my human side. I enjoyed being able to debate about the topics that were proposed." [S3].

Another gain perceived by the students was the feedback sessions after each presentation. Students were encouraged to exercise assertive communication when expressing their perspectives, in addition to encouraging critical thinking by bringing points of improvement to the classmates.

Although the methodology has as a central basis the participation of students to make a feasible network learning, there were challenges in engaging students to actively participate in the seminars. Some indicators, raised through participant observation, were:

a. Few students opened the webcam during classes;
b. At various times allowed for interaction, there was a general hesitation in sharing information, or asking questions;
c. The groups responsible for the seminars did not meetthe improvement's feedbacks (such as: enhancing the theoretical level of the information brought, structuring the presentation in order to have greater interaction and dynamism during the execution).

Furthermore, at the end of the semester, students' individual feedback on the applied methodology was collected. Among the points of improvement brought by the students, the following stand out:

a. The unpreparedness of some students who did not study properly before presenting the content, and consequently, the demand for more lessons from the teacher;

b. Lack of structured guidance on what was expected from the presentation;
c. The methodology was based excessively on the conduct of students;
d. The methodology was not so productive considering the context of the pandemic, due to generalized social stress;
e. Learning differently from those who conduct the seminar compared to those who are watching, resulting in an uneven absorption of content;
f. Although the methodology is active, the dynamics and interactivity between students represented a small portion of the class time, figuring students as passive agents of knowledge;
g. Paying attention to a screen for 2 hours straight causes infoxication, making the learning process tiring;
h. There was an insufficient variety of dynamics brought by the presenters, and even though the themes of each seminar were different, the classes seemed repetitive, as the format used were similar.

IV. DISCUSSION

During the semester, the students' difficulty in taking an active posture in their own learning was evident, since they showed more passivity than expected, comparing to what used to happen during face-to-face classes in this discipline. Due to the atypical nature of the academic semester, which took place during the pandemic, the hypothesis was raised that this occurred due to virtual social conformity [33], which acted in a way to put obstacles for the students' approach.

To analyze the points of improvement that were raised, the data was segmented and grouped. These were arranged in categories [32] defined as shown below.

4.1 Resistance to change

The notes reinforce a predilection for maintaining traditional learning practices. This can be attributed to the fact that active methodologies demand more effort and individual commitment to the construction of their own knowledge.

4.2 Ineffective communication

Much of the online interaction occurs by written communication, viaonline chat. The use of this tool is more objective, having no communicative function of debate. Oral communication, through speeches, which is frequent in classrooms, is rarer when there is a screen, such as a computer or a cell phone. In these conditions, there is a lack of deepening in the discussions raised, in addition to the impediment to the observation of non-verbal communication, leaving gaps in its ratification.

4.3 Group distancing

The pandemic context makes people focus more on themselves than on group work, due to social isolation. However, considering that the methodology demands that the group stimulate the development and good performance of its members, a gap emerges in achieving the desired results. With that in mind, as well as the previously discussed resistance to change, a question appears: how to make students understand the importance of network learning?

In addition to the physical distance, it is observed that students use the screen as a shield to hide and not to be seen by the group. Thus, students remain in the passive position, of one who receives the knowledge, instead of acting on and actively seeking their development.

4.4 Cognitive obstacles

Given the fact that the relationship created with learning itself took place more distantly and passively in the virtual environment, the following questions arise: what are the new strategies for students to develop socio-emotional skills? How to dissolve or mitigate the barriers of integration among students who are physically distant? What nuances of human behavior duringhuman-computer interactions do we need to take into account to adjust the methodology?

There are several questions to ponder about cognition and its influence on online learning, questions that might be answered as current teaching practices consider different contexts such as those being experienced.

V.   CONCLUSION

As social transformations occur, it is necessary to create strategies for the teaching and learning model to follow such changes. In this context, this case study fulfilled the objective of investigating an active learning methodology application, that was adapted for remote teaching, in the discipline of Work Organization in Production, towards analyzing the development of socioemotional skills together with the assimilation of technical concepts and systematization of the CyberSix Learning methodology.

In general, the students considered that the experience added value in the construction of knowledge, especially concerning critical thinking and the development of assertive communication. Comparing to traditional disciplines, the average response of how much they consider they learned in this subject was 4, on a scale from 1 to 5.

However, students' engagement barriers were noted, as well as the lack of an in-depth understanding of the role they should play. Among the classified difficulty points, thesewere found: resistance to changes, ineffective communication, group distance, and cognitive obstacles.

It is noteworthy that the application of the CyberSix Learning methodology was made in only one case and in an adverse external context, which is the pandemic of COVID-19. Hence, as future research, it is indicated to use the methodology in different disciplines and fields of knowledge, and in a post-pandemic context to compare its influence on results.

Therefore, it is suggested that other researchers, who are interested in applying the CyberSix Learning methodology, contact this research team, as a means to contribute to the construction of knowledge collectively and improvement of the method.

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Do Globalization and Economic Development Promote Renewable Energy Use in Ghana?

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Abstract— *The fight against global warming has been a global battle. Environmental sustainability and a sustainable economy have been a concern for many nations, government organizations, and non-government organizations. Therefore, it is highly recommended to investigate the factors that lead to carbon emissions and how the world could overcome them. This study uses GMM and FMOLS to analyze the contribution of globalization which is measured as foreign direct investment and trade openness, economic development, and population growth towards the use of renewable energy. The period under study is from 1990 to 2015. The result of the study indicates trade openness helps promote the use of renewable energy. A 1% increase in trade openness would raise renewable energy consumption by 39%. However, foreign direct investment does not motivate the use of renewable energy, and economic development does not add to renewable energy consumption. Population growth helps promote renewable energy usage. The government of Ghana has to restrict its environmental regulations to protect the environment from foreign investors.*

I. INTRODUCTION

Global warming is one of the most argued environmental issues globally. It is recently believed that the high rising of carbon emissions globally is as the result of globalization and economic development. The international economy continues to experience a consistent rise in carbon emissions, making it problematic to attain the Paris agreement on climate change. Global warming-related to greenhouse gases (GHGs) and energy restrictions are the major threats to the international economy. The greatest contributor of the GHGs is carbon emissions, and it accounts for about 72 percent of the world's emitted GHGs. The World Health Organization 2015 report indicates that energy and fuel used in residential sectors account for 18% of global GHGs. The increase of GHGs global has put both human life and the environment in danger. 2017 was recorded as the year of natural disasters, which covers wildfire, drought, hurricanes, and heatwaves, and the international bodies

lost 31billion dollars. As the result of poverty, dependency on climate for economic activities, and low technological know-how, Africa especially Sub Sahara Africa suffered seriously from the problem (Frimpong, Van Etten, Oosthuzien, Fannam Nunfam, & Studies, 2017).

The role of energy in economic development cannot be undermined. Energy consumption is having tremendous growth in developing countries as a result of industrialization, economic development, and population growth. Energy is seen to be the force behind economic development and is considered as one of the utmost relevant strategic commodities (Sahir & Qureshi, 2007). Energy has influence on pollution of the environment and sustain the environment as well. There has been a rising demand for energy due to globalization. The increase in demand for energy because of globalization has resulted in the search for sustainable energy since the most dependent energy is not sustainable. Fossil fuel is the most dependent energy in many countries, and the increase in energy

demand has resulted in the search for sustainable energy since fossil energy is not sustainable. Kraft and Kraft (1978) is the first study introduced when energy usage and economic development became a concern. The study indicated that economic growth causes the use of renewable energy in the U.S. (Kraft & Kraft, 1978). The result explains that economic development responds to energy used.

The relevance of energy in economic development is appreciated by many. The position of energy in developing and developed economies has caused a rise in demand for energy. The high demand for energy has further raised environmental concerns. Energy is argued as the main contributor of GHGs, which is considered as the main source of global warming. The option onboard is to reduce the usage of fossil fuel and substitute it with renewable energy. Ghana recently has been coupled with the implication of energy and fuel use and promoting environmental quality (Appiah, 2018). However, the fact about the initiative of reducing the use of fossil energy is mixed. The energy conservative policy carries the problem of hurting Ghana's economic development if proper policies are put in place, the other side is it would help reduce the rate of GHG emissions. Energy conservation without proper technological progress would negatively affect the economy (Odhiambo, 2009).

Many studies have supported the argument that renewable energy helps in sustaining the environment and promoting economic activities.Hu, Xie, Fang, and Zhang (2018) research on 25 developing countries to assess the effect of energy usage and carbon emissions from the period of 1996-2012, the result of the research indicates that renewable energy helps control carbon emissions. In addition to this, a study by Bhattacharya, Churchill, and Paramati (2017) on 85 developed and developing nations to assess the effect of renewable energy and carbon emissions indicates that, renewable energy influences carbon emissions reduction and promotes economic growth. Nevertheless, other studies do not appreciate the presence of renewable energy and argue that, both renewable energy and fossil energy influence carbon emissions in the long-term or it has no effect on carbon emissions. Al-Mulali, Saboori, and Ozturk (2015) research on Vietnam indicates that as a result of the low consumption of renewable energy in the country, it has no control on carbon emissions. Apergis, Payne, Menyah, and Wolde-Rufael (2010) based their study on 29 developing countries shows that as a result of a low level of technology, renewable energy influences carbon emissions in the nations understudy.

In the view of Adams and Acheampong (2019), `the contradictions in the result might be influenced by regional income specific differences which are related to political institutions. However, factors that contribute to the use of renewable energy like foreign direct investment, financial development, and trade openness cannot be undermined. Economic development is not of the same level in every country. It differs from country to country, region to region, and continent to continent. These influence on renewable energy usage and effects on carbon emissions is very necessary to acknowledge.

Globalization in the sense of this study is the integration of the global economy through foreign direct investment and trade openness. The recent reduction in taxes and tariffs is as the result of globalization to foster the global economy and increase productivity. The view of the proglobalist indicates a positive effect of globalization on the environment, and the anti-globalist views otherwise. According to World Trade Organization 2018 report, foreign direct investment and trade openness liberation was enhanced from the late 1990s; however, after the 2008 economic crisis, there was a deceleration (Organization, 2018). Foreign direct investment has been recommended to be a key instrument in encouraging economic development and maintain environmental quality. These two advantages have influenced many advocates and analysts to provide for developing countries policy recommendations regarding foreign direct investments (Nsouli & Funke, 2003).

There are two world-recognized hypotheses that explain the relationship between globalization and the environment. The pollution haven hypothesis, which is the first one, explains that the polluting business in the global north relocate to the global south with flexible environmental regulation and at the long-term pollute the environment (Walter & Ugelow, 1979). These companies in the developed countries where environmental regulations are rigid relocate to developing countries where there is no rigid restriction on the environment and find it as the resting place for their pollution. The second is the pollution halo hypothesis which explains that, the host countries normally the global south enjoys positive benefits from trade and foreign direct investment since it is associated with technology transfer and efficient machines with low carbon emissions (Zarsky, 1999). It does not consider globalization as a threat but rather a blessing to the receiving country. The pollution halo further acknowledges the presence of foreign direct investment as environmentally friendly.

Basically, renewable energy like solar and hydro input on carbon emissions is very low as compared to

fossil energy. The international bodies and the concerned individuals are, therefore, encouraging the use of renewable energy as a means to replace fossil fuel to sustain the environment (Shahbaz, Nasreen, Ahmed, & Hammoudeh, 2017). Sub-Sahara Africa countries are endowed with a great abundance of renewable energy, and the investment into the project in renewable energy technologies is basically required for the expansion of their economies. Encouraging the development and the use of clean technologies is a good policy that would help to decrease GHGs to combat global warming (Apergis, Ben Jebli, & Ben Youssef, 2018).

An increase in energy accessibility and protection of the environment has introduced renewable energy development as the mainstream strategy (Hayford Isaac, Wei, & Justice, 2021). Policymakers have embraced the Sustainable Energy for All policy and have enacted the 2011 Renewable Energy Act as a means of supporting the initiative. In the view of Ankrah and Lin (2020), the development of renewable energy is necessary to ensure future energy sustainability and the factors that influenced the use of renewable energy are to be recognized. Renewable energy's impact on carbon emissions has dominated the world's concern due to the environmental pollution and global warming carbon emissions caused. Many studies have researched the effect renewable energy, economic growth, and fossil energy have on carbon emissions (Alkhathlan & Javid, 2013; Alshehry & Belloumi, 2015; Antonakakis, Chatziantoniou, & Filis, 2017; Awodumi & Adewuyi, 2019; Jahangir Alam, Ara Begum, Buysse, & Van Huylenbroeck, 2012). However, to the best of my knowledge and with serious literature review, no study has been done on whether globalization and economic development could help promote the use of renewable energy in Ghana. Renewable energy is seen as the best substitute for fossil energy which is dangerous to the environment. Therefore, in adding to the already existing literature on renewable energy, economic growth, and carbon emissions, this study investigates if globalization which is measured as foreign direct investment and trade openness and economic growth, could increase the demand and use of renewable energy in Ghana. Although (Acheampong, Adams, & Boateng, 2019) researched on globalization and renewable energy in Sub Sahara Africa but the focus was on the effect the variables have on carbon emissions. Nevertheless, this study focus on the effect of globalization on renewable energy. Since this study is the first research towards this direction, it would create awareness on either to appreciate the presence of globalization when the search of cleaner energy is a concern or not. The study would further

provide policy recommendations to policymakers when making policies related to the environment.

The debate for Ghana in respect to renewable energy is its abundance and how the country can develop to provide energy security and access (IRENA, 2015). Policymakers have shown solid commitment with the enacting of the Renewable Energy Act in 2011. This to scale up the use of renewable energy in Ghana, but still, the usage is not impressive. Although the policymakers have expressed their concern towards the use of renewable energy in Ghana by the enactment of the 2011 Act, however, the Act is too generic and short of a comprehensive implementation plan (Ashong, 2016). The Act provides provision for only two major policy measures, which are the Feed-In-Tariff and the Renewable Purchase Obligation. "The Feed-In-Tariff which generates pricing motivations for development and use of renewable energy resources; and the Renewable Purchase Obligation which orders electricity producers to place a compulsory percentage of Renewable Energy Source-Electricity on the grid or pay a determined premium" (Ashong, 2016).

From the figures (1, 2, 3), we could witness a fall in renewable energy usage in Ghana. The best achievement was in the year 1991, and the lowest achievement in the year 2015. This shows that the growth of Ghana's renewable energy usage has been falling, and the rise in some years is not strong enough. Figure 1 gives the relationship that has existed between renewable energy usage and foreign direct investment from 1990 to 2015. The figure shows that, in the years 1994 and 2000, an increase in foreign direct investment caused renewable energy to rise. In the year 2008, there was a sharp increase in both variables. However, renewable energy raised from a sharp fall in 2007. The relationship between the two variables is not constant and unpredictable. The two variables sometimes arise together, fall together, and mostly in the opposite direction.

Figure 2 shows that renewable energy usage and economic growth over the period have experienced opposite directional relationship. The economic growth has been quite constant while renewable energy usage continues to fall. In exception, both variables experienced a sharp fall in 2007 and a sharp rise in 2008, and a sharp fall again in 2009. Figure 3 gives the situation between renewable energy and trade openness from 1990 to 2015. The figure shows in the year 1997. Ghana attained the same point for both renewable energy and trade openness; however, trade openness was rising, and renewable energy usage was falling. Trade openness attained the highest score in the year 2000 and the lowest score in the year 1991. Renewable energy attained the highest score in the

year 1991, where trade openness attained its lowest score and the lowest score in the year 2015.

In the view of Ahmad et al. (2016), trade openness as part of globalization has contributed tremendously to economic development. From the mid-twentieth century, the international economy has massively improved with the credit to barrier-breaking to access the international market, transportation enhancement, international investment, intensive research, and improvement in technology. Energy consumed for the past decades reflects the global economic development today. Energy can be described as the "oxygen" that provides life to all economic activities. In the course for the global south to attain a high standard of living and sustainable economic development, the consumption of energy is at a higher rate. Nevertheless, global warming as the result of environmental pollution is associated with energy consumption (Alkhathlan & Javid, 2013).

The rest of the study has been structured as, section 2 provides the methodology, section 3 the results, section 4 the conclusion and policy recommendation
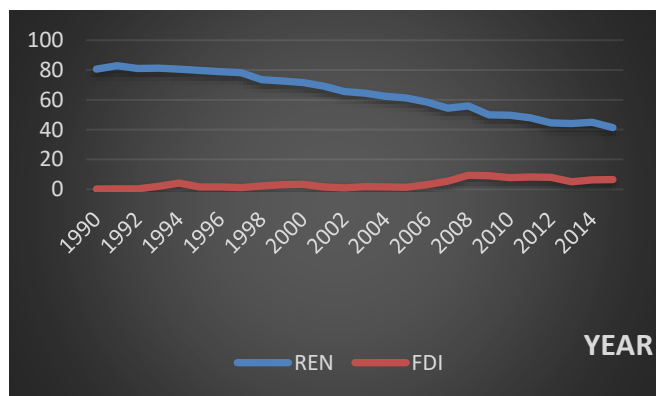
Fig. 1 Renewable energy consumption and FDI
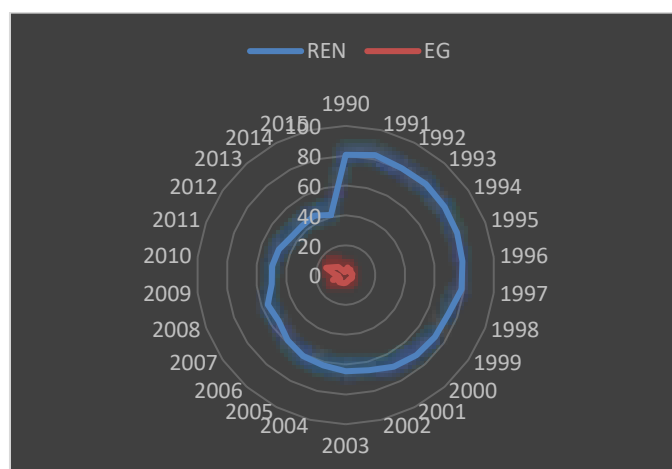
Fig. 2 Renewable energy and economic development
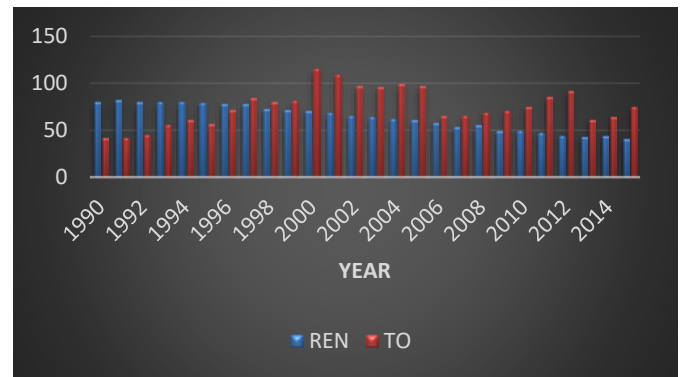
Fig. 3 Renewable energy usage and trade openness

II.   METHODOLOGY

This research follows the empirical model of (Acheampong et al., 2019) and (Shahbaz, Balsalobre-Lorente, & Sinha, 2019) to analyze the effect of foreign direct investment, economic development, population growth, and trade openness on renewable energy. Renewable energy is represented as ($\ln ren$), foreign direct investment ($\ln fdi$), economic development ($\ln eg$), population growth ($\ln pg$), and trade openness ($\ln to$).

$$\ln ren_{it} = \alpha_1 + \alpha_2 \ln to_{it} + \alpha_3 \ln eg_{it} + \alpha_4 \ln pg_{it} + \alpha_5 \ln fdi_{it} + \varepsilon_{it}$$

Where i =1-26, t = time (1990 to 2015), α_1 - α_5 are the coefficient and ε is the error term.

2.1. Data

The data for this study is from the year 1990-2015 for Ghana, which was obtained from World Bank Indicators (WBI). The renewable energy consumption is measured as total renewable energy consumption without fossil fuel and represent the dependent variable, FDI is measured as foreign direct investment net inflows % of GDP, GDP is measured as annual GDP growth, trade openness is measured as total import and export activities % of GDP, and the population is measured as population growth annual percentage. Table 1 contains summary of description and statistics of the used variables

Table 1. Descriptive statistics

	ln *ren*	ln *eg*	ln *pg*	ln *to*	ln *fdi*
mean	4.1418	1.6012	0.9334	4.2957	0.9106
median	4.1754	1.5371	0.9172	4.3010	0.9703
maximum	4.4180	2.6424	1.0633	4.7540	2.2478
minimum	3.7236	0.7785	0.8193	3.7492	-1.3811
Std. deviation	0.2293	0.3967	0.0702	0.2741	1.0438

III. RESULTS

Table 2 presents the correlational relationship that exists among the variables. Renewable energy usage has a strong positive correlation with population growth (0.7498). However, renewable energy has a negative correlation with the rest of the variables. It has a strong negative correlation with foreign direct investment (-0.7479) and a weak negative correlation with economic development and trade openness (-0.3214, -0.2600), respectively. Foreign direct investment has a moderately strong negative correlation with population growth (-0.6299) and a weak positive correlation with trade openness (0.3682). Population growth has a moderately strong negative correlation with trade openness (-0.6919), and economic development has a weaker positive correlation with trade openness (0.1783).

Table 2. Correlation

	ln *ren*	ln *eg*	ln *fdi*	ln *pg*	ln *to*
ln *ren*	1				
ln *eg*	-0.3214	1			
ln *fdi*	-0.7479	0.3292	1		
ln *pg*	0.7498	-0.1202	-0.6299	1	
ln *to*	-0.2600	0.1783	0.3682	-0.6919	1

Table 3 presents the empirical result for GMM. The coefficients of all the estimated variables are in natural logarithms; therefore, its interpretation should be based on long-term elasticities. The result indicates that the presence of foreign direct investment, which is one of the globalization variables, does not influence the use of renewable energy in Ghana under the period of study. Foreign direct investment has a negative and significant influence on renewable energy usage. In another sense, if the presence of foreign direct investment does not promote the use of renewable energy, then it causes carbon emissions in Ghana. The result supports the pollution haven effect, which states that the presence of foreign direct investment caused environmental pollution in the receiving countries. This is as the result of flexible environmental regulations in the receiving countries, which makes foreign firms relocate with their high environmental unfriendly businesses to the receiving country. The result of this study is supported by (Salahuddina, Alam, Ozturk, & Sohag, 2017; Shahbaz et al., 2019), which had the same result in their analysis that,

foreign direct investment causes carbon emissions since it does not promote the use of renewable energy which is environmentally friendly. The other variable for globalization is trade openness, and the result indicates that trade openness promotes the use of renewable energy. The result shows that trade openness helps mitigate carbon emissions since it promotes the use of renewable energy. The increase in exports and imports helps enhance the use of renewable energy in Ghana. It provides the platform to import technologies needed for renewable energy usage and further improves economic activities, which provides a platform for renewable energy usage expansion. The result is supported by (Shahbaz, Hye, Tiwari, & Leitão, 2013), which provides proves to support the argument, trade openness mitigates carbon emissions. Research on Brazil indicated bidirectional causality among trade openness and the energies which was understudy. Meaning in the long-run, both trade openness and energies cause the increase of either other (Hdom & Fuinhas, 2020).

The result of the study further shows that population growth in Ghana causes the use of renewable

energy. Ghana, over the period of understudy, has experienced a fall in its population growth, and it has contributed positively to its renewable energy usage. This means population growth has a role to play in the transition from fossil fuel to renewable energy. The population has to be controlled to meet the energy available after the energy conservation policy. The result is in support of (Begum, Sohag, Abdullah, & Jaafar, 2014) that population growth helps mitigate carbon emissions. Ghana's population is controlled by family planning, and the use of contraceptives. Economic development in Ghana has no effect on renewable energy usage. The result indicates that, Ghana's economy has not grown enough to promote the use of renewable energy. There are other

studies that state that economic development causes carbon emissions (Malik et al., 2020; Ridzuan, Marwan, Khalid, Ali, & Tseng, 2020). However, it is not so for Ghana. Saidi and Hammami (2015) research on 58 countries indicated that, economic development has a significant and positive influence on energy. A study on Egypt indicated a bidirectional effect between renewable energy electricity and economic development (Ibrahiem, 2015). Research on India by (Ahmad et al., 2016) indicated a bidirectional relation between energy and economic development. According to (Appiah, 2018) research, it indicated that energy consumption influence economic development in Ghana but not vice versa.

Table 3. GMM

Variable	Coefficient	Std. Error	t-Statistic
$\ln eg$	-0.0984**	0.0486	-2.0245
$\ln to$	0.3908*	0.0799	4.8888
$\ln pg$	2.9906*	0.3487	8.5762
$\ln fdi$	-0.0568**	0.0261	-2.1733
R^2			0.800599
Adjusted R^2			0.762618
J-statistic			5.328139

3.1. Robustness Check

3.1.1. Alternative estimator

There is no problem of endogeneity when GMM is used for estimation. The GMM is capable of checking and controlling all the endogeneity and arbitrary heteroscedasticity in any unknown form (Baum, Schaffer, & Stillman, 2003). In other to certify the firmness of the

result, we used the FMOLS estimation technique, which the result has been presented on table 4. We used the FMOLS as part of the robust check. The results of the FMOLS did not contradict or overturn the result we got for IV-GMM regarding the signs and percentage-wise. The result of the GMM is the same for the FMOLS indicating that, there is no problem with the model used and its outcome.

Table 4. FMOLS

Variable	Coefficient	Std. Error	t-Statistic
$\ln eg$	-0.1450**	0.0652	-2.2256
$\ln to$	0.4995*	0.1278	3.9083
$\ln pg$	3.1031*	0.5809	5.3418
$\ln fdi$	-0.0815**	0.0332	-2.4543
R^2			0.8037
Adjusted R^2			0.7644
Sum squared resid			0.2454

IV.   CONCLUSION AND POLICY RECOMMENDATION

4.1. Conclusion

Energy is considered as the "oxygen" for economic development. Every nation depends on energy for its economic prosperity and continuity. Therefore, it very important to examine the factors that promote the use of renewable energy and make policy recommendations for the development of Ghana's economy. The study uses GMM to assess whether population growth, economic development, and globalization which is measured in foreign direct investment, and trade openness promote the use of renewable energy. The result of the study indicates that, foreign direct investment and economic development do not promote the use of renewable enable energy in Ghana. However, trade openness and population growth promote the consumption of renewable energy. To affirm the result, FMOLS was used as a robustness check, and the result from the FMOLS confirms the results from GMM. The signs and the percentages are all the same. In other to promote environmental and economic sustainability in Ghana, policy recommendations have been provided.

4.2. Policy recommendation

Based on our study, the result indicates that, trade openness promotes the use of renewable energy in Ghana. Therefore, the government should take advantage of the implication trade openness has on the environment to expand its market. The expansion of the market would facilitate the renewable energy usage increase and enhance economic development. Through importation and exportation, Ghana could benefit from technology transfer. In this respect, companies could import low carbon technologies to enable the reduction of carbon emissions, and companies could further import machines that could facilitate the use of renewable energy in production. The government of Ghana has to provide tax-free incentives to encourage companies to import renewable technologies and use renewable energy in their production. Population growth, according to our study result, promotes the use of renewable energy. Ghana, over the past decade, has experienced a fall in its population growth and its effect on the environment is good for environmental sustainability. Policies like the use of contraceptives and family planning have been working for Ghana, and the government should continue with education to enlighten the citizens on the need for population control.

Foreign direct investment does not motivate the use of renewable energy in Ghana. The result of our research indicates that, foreign direct investment has a negative effect on renewable energy usage. This might be as the result of flexible environmental regulations. The government should pay more attention to environmental laws and restrict their regulation. Although, many nations depend on foreign direct investment for economic growth but we should not undermine its effect on the environment.

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An Assessment on the Test Anxiety and Academic Performance of Information Technology Students

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Abstract— *In humans' daily life, people experience different levels of anxiety. Some experiences a low level of anxiety, others experience incredibly high. Anxiety significantly affects people in different forms. Higher education students experience anxiety attributed to different factors and one of which includes test anxiety. This study sought to describe the test anxiety among the Information Technology (IT) students and assess if test anxiety has a significant relationship to students' academic performance. The researchers applied a descriptive-correlational design to describe the IT students' test anxiety and test the relationship of the variables under investigation. The researchers adopted an instrument for this study. This study was conducted in a State University in Nueva Ecija, Philippines. A total of 394 students enrolled in an IT Major Course during the second semester of the academic year 2019-2020 voluntarily participated as respondents for this study. Results revealed that IT students have "somewhat typically" experienced test anxiety (WM = 2.734). Moreover, results showed that test anxiety among IT students has a significant positive relationship to their academic performance (p-value = 0.000, r = 0.347). Researchers suggest utilizing the positive effect of test anxiety in learning IT courses in order for students to improve their academic performance continuously.*

I. INTRODUCTION

Every day, human experiences different levels of anxiety. Anxiety may be caused by foreseen or unforeseen events, contributing to how humans behave and perform. Anxiety is a subjective feeling wherein one feels tension, uneasiness, disquiet, and worry caused by the stimulation in the nervous system (Spielberger, 1983). Students with an anxiety disorder may exhibit a lack of interest in learning, poor academic performance, and low academic motivation levels (Vitasari et al., 2010). However, an average level of anxiety helps sustain hard work (Dawood, 201), which may positively affect student attitude towards learning. Thus, students tend to exert more effort and work hard towards achieving a better outcome.

Students in higher education experience anxiety caused by different factors, and it has been acknowledged by students and educators (Vitasari et al. 2010). Most of the time, undergraduate students' anxiety has negative effects on their personal, social, and academic performance (Zahrakar, 2008). Anxiety constitutes poor performance among students, which has been one of the major predictors of academic performance (McCraty, 2007 and McCraty, et al., 2000). Anxiety has facilitating and debilitating effects on academic achievement (Ibrahim, 1996). It causes students to exhibit mixed attitudes about learning, particularly in taking tests.

Over the years, several studies have been conducted to explain the relationship between academic performance

and anxiety from different contexts (Dawood et al., 2016, Vitasari et al., 2010). The researchers conducted this study involving computing students only. Only a few studies focused on assessing the test anxiety of Information Technology (IT) and academic performance in a computing course.

This study aims to assess the level of test anxiety among undergraduate students enrolled in the Information Technology program and its relationship to their academic performance. Specifically, it seeks to answer the following:

1. How may the demographic profile of the respondents be described in terms of Sex and Age;
2. How may the test anxiety among IT students be described; and
3. Is there a significant relationship between test anxiety and the academic performance of the IT students?

II. METHODOLOGY

This study utilized the descriptive-correlational design of research to describe the test anxiety among the IT students and know whether it significantly relates to their academic performance. The researchers intended to employ the total sampling technique. Of the 411 students enrolled in an IT Major Course, 394 voluntarily served as the respondents for this study during the second semester of the academic year 2019-2020, where the pandemic had started. The number of respondents constitutes a 1.01 confidence interval. Thus, the result can be representative of the entire population.

The instrument used to assess the test anxiety of the students was consist of two parts. The first part covers the demographic profile of the respondents, including their sex and age. The second part of the instrument consisted of 10 items based on Ubaka et al. (2015). However, the researchers revised the second part of the instrument's contents to suit the context and needs of this study. To ensure that the instrument was valid and reliable, the researchers performed content and face validity. Reliability analysis was also conducted to check the items included in the instrument. Table 1 shows the result of the reliability analysis.

Table 1: Reliability Analysis

Instrument	Cronbach's Alpha	No. of Items
Test Anxiety Questionnaire	0.861	10

After ensuring that the instrument was valid and reliable, the researchers performed data gathering. Due to

the pandemic, the researchers were not able to personally handed-out the survey questionnaire. However, they made sure that the instructions in the instrument were clear and easy to understand. Using Google Forms as a medium, the researchers sent them out to the respondents. The respondents were assured that the researchers only used the data collected for this study.

Table 2 presents the scoring rubric for test anxiety.

Table 2: Scoring Rubric for Test Anxiety

Range	Verbal Interpretation	Verbal Description
4.60 – 5.00	Very typical of me	The IT students experience a very high possibility of test anxiety.
3.60 – 4.59	Fairly typical of me	The IT students experience a high possibility of test anxiety.
2.60 – 3.59	Somewhat typical of me	The IT students experience a possibility of test anxiety
1.60 – 2.59	Not very typical of me	The IT students experience a rare possibility of test anxiety.
1.00 – 1.59	Not at all typical of me	The IT students experience no possibility of test anxiety.

After successfully collecting the data, the researchers coded, entered, cleaned, and analyzed them using SPSS version 23. Frequency distribution, percentage, and weighted mean score were used for the descriptive statistics, while a correlation test was used to understand the relationship between the variables.

III. RESULTS AND DISCUSSION

1.1. The Demographic Profile of the Respondents

Of the 394 respondents, Fig. 1 shows that 280 males and 114 females enrolled in the course. Two hundred eighty students constitute 71.1%, while 114 represents 28.9% of the respondents. There is a 42.2% difference in terms of sex, implying a gap exists in the program.
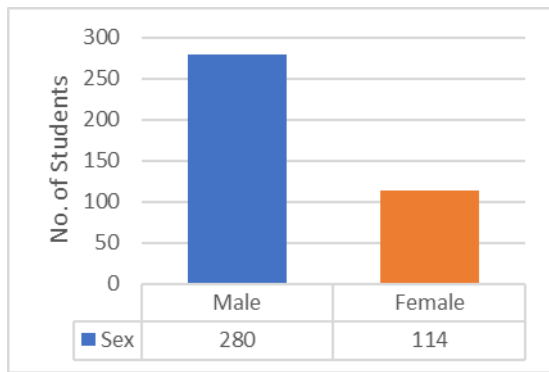
Fig.1: Frequency Distribution of IT students in terms of Sex

On the other hand, Fig. 2 presents the frequency and percentage distribution based on age. Results revealed that respondents were composed of students age 18 (7, 1.8%), 19 (114, 28.9%, 20 (234, 59.4%) and 21 (39, 9.9%).
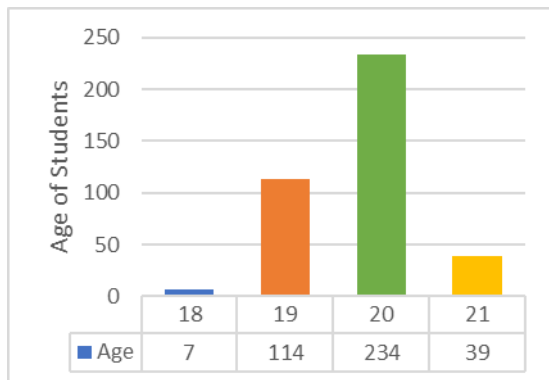
Fig.2: Frequency Distribution of IT students in terms of Age

1.2. Test Anxiety among IT Students

Test anxiety is a psychological condition where students experience extreme distress and anxiety. This occurs before and during testing activities. Symptoms of test anxiety can manifest physically, behaviorally, cognitively, and emotionally among students.

Table 3 presents the Weighted Mean Score Distribution for assessing the level of IT students' test anxiety. Results revealed that before taking tests, students perceived the thought of doing poorly interfere their performance during examination somewhat typical of them (WM=3.023). Meanwhile, it was somewhat typical of them to wish that tests or examinations will not bother them so much (WM =3.211) and that even if they are well prepared to take examinations or tests, they still feel anxious about it (WM =3.282). However, it was not very typical of them (WM =2.360) to feel panic when they have to take an examination.

During examinations, results revealed that IT students somewhat typically get so nervous that they tend to forget information that they already know (WM =2.853), resulting to increase in heart beat which may affect their actual performance in taking the exam (WM =2.934) but not sweating (WM=2.112). Because of this, students tend to think of things which are unrelated to the actual study materials (WM =2.827).

Table 3: Test Anxiety among IT Students

	Items	Weighted Mean (WM)	Verbal Interpretation
1	The thought of doing poorly interferes with my performance on examination.	3.023	Somewhat Typical
2	During an examination, I frequently get so nervous that I forget information I know.	2.853	Somewhat Typical
3	While taking examination, I sweat a great deal.	2.112	Not Very Typical
4	During examination, I find myself thinking of things unrelated to the actual study materials.	2.827	Somewhat Typical
5	I panic when I have to take an examination.	2.360	Not Very Typical
6	After important examination, I am frequently so tense that my stomach gets upset.	2.376	Not Very Typical
7	I usually feel my heart beating very fast during an examination	2.934	Somewhat Typical
8	I usually get very depressed after taking an examination	2.358	Not Very Typical
9	I wish examination did not bother me so much.	3.211	Somewhat Typical
10	Even when I am well prepared for an examination, I feel very anxious about it.	3.282	Somewhat Typical
Test Anxiety Overall Grand Mean		**2.734**	
Verbal Interpretation		**Somewhat Typical**	

Results revealed that IT students do not get depressed about their performance after taking exams while taking the exam (WM =2.358). Students do not also experience that their stomach gets upset as a result of anxiety caused by the exam (WM = 2.376).

Students somewhat typically experienced test anxiety based on the test anxiety overall grand mean of 2.734. However, most of the anxiety felt by the students may be

attributed before taking the examinations. Based on the results, items 1, 9, and 10, which pertain to the circumstances before an actual exam, got mostly "somewhat typical" results. Oxford Learning (2018) affirms that a bit of pre-exam nervousness may negatively impact performance. This nervousness may be attributed to a lack of preparation, motivation, and the drive to achieve better results. Sawchuk (2017) asserts that though little nervousness before taking tests is normal and can further help students sharpen their mind and focus, test anxiety feelings of worry and doubt may lead to lower performance and negative results. In an article, Sawchuk (2017) provided some strategies that may help reduce test anxiety, including learning how to study efficiently and regularly at the same place or area while practicing to take a frequent pre-test to establish consistency and better study habit. It is also suggested that students take time to communicate with their teachers about their lesson to establish better communication channels, clarify lessons, and grasp new concepts through follow-ups. Lastly,

students must relax, eat nutritious food, exercise, proper sleep, and acknowledge that some personal learning disabilities exist and can be improved.

1.3. Relationship between Test Anxiety and Academic Performance of IT Students

Table 4: Relationship between Academic Performance and Test Anxiety

Variables		Test Anxiety	Verbal Interpretation
Academic Performance	r	0.347	Significant Relationship
	p-value	0.000	

*Correlation is significant at the 0.05 level (2-tailed)

In Table 4, the test of the relationship between the students' academic performance and test anxiety has been presented, indicating a significant relationship between the variables *(p = 0.000)*. As reflected, the correlation coefficient *(r = 0.347)* indicates a low positive correlation between the variables. Meaning, there is an observed correlation but minimal. The results imply that anxiety positively affects the IT students' academic performance enrolled in an IT Major Course. According to Dawood (2016), a small anxiety level allows people to work hard further and become more responsible for what they do. In the students enrolled in an IT Major Course, respondents tend to exert more effort and become more responsible for their learning when they feel a minimal or small level of

anxiety. In turn, it positively affects their academic performance.

IV.   CONCLUSION

This study aimed to describe the IT students' test anxiety and its relationship to their academic performance. The descriptive-correlational design was used with 394 respondents who voluntarily participated in this study. Results revealed that the IT students' test anxiety is "somewhat typical" of them to experience. Testing the test anxiety related to their academic performance in an IT Major Course, results showed a significant relationship among the variables under investigation. Results implied that the test anxiety experienced helped the students positively achieve better academic performance.

RECOMMENDATIONS

Based from the results of this study, the following are the drawn recommendations:

1. Replicate the current study and consider involving other students enrolled in different IT course;
2. Inform students of the positive and negative effects of test anxiety and other forms for them to be more aware of how to handle and cope up with them;

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Rigor Index of juvenile cobia (*Rachycentron canadum*): study with anesthesia (eugenol) and hypothermia

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Abstract **-** *Consumers rigorously assess the quality of fishing products, considering mainly freshness and appearance. The slaughter method is an important factor in relation to the freshness of the fish, because it maintains important organoleptic characteristics that will influence the marketing of these products, therefore, in this study an evaluation of the Rigor Index (RI%) of cobia was performed. The following methods were used: in desensitizing with eugenol and hypothermia. Immediately after the slaughter, the monitoring of rigor mortis began. In the method of slaughter with eugenol reached full rigor after 6 hours, and in the method by hypothermia lasted 4 hours. The slaughter method with lower stress showed a significant difference, with a positive influence on the duration of the stages of rigor mortis.*

I. INTRODUCTION

The evaluation of the freshness of the fish can be done through sensory, physicochemical and microbiological methods, but due to the subjectivity of sensory methods and high costs and delays in microbiological tests, the evaluation fish freshness is often made by chemical methods that count the products that enzyme and bacterial activities produce [1]. Some factors such as: postmortem degree of energy exhaustion (*rigor mortis*); physical damage, cleaning and hygiene influence the freshness of the fish [2].

The process of *rigor mortis* is marked by the muscle contraction of an animal after its death, so the animal muscle loses elasticity [1]. It is correct to affirm that *rigor mortis* is a direct consequence of ATP (adenosine triphosphate) present in the body. When ATP concentrations are low, when there is a large energy expenditure before or during slaughter, the stiffness of muscle fibers appears faster because of this ATP expenditure [3]. This ATP expenditure is linked to metabolic anaerobic due to the lack of oxygen availability of the muscle, then moving to the degradation of muscle glycogen to be the main source of metabolic energy. Thus, the muscle starts to produce lactic acid, which comes from glycolysis (glycogen breakage) and hydrolysis of ATP, causing a decrease in muscle pH and a stiffening of the muscle [4].

The period of *rigor mortis* will vary according to each type of species, physiological factors, degree of exhaustion of fish, size, water temperature and cultivation [2]. In addition, the stress associated with the management at the time of slaughter will directly influence the reduction of *rigor mortis* time, consequently, on shelf life.

Over time, the choice of slaughter methods is based almost exclusively on ease of application and those with the lowest cost, and not on those that cause less suffering

[5]. Several behavioral, anatomical, and physiological studies have proven that similarly to birds and mammals, fish could feel pain and fear [6].

The slaughter process of fish can be defined in two stages, the first is the stunned stage, where organisms are sensitized; the second stage is the sacrifice. These two stages can occur simultaneously or in separate actions [5].

Quality slaughter, considered ideal, should be easy and fast to perform, hygienic, in addition to causing the least possible damage to the integrity of the meat [7]. Among the most used, we highlight the techniques of humane slaughter, which use methods of in desensitizing such as termonarcose, bone marrow section, gill sangria, immobilization by electrical impulses, and asphyxia in CO_2.

The use of eugenol is among the most used in desensitizing methods in fish slaughter. In addition to the low acquisition cost [8], the use of eugenol does not cause any harmful effect on fish tissues, thus maintaining the quality of the product [9], and causes rapid deep anesthesia in fish [10]. Therefore, this method, in addition to possibly bringing benefits to the productive chair such as support in logistics and longer shelf life, also ensures a humane slaughter, considering the animal welfare which consumers are increasingly interested in.

As opposed to methods with anesthesia, thermal shock slaughter by immersing fish in cold water is one of the most used for slaughtering fish and is not well accepted in terms of animal welfare, since the loss of function is not immediate, leading individuals to prolonged stress [11].

The cobia, *Rachycentron canadum* (Linnaeus, 1766) is a coastal pelagic species with a large presence in the Atlantic Ocean, which in a natural environment can reach up to 60 kg and measure 2 m in length, which currently has great potential in aquaculture, this potential is given by easy obtaining of spawning in captivity, high fertility, rusticity of the species in addition to the high rate of adaptation to artificial systems, having great commercial capacity in Brazil [12].

The present study aimed to observe the process and determine the rate of *rigor mortis* of the juveniles cobia (*Rachycentron canadum*) created in captivity, comparing the results to two different methods of slaughter.

II.   MATERIAL AND METHODS

The cobias (*Rachycentron canadum*) (Fig. 1) used in the experiment were acquired from the Laboratory of Nutrition and Propagation of Aquatic Organisms (LANPOA) of the Federal Institute of Espírito Santo Campus Piúma.

Fig.1. Specimen of juvenile cobia (Rachycentron canadum) used in the study.

A random sample of 6 specimens was removed from the recirculating aquaculture systems, and were immediately slaughtered. In order to verify the influence of the form of slaughter on the Rigor Index (RI%), two different slaughter methodologies were tested as described in Table 1.

Table 1. Description of the slaughter methods

Method slaughter	Description
Eugenol and bone marrow section	Immersion for 10 minutes in eugenol solution at the ratio of 1.5ml/L and subsequently sacrifice by means of a cross section of the spinal cord immediately after the occipital region.
Hypothermia	Immersion for 10 minutes in water/ice slurry (ratio of 1:1).

After slaughter, the total length of the fish and the weight of each specimen were measured. According to the methodology proposed the Rigor Index (RI%) was measured and calculated according to the equation (1) [13], where D0 is the distance value that separates the base from the caudal fin to the reference point, immediately after death and Dt is the distance value that separates the base from the caudal fin to the reference point at the time intervals selected as illustrated in Fig. 2.

Equation (1):

Rigor Index (RI%) = [(D0 – Dt) / D0] x 100
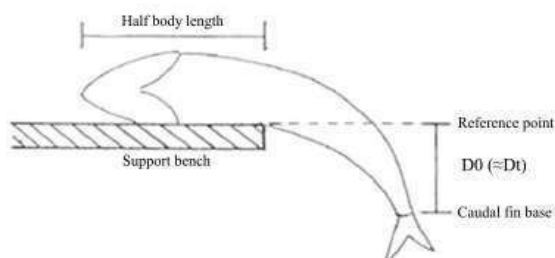
Fig.2. Illustrated adapted from the methodology proposed for the calculation Rigor Index (RI%) [13].

Fig.3. Development curve Rigor Index (RI%) in juveniles cobia (Rachycentron canadum) slaughtered by hypothermia methods and unsensitized with eugenol.

Table 2. Values of the Rigor Index (RI%) between the treatments used for juveniles cobia (Rachycentron canadum) slaughter (n= 46 measurements).

Methods	Rigor Index (RI%)
	means ± SD
Hypothermia	73.66 ± 3.68^{a}
Eugenol	60.31 ± 6.34^{b}

Note: Different lowercase letters indicate statistical difference, ANOVA test, with Post-hoc Tukey's test, $p < 0.05$.

The process of determining the stage of *rigor mortis* began shortly after the slaughter, being measured every 20 minutes. The experiment lasted 15 hours and was carried out at the Ifes Piúma Fish Processing Laboratory. Initial temperature and temperature variation throughout the day were measured with the aid of a portable digital thermometer with an ION© skewer probe with temperature range from -50ºC to 200ºC.

The values of the Rigor Index (RI%) were submitted to statistical analysis of variance (ANOVA) for the significance of 5.0% with Post-hoc Tukey's test, using the program BioStat (AnalystSoft).

III. RESULTS AND DISCUSSION

For the method of slaughter with eugenol and bone marrow section the mean total length of these, it was 23.2 cm and the average weight 61.74g; hypothermia slaughter was 22.9 cm and the average weight of the specimen's equivalent to 68.49g.

In the method of slaughter of fish by hypothermia there was no muscle contraction of the fish for approximately 20 min., the mean D0 was 4.57 cm, *pre-rigor* stage. The process of *rigor mortis* occurred in a growing way and lasted 4 hours to reach *full rigor*, after slaughter. Staying for 4:40 hours in *full rigor*, and then the *post-rigor* stage begins.

The method of desensitizing with eugenol the mean D0 was 4.77 cm, *pre-rigor* stage. The process of *rigor mortis* occurred in a growing way, but more time-consuming reaching *full rigor* after 6 hours remaining for 2:40 hours in *full rigor* and later starting the *post-rigor* stage.

The initial ambient temperature at the site of the measurements was 24.7ºC and ranged from 23.8ºC to 27.2ºC throughout the day. Fig. 3 shows the development of the Rigor Index (RI%) in juveniles cobia in the two slaughter methods.

According to the ANOVA variance analysis, the $p < 0.05$ value was observed (Table 2), that is, there was a significant difference between the two slaughter methods. It can be observed that in the hypothermia slaughter method, the *rigor mortis* begins immediately after the slaughter of the animal, already in the method of desensitizing with eugenol and bone marrow section was delayed for longer compared to the other method.

There are several methods of sacrificing fish, such as: asphyxiation (in air or ice), evisceration, thermal shock (hypothermia), electric shock, immersion in water saturated with CO_2, anesthetics (eugenol), bone marrow section, among others. Since the technique employed at the time of slaughter can slow or even intensify the onset of *rigor mortis* [5][14]. In addition, slaughter is one of the most stressful steps in animal production, its effects can generate undesirable sensory aspects and accelerate the processes of fish deterioration, reducing the shelf life of the product [4].

The results show that the behavioral reactions caused by each treatment end up influencing the initial time of *rigor mortis* thus, we can say that until 6 hours after

slaughter, the cobia sacrificed with eugenol remained fresher in relation to those slaughtered by hypothermia.

According to study the *rigor mortis* predetermines the shelf life of the fish, so if we extend or prolong this process, consequently there will be a decrease in the development of deteriorating microorganisms, ensuring fresh and quality meat [15].

Rigor mortis occurs simultaneously with decreased amount of glucose and ATP present in the fish muscle and together with the degradation of glycogen in lactic acid [4][16], These processes occur quickly when we have an imbalance of homeostasis, the stress generated during the hypothermia slaughter process can generate panic, discomfort and leakage situations, causing fish to use their energy reserves and consequently accelerate the stages of *rigor mortis* [5].

Evaluating tambaqui quality (*Colossoma macropomum*), sacrificed by asphyxiation and kept on ice, the stage of *full rigor* occurred 30 minutes after slaughter [14]. For matrinxãs (*Brycon cephalus*) slaughtered and kept on ice, the stage of *full rigor* occurred at 75 minutes after death [15]. The use of eugenol also showed greater efficacy in reducing post-slaughter strep in the study by [16] with juvenile common snook.

These results show that both methods used in the present study were efficient for cobia slaughter, managing to considerably delay the arrival time in the stage of *full rigor*. However, the use of eugenol presented the best result because it achieved the highest results of the Rigor Index (RI%). Eugenol, in addition to having antiseptic effects it also acts in reducing stress in fish [17][18][19].

The initial period of *rigor mortis*, duration and completion time can be influenced by several factors, such as fish fat degree, species, morphometric data and slaughter methods [4][20]. Knowing the time that the cobia created in captivity enters the stage of *rigor mortis* is fundamental for creating a specific management protocol, aiming at a better use in the stage of fish processing, especially in the production of fillets, because it is essential that during this stage the fish is still in the *pre-rigor* stage, resulting significantly in sensory qualities, such as texture and color of fresh fillets [4][21][22].

This stage can be delayed with the cooling of the fish shortly after its slaughter, increasing the service life and maintaining the quality of the product. In addition, conservation is important because it acts directly in the decrease in microbial actions after the process of *rigor mortis* [20].

A higher RI% value reveals a longer period of the *rigor mortis* process, this increase gives the fish longer freshness time. At 15 hours of the experiment, it was observed that the slaughter by eugenol presented the highest value of the Rigor Index (RI%) (69.76±6.04) then by hypothermia (70.02±2.12).

IV. CONCLUSION

There was a significant difference between the different methods of slaughtering juveniles cobia to determine the Rigor Index (RI%). The eugenol slaughter method showed a delay in the beginning of the *rigor mortis* process, indicating a less stressful methodology positively influences the duration of the *rigor mortis* stages, and consequently the freshness of the fish, enabling better quality products and longer shelf life.

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Thermopluviometric Extremes in the Municipalities Djougou and Ouake

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Abstract— *Climate change is a great challenge of the century, requiring a global response. Climate change is hastening, the poorest and most vulnerable communities are most affected. Forecasting weather and hydrological phenomena is a crucial element in implementing operational management strategies.*

To achieve this, daily temperature and rainfall records from 1951 to 2015 are extracted from the Weather-Benin database. Daily temperature and rain projections (2006-2050) are provided by Climate Analytics. SPI has been used to characterize the magnitude of hydroclimatic hazards. Seven of the twenty-seven indices of the RClimDex software were used to characterize extreme weather events.

It results that the study area is frequently subject to episodes of short droughts (SPI1 and 3). The increase in successive dry days in the municipalities of Djougou-Glazoué is explained by the fact that the slopes (slope) are above 0 and are respectively 0.059; 3,19; 0,48; 0.52 and 0.057 with a significance p-values which values are equal to 0.78; 19,6 ; 0,059; 0,016; 0,82. Similarly, the 99th percentile shows an increase in positive slope and p-value meaning levels of 0.628 and R2 of 0.4%, respectively. These various extreme events increase the vulnerability of communities, producers, households and women farmers' groups.

I. INTRODUCTION

Global warming observed for more than a century affects not only the average temperature, but the entire statistical distribution of temperatures, i.e. the full range of possible temperatures possible at a place and time (J.CATTIAUX, 2020, p.2)

According to the IPCC's Fifth Assessment Report (2017), climate change is expected to increase climate risks in many regions, mainly in low-income developing countries, over the course of the 21st century, compared to a baseline situation without climate change. The most vulnerable sectors identified by the IPCC (2007b) include agriculture, food and water. Sub-Saharan Africa is likely to suffer most not only in terms of reduced agricultural productivity and increased water insecurity (B.O. Elasha, 2009, p 4) but also from increased exposure to coastal floods, extreme weather events and increased risks to human health.

Extreme weather events weaken affected vulnerable households by destroying their livelihoods, reducing their purchasing power and weakening their resilience already reduced by structural factors such as poverty, limited access to basic services and volatile food prices (FAO, 2011, p.7). The capacity of local people and governments

to cope with natural disasters remains relatively low, and extreme weather events that increase in frequency and impact in the context of global climate change are direct threats (FAO, 2011, p.7).

The identification of extreme events is needed so as to help decision-makers in all sectors of activity assess the consequences of climate change or implement adaptation measures.. Predicting extreme weather and hydrological events that could lead to floods and droughts is a crucial element in anticipating, preparing for, and implementing individual and collective measures to ensure people's safety and property at the local level. That's why this research aims to analyze the rainfall extremes triggering extreme events in the Municipalities of Djougou and Ouaké.

II.   INTRODUCING THE STUDY ENVIRONMENT

The Municipalities of Djougou and Ouaké lie between 9-20' and 10-20' north latitude and between 1-20' and 2'10' of east longitude and extend over an area of 5466 km2 (Figure 1). The communal doublet is limited to the north by the Municipalities of Ouassa Péhunco and Copargo, to the south by the Municipality of Bassila, to the east by the Municipality of Tchaourou , Sinendé and N'dali and the west by the Republic of Togo.
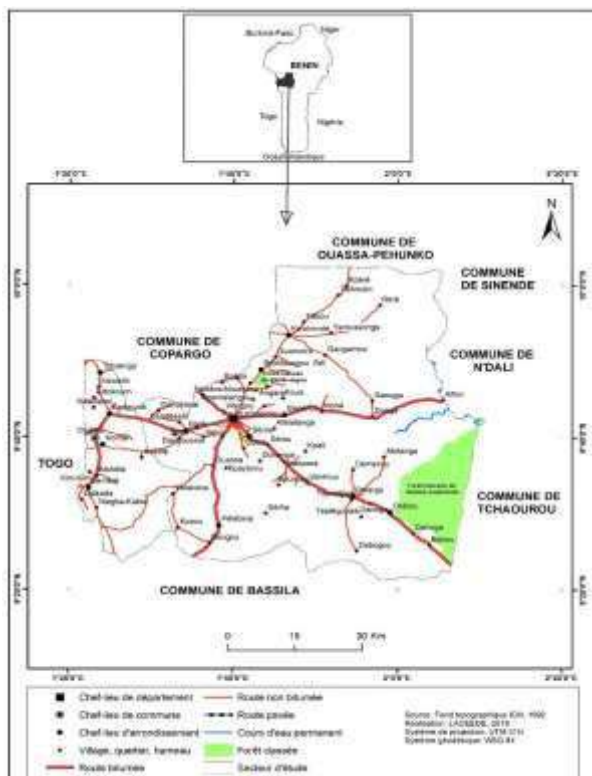
Fig 1: Geographical and administrative locations of Djougou and Ouaké

The climate in the municipalities of Ouaké and Djougou is of the Sudan-Guinean type, with an alternation of two seasons: a dry season from mid-October to mid-April followed by a rainy season covering the period from mid-April to mid-October. The precipitations, often random, range from 800 mm to 1300 mm and can reach or exceed the remarkable height of 1500 mm. The months of August and September are usually the wettest months of the year.

At pedagogical level, soils are largely ferruginous (lasterine soils, gravel, stony) low in humus and shallow on which the vegetation cover is essentially shrub or tree savannah. The most common species are: shea (V*ittelaria paradoxa*), nere (*Parkiabiglobosa*), baobab (*Adansoniadigitata*) and prowler (*Borassus aethiopium*); acacia spp, Burkeaafricana. Favourable crops on these soils are: cotton (*Gossypium sp.),* peanut (Arachishypogaea), maize (Zeamays); mil (*Panicum miliaceum*), sorghum (*Sorghumbricolor*), yam (*Dioscorea spp.*) and cassava (*Manihot esculenta).*

III.   METHODOLOGICAL APPROACH

3.1- Data used

The climatic variables used in this study are mainly temperature records and rain heights at the daily time of 1951 to 2015 extracted from the Weather-Benin database. Future climate projections of daily temperature and rain (2006-2050) provided by Climate Analytics. These climate projections based on four regional climate models (RCM) for the RCP4.5 emission scenario were provided for the analyses. The GCM-RCM combinations considered in this study include MPIESM-REMO, HADGEM2-CCLM4, ECEARTH-RACMO and IPSL-RCA under RCP 4.5 scenario.

3.2- Method of characterizing climate extremes

3.2.1- Standardized Precipitation Index (SPI)

The SPI index was designed to quantify precipitation deficits at multiple time scales. The standardized precipitation index is a statistical indicator that assesses or characterizes the magnitude of hydro climatic hazards in a series of data (Mckee et al., cited by H. Koumassi (2014, p. 83). It quantifies the difference in precipitation over a period, deficit or surplus from historical average precipitation in a series of historical data. To characterize the magnitude and intensity of weather droughts, very simple and effective weather drought indices such as the standardized precipitation index are used (C. Faye et al.; 2017, p.3). The standardized index is based on the equiprobability of transformation of rain values, aggregated to k-month in normal standard values, with k

generally set according to the objectives of the analysis (e.g., k - 1, 3, 6, 9, 12, 24, 36 months). For Nora et al (2017), the SPI index offers good flexibility of use: it can be calculated for multiple time scales and when it covers a relatively short period of time, between 1 and 3 months, for example, the SPI index can quickly detect and assess drought situations. According to McKee et al. (1993); Guttman (1998) taken over by Koumassi (2014, p.85), PPIs are based on the definition of a threshold for whether or not to declare a dry or wet year. It is obtained using the WMO's SPI SL_6 software (2012), available on http://drought.unl.edu/MonitoringTools/DownloadableSPI Program.aspx: The calculated SPI indices are interpreted according to the classes in Table I

Table I: Grades and interpretation grid of SPI showing damp periods.

SPI grades	Interpretation grid
2 and more	*Extremely wet*
1,5 to 1,99	*Very wet*
1 to 1,49	*Moderately wet*
-0,99 to 0,99	*Close to normal*
-1 to -1,49	*Moderately dry*
-1,5 à -1,99	*Very dry*
-2 and less	*Extremely dry*

Source: Mckee et al., (1993)

3.2.2- Method of characterizing other extreme indices

The variability of extreme weather events is highlighted in this study by calculating the indices of the RClimDex software. This software contains twenty-seven indices suggested by the team of Experts on Climate Change Index Detection (Expert Team on Climate Change Detection Indices ETCCDI). Detailed descriptions of these indicators and the RClimDexs software are available on the web of the ETCCDI (http://cccma.seos.uvic.ca/ETCCDMI/software.shtml). In this study, 7 indices were calculated including five (05) of extreme precipitation (table II). The remaining two (02) indices were devoted to minimum and maximum temperatures.

Table II: Climate Extremes Indixes

Acronyms	Precipitation Indices
SPI	*Standardized Precipitation Indices*
CDD	*Consecutive Dry Days*
CWD	*Consecutive Rainy Days*
SDII	*Simple Intensity of Rains*
R95p	*rainy days*
R99p	*Extremely rainy days*
Temperature indices	
TXx	*Maximum of Tmax*
TNx	*Maximum of Tmax*

Source :
http://cccma.seos.uvic.ca/ETCCDMI/software.shtml

IV. RESULTS

4.1- Descriptive statistics of the evolution of climate indices

Table III presents statistical results of changes in climate indices in the Municipalities of Djougou and Ouaké

Table III: Statistical results of the change in minimum and maximum temperature in the project's target municipalities

Variables	p-value	R2 (%)	Pente (slope estimate)
TMax	0	55,2	0,026
TMin	0	36,3	0,015
CDD	0,059	6,6	0,484
CWD	0,398	1,4	-0,518
SDII	0,73	0,2	-0,007
R95p	0,407	1,3	-1,213
R99p	0,628	0,4	0,432

4.2- Evolution of standardized rainfall indices

Figure 2 shows the evolution of standardized rainfall indices.
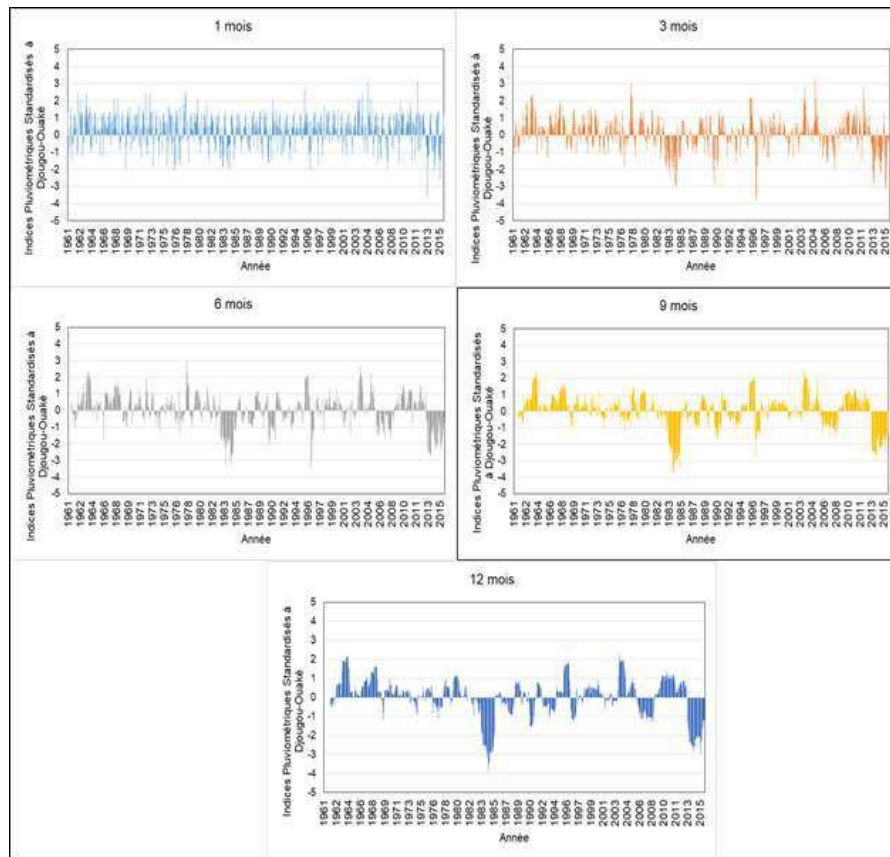
Fig 2: Rainfall Indexes Standardized in Djougou and Ouaké for 1 month, 3 months, 6 months, 9 months and 12 months with SPI_SL_6 (WMO, 2012)

The analysis of Figures 2 shows that as the time rate increases from 1 month to 12 months, there is an aggregation of information that could better characterize dry and wet periods in the municipalities. Thus, the originality of the analysis of rainfall indices with the approach of the SPI_SL_6 model of the WMO (2012) aims to disaggregate information relating to the characterization of standardized rainfall indices. Indeed, the analysis of the figure (2) indicates that in the target municipalities are more affected by drought episodes of 1,

3 and 6 months. This reflects the predominance of negative values recorded in SPI, 3 and 6. One could therefore conclude that women's groups are more affected by episodes of short-term droughts.

To better assess drought events, changes in maximum and minimum temperatures were calculated. Figure 3 presents statistical results of the evolution of the minimum and maximum temperature in the project's target municipalities.
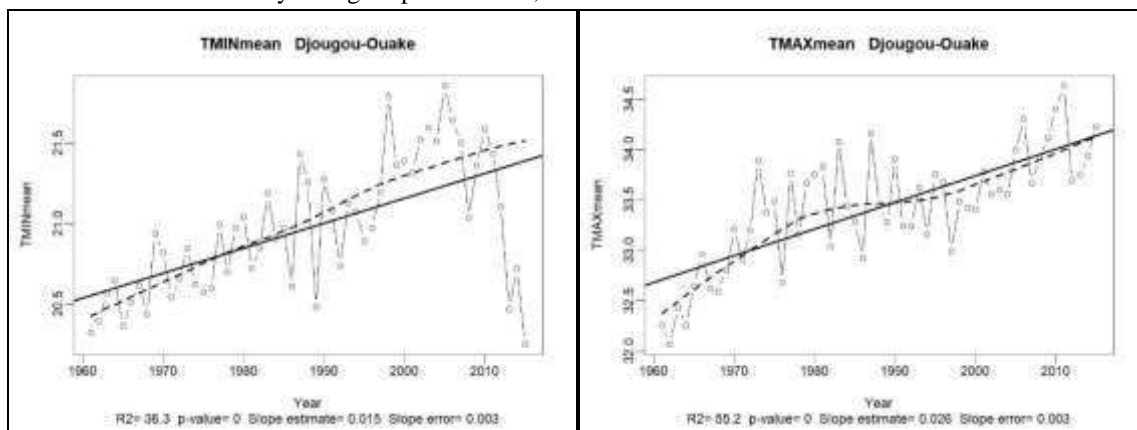
Fig.3: Interannual evolution of light and maximum temperature in Natitingou

Figure 3 shows that minimum and maximum temperatures show variability throughout the series with an upward trend in both municipalities. Minimum and maximum temperatures are actually rising in the various municipalities over the period 1961 to 2015. This is justified by the fact that the slope or value of the directing coefficient of the right equation is positive or even higher and significant for p-value = 0. This is justified by the fact that the R^2 coefficient of maximum temperature determination is less than 40% in the municipalities of Djougou-Ouaké. Considering the values of the R^2 coefficient of minimum temperatures, this research indicates that they are above 50% in the municipalities of Djougou-Ouaké. Since the increase in temperature has been a global phenomenon in recent decades (IPCC, 2018), it can therefore be attributed to the high anthropoisation and forms of land use, to deforestation especially in the municipalities of Djougou-Ouaké at the expense of cotton cultivation. However, plant cover plays a very important role in regulating ambient atmospheric temperatures and carbon sequestration that mitigates global warming (Weissenberger and Silva 2010, p.14). As for Ozer and Perrin (2014, p.11), rising temperatures can lead to risks to the agricultural calendar and food security problems. It should be remembered that the increase in temperature in the municipalities concerned are the source of extreme climatic events, including drought and floods that occur in these municipalities and make vulnerable human and environmental systems, and water-dependent activities against which women are most affected.

4.3- Evolution in the number of consecutive rainfall

Figure 4 illustrates the variability of consecutive dry days from 1961 to 2015 in the municipalities of Djougou and Ouaké.
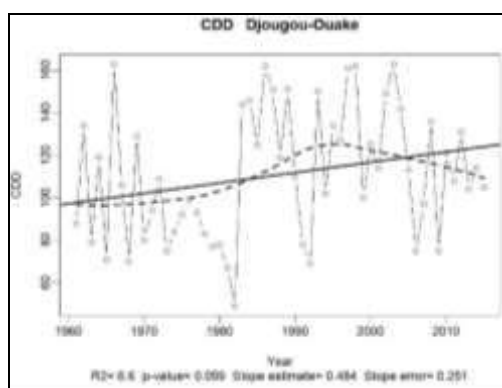
Fig 4: Consecutive Dry Day Variability (CDD) in project target municipalities from 1961 to 2015

The increase in consecutive dry days in the municipalities of Djougou-Glazoué is explained by the fact that the slopes (slope) are above 0 and are 0.059 respectively; 3,19;

0,48; 0.52 and 0.057 with a significance of the value of the value of which in the following order are: 0.78; 19,6 ; 0,059; 0,016; 0.82. However, the R^2 values are not greater than 15% in the rainfall data of these municipalities. However, increased dry days can lead to heat waves, rainfall recession, water stress and desiccation and loss of pasture and the proliferation of diseases including much more infections observed in women. Rainfall data analysis shows a decrease in consecutive dry days (positive slope and above 0 with a meaning of 0.059 and 6.6, respectively). This confirms and explains this upward trend.

4.4- Evolution of consecutive rainy days (CWD) in target municipalities from 1961 to 2015

Figure 5 shows the evolution of consecutive rainy days in the municipalities of Djougou and Ouaké. Thus, the analysis of this figure 5 shows that, just like consecutive dry days, consecutive rainy days in municipalities vary in time and space.
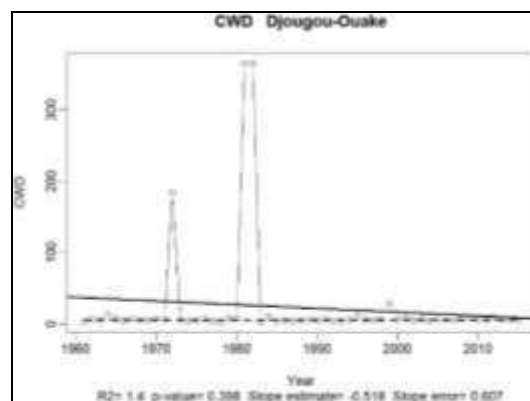
Fig 5: Consecutive Rainy Day Variability (CWD) in project target municipalities from 1961 to 2015

Statistical data including slopes relating to the guiding coefficient of the linear regression line, below zero with meaning of p-values equal to 0.752; 0; 0.398 corresponding respectively to the municipalities of Adja-Ouèrè, Athiémé, Djougou-Ouaké confirm that these municipalities are facing the decrease in consecutive rainy days, with R^2 values ranging from 1.4. In the same context, Houndénou and Hernandez (1998, p.27), had previously reported that the decrease in rainy days can generate a significant decrease in heavy rains and a relative increase in low and moderate precipitation marked by a late start and an early end of the season rains. This situation is not without consequences for the agrarian landscape and agro ecological areas in which these municipalities are located.

According to Agossou (2008) and Koumassi (2014), excess rain is likely to induce risks of flooding, erosion in

an anthropogenic environment, or in flood plains where people engage in agricultural activities, pastoralism, processing of agricultural products.

4.5- Evolution of the daily rain intensity index (SDII) in municipalities

Figure 6 shows the evolution of daily rain intensity (SDII) in the project's target municipalities.
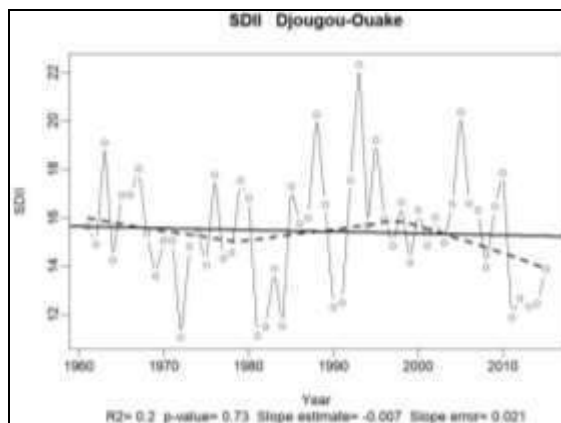
Fig 6: Variability in the Daily Rain Intensity Index (SDII) in the project's target municipalities from 1961 to 2015

The analysis of Figure 6 shows that the daily rain intensity index varies from year to year and they are either up or down in some municipalities. From 1990 on, an increase in the daily intensity of rain was observed in both Communes. These findings had already been made by H. Koumassi (2014) in the Sota watershed at the Coubérie outlet in northern Benin. Other authors such as E. Amoussou et al.,(2014,p.334); J. Kodja et al., (2018) indicated that this rise in daily rainfall intensity indices is related to the rainfall recovery recorded from the 1990s in sub-Saharan Africa including Benin.

Indeed, the increase in the daily intensity of rain observed in this study is explained by the fact that statistical analyses illustrate that the slope or slope corresponding to the direction coefficient of the linear equation right are on the one hand above zero with a meaning of p-values of 0.73. This has implications for societal issues in the various municipalities which increases the vulnerability of communities, producers, households and women's groups that invest in agro-pastoral activities.

4.6- Evolution of the corresponding rainfall heights to the 95th percentile in the target municipalities from 1961 to 2015

Figure 7 shows the evolution of the rain heights that correspond to the 95th percentile of rain in the municipalities of Djougou and Ouakéde 1961 to 2015
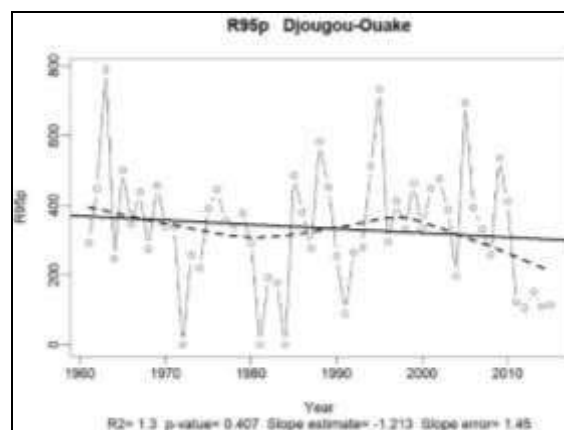
Fig.7: Variability in rainfall heights corresponding to the 95th percentile in target municipalities

The 95th percentile rainfalls are the characteristic rains of heavy rainfall events (Karl et al., 1999; Frich et al., 2002). Indeed, the analysis of Figure 7, leads to say that the heights of 95th percentiles show an upward trend in the Djougou-Ouaké. This can be attributed to the perverse effects of global warming. Very strong rain events are on the rise in the municipalities. The value of the R2 is 1.3%. Statistical information confirms that the rainfall heights associated with the 95th percentile of rain are decreasing. This decrease is illustrated by the negative slope with a meaning of p-values equal to 0.017 in the municipalities of Djougou and Ouaké.

4.7- Evolution of the corresponding rainfall heights to the 99th percentile in the target municipalities from 1961 to 2015

Figure 9 shows the variability of the rain heights of the 99th percentiles of rain.
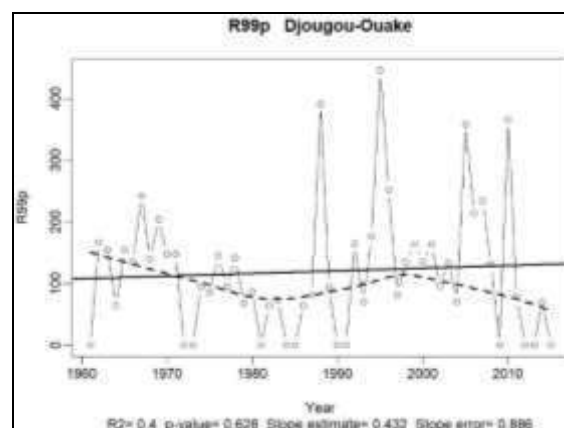
Fig.8: Variability in rainfall heights corresponding to the 99th percentile in target municipalities

The 99th percentile rainfall is the corresponding rainfall to extremely strong rainfall events. Thus, from the analysis of

Figure 8, it should be said that these extreme rain events show an upward trend in the municipalities of Djougou and Ouaké. The descriptive statistics clearly illustrate this increase by positive slope and levels of value significance of 0.628 and R2 of 0.4%, respectively. Of course, this situation is not without repercussions on human and environmental systems in the context of global changes where it is the rainfall accumulation associated with the various forms of land occupation that contribute to the outbreak of floods as in the intervention municipalities of this project.

V.   CONCLUSION

The intensity and increasing frequency of extreme events affecting the world is only one aspect of the impact of climate change. Extreme weather events make us aware of the complexity of the effects of climate change and our differential vulnerability to extreme climate risks. Knowledge of rainfall extremes in the Municipalities of Djougou and Ouaké is a decision-making tool for decision-makers at various levels. These indices will make it possible to anticipate, prepare for the crisis and implement local measures.

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Intrusion Detection System in Software Defined Networks using Machine Learning Approach

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Abstract— *Now a days, Network Security is becoming the most challenging task. As a result in the growth of internet, the attacks in the network has also been increased. This can be hold back by the intrusion detection system, it identifies the unwanted attacks and unauthorized access in the network. The comprehensive overview of the detailed survey is analyzed with the existing dataset for identifying the unusual attacks in the network. Here machine learning classification algorithms is used to detect several category of attacks. The machine learning techniques can result in higher detection rates, lower false alarm rates and reasonable computation and communication costs. In this paper KDD cup99 is used to evaluate the machine learning algorithms for intrusion detection system. Here we have implemented the experiment on intrusion detection system which uses machine learning algorithms like Naïve Bayes and k-means clustering algorithm.*

I. INTRODUCTION

Software Defined Networking (SDN) is a reach to networking that uses software-based controllers or application programming interfaces to meet up with fundamental hardware infrastructure and direct traffic on a network. Software defined networking is a reach via which we take the control plane away from the switch allot it to a centralized unit called SDN controller. Network administrator can outline traffic via a centralized console without having to be in contact with the individual switches. The data plane will still live in the switch and when a packet set foot in a switch, its forwarding activity is clear-cut based on the entries of flow tables, which are pre allotted by the controller.
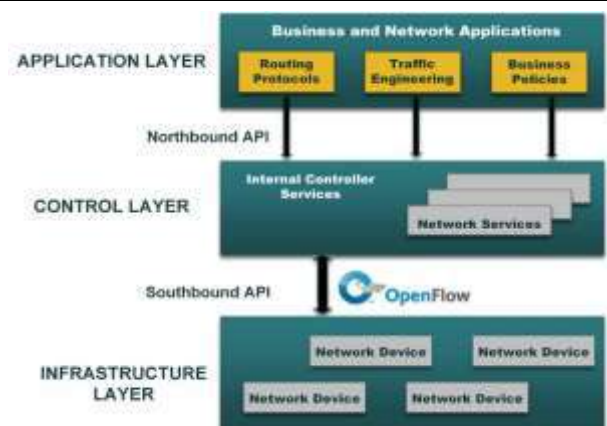
Fig.1: SDN Architecture

Network Virtualization is the process of incorporating hardware and software network assetsand computing into single software software-based entity, that is virtual network and it also helps in incorporating the accessibleassets and splash up the accessible bandwidth to passage, which is unconventional of other and allocated to particular appliance in actual time. Every single channel is unconventionally secured.

Network virtualization is of two types-internal and external.Internal Virtualization refers of using networks by quality in software on single server. It contributes network quality based only on softwares. In networks VMare server is used as common virtualization. However Internal Virtualization is more involute itself and can provide Virtual Switching, Virtual Networking and also Virtual firewall solutions. The advantage of Internal Network Virtualization is it is not hardware dependent and also known as storage virtualization.

External Virtualization is a virtual local area networks and by making use of these systems, they are actually attached to equivalent local networks into various virtual networks and put together by the admin.It utilizesdeviceslike adopters, switches or networks to incorporatesurplus networks into essential units and also uses a CISCO software. The advantages in it is that it has very small footprints due to its devoted nature, so that no other resources can be shared.

Malicious attack can also be called as Malware attacks and it is damage to the device and our cybersecurity.It is provoked by cyber attackers to harm our networks or computer without the victim'sknowledge to gain the personal information. The types of malware attack contains viruses, spyware, and ransomware. This happens on all organized devices and OS together with Windows, macOS, Android and iOS. Malware is even more complex to determine and can get mocked without noticed by the user. There is no interplay needed on the user part other than the looking in on infected webpage.

It is astrike which meant for closing a network and also making inaccessible to the intended user.It happens when the users are unfit to approach information systems, devices or the network resources due to activity of malicious cyber threat. There are two general methods ofDoS - Floodingservices or crashing services. Flood attacks happens when too much traffic is received for the server causes them to slow down the system and also makes to terminate. Also the popular flood attacks get together with Buffer overflow attacks, ICMP flood, SYN flood. An additional type of DoS attack is Distributed Denial of Service (DDoS).

DDoS is a malicious attack to make an online service inaccessible to users, temporarily breaking the service of its hosting server. It is different from other denial service attacks in it uses single Internet connected device with malicious attack. DoS and DDoS attacks can be classified into three types – Volume based Attack, Protocol attacks, Application layer attacks.Volume based attack are the attacks by engrossing them with a global network of scrubbing centres that scale on request to counter multi

gigabyte DDoS attacks. Protocol Attacks are the attack by the bad traffic before stick out the site. Application Layer Attacks are by observingthe visitor behaviour blocking bad bots and demanding the suspicious entities. The best methods of DDoS attacks are UDP Flood, ICMP flood, SYN flood, Ping of deaths, Slowloris, NTP Amplification, HTTP flood. DDoS can be exposed using in-line examination of all packets and out-of-band exposition via traffic flow records.

A firewall is a network security device that observers and filters the incoming and outgoing network traffics and plans whether to allow or block the specific traffic security rules. A firewall can be of both software and hardware. The require of Firewall is to secure the system. Without Firewall the system is open to threats and damage. It works as a filtration system for the data attempting to get in to the computer or networks. Firewall scam packets for malicious attack has been already detected as a threats. Incoming traffic is treated differently. The types of firewall are Host-based firewall-It is installed on each network node which masters each incoming and outgoing packets.Network based firewall- these firewalls filter all incoming and outgoing traffic across the networks. A network firewall might have to or more network interface cards.

II. LITERATURE SURVEY

The Survey confer the related works relevant to using KDD dataset for implementing machine learning algorithms to detect the malicious attack. Studies in SDN security have widelysupervened in the enlargement of system that handle security issues connected with the use of Open-Flow. The classifier selection model proposed by the author [1][2][5] made an evaluation in intrusion detection system using the NSL-KDD dataset and also by implementing number of machine learning techniques like Naïve Bayes, SVM, Decision tree, Neural network, K-nearest neighbour algorithm(K-NN) to find their accuracy in each algorithm.

According to another study, [3,4,6] implemented in Scala programming using the ML lib learning library in Apache Spark. The algorithm proposed by the author was support vector machine algorithm against intrusion detection using machine learning on Big data environment. In this proposed method the author imported the dataset and exported it into RDD dataset in Apache Spark and implemented the pre-processing and feature selection phase. Some researches focus on attribute selection algorithm as they increase the computational cost. The author Chibuzor John Ugochukwu, &E.O Bennett focused on selecting the significant attribute and implemented the

detection system based on Bayes net, J48, Random forest and Random tree algorithm in Weka tool. Dataset used was KDD cup99.

The [5, 7, 9]in addition to random tree classifier, Random forest classifier, J48, Naïve Bayes, Decision table they have also implemented multi-layer perception, and also

they propose a methodology to detect different types of intrusion within the KDD. In this paper it is known that there is no single machine learning algorithm which can handle the efficiency of different types of attack.

Algorithms, tools and dataset in some of the reference base papers are as follows,

S No	Year	Algorithm used	Tools used	Dataset
1	2018	Naïve Bayes, SVM, Decision Tree, Neural Network, K-Nearest Neighbour Algorithm(K-NN)	Weka	NSL-KDD
2	2018	Spark-Chi-SVM Model	ML lib, Apache Spark	KDD cup99
3	2018	Bayes Net, J48, Random Forest, Random Tree	Weka	KDD cup99
4	2018	Multi-Layer Perceptron, Random Tree Classifier, Random Forest, J48, Naïve Bayes, Decision Tree	Weka	KDD cup99
5	2020	Decision Tree, Random Forest, XG Boost, Support Vector Machine(SVM), Deep Neural Network.	Weka, GNS3	NSL-KDD
6	2019	T-Sne Plot	Weka , hping3	NSL-KDD
7	2019	Naïve Bayes, Decision Tree	Weka	KDD cup99
8	2020	Decision Tree, K-Nearest Neighbour, Support Vector Machine, K-Mean Clustering, Artificial Neural Network	Weka	NSL-KDD
9	2010	Support Vector Machine, Naïve Bayes, K-Nearest Neighbour Algorithm	Weka, WINPCAP	KDD cup99

III.   PROPOSED SYSTEM

To detect the malicious attackthe following modules are used,Data Pre-Processing, Attribute Selection, Traffic Grouping and TrafficClassification.
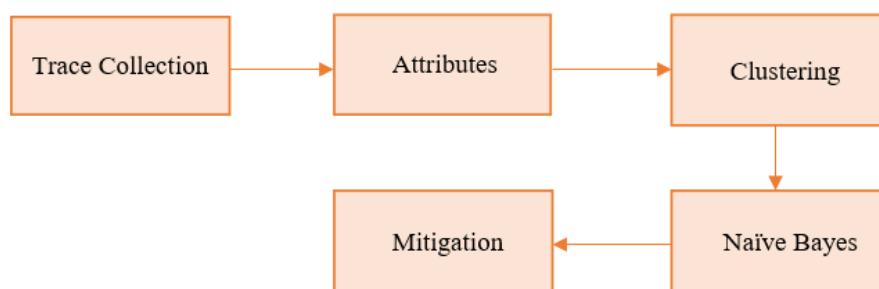
Fig.2: Proposed overall Architecture

3.1 Data Pre-Processing

Data Pre-processing is a data mining technique that converts raw data into an understandable and readable format. Data pre-processing is the beginning of the process. Actual data is frequently insufficient, uncertain, require in obvious behaviours or tendency and is

probableofcarrying many errors. Data pre-processing is a demonstrated method tosort out such errors. To make the process simpler data pre-processing is classified into four stages: Data cleaning, Data integration, Data reduction and Data transformation. Data is supposed to be impure if it contains any duplicate or unreal value and noise that interrupt the attribute values and the unfound variables, so

data pre-processing is essential as it is critical in any data mining process as they straightcrash theachievement of the project. It is the conversion applied to the data before suckle to the algorithm.

3.1.1 Steps in data Pre-processing in machine learning

- Acquire the dataset
- Import libraries
- Import the dataset
- Identifying and handling the missing values
- Splitting the dataset into train and test set
- Feature scaling

3.2 Attribute Selection

The mandatory attributes used in Naïve Bayes algorithm to detect the malicious attacks are

- Source mac address
- Source Ip address
- Destination mac address
- Destination Ip address
- Time

3.3 Traffic Groping

To detect the malicious attack here the algorithm used is K-means Clustering Algorithm.K-means clustering is one of the simplest and well-liked unsupervised machine learning algorithms. K-means algorithm determines K number of centroids, and then assigns every data point to the neighbouring cluster, while caring the centroids as small as possible. K clarifies the number of pre-defined clusters that have to be developed in the process, as if K=2, then there will be 2 clusters and for K=3, there will be 3 clusters. It is a centroid-based algorithm. The motive of this algorithm is to keep down the sum of distances between the data point and their matching clusters. The algorithm grasp the unlabelled dataset as input, classifies the dataset into k-number of clusters, and recurrent the process until it does not find the finest clusters. The value of k should be pre-arranged in this algorithm. The k-means clustering algorithm mainly perform two tasks

- Determines the finest value for k centre points or centroids by anrepetition process.
- Assigns each data point to its neighbouring k-centre. Those data points which are neighbour to the particular k-centre, create a cluster.

3.4 Traffic classification

To detect the malicious attack here the algorithm used is Naïve Bayes Classifier.Naïve Bayes algorithm is a supervised learning algorithm, which is depended on Bayes Theorem. It is generally used in text classification that contains a high-dimensional training dataset. Naïve Bayes Classifier is one of the easier and most successful Classification algorithms which helps in defining the fast machine learning modules that can make quick forecasting. It is a probabilistic classifier, which means it forecast on the basis of the probability of an object. A Naïve Bayes classifier suppose that the presence or absence of a specific feature of a class is unrelated to the presence or absence of any other feature, it's naïve because it makes supposition that may or may not turn out to be true. Bayes Theorem is used to determine the probability of a hypothesis with earlier knowledge. It depends on the conditional probability. The formula for Bayes Theorem is given as

$$P(A\backslash B)=P(B\backslash A)P(A) \,/\, P(B)$$

IV.   RESULT & ANALYSIS

By using Weka tool the malicious attack have been detected. Weka (Waikato Environment for Knowledge Analysis) is a group of machine learning algorithms for data mining tasks. The algorithms can either be applied straight to a dataset or called from our own java code. Weka contains tools for data pre-processing, Classification, Clustering, association rules and visualization. Weka hold up a large number of file formats for the data, and the default file type is ARFF. This tool gets the data file format in comma separated value (csv) or attribute-relation file format (arff). As Weka is written in java which is well documented and allocates integration into our own application. It has the feature of command line interface as all software features can be used from the command line. The KDD 99 dataset is used for the experiments. It is the most used dataset for Intrusion Detection System. As the size of the KDD 99 dataset is very large and has approximately 490000 records with 41 features it is difficult to extract all the data. So the dataset is reduced to meet requirement.

4.1 Result of K-means Clustering algorithm

```
Final cluster centroids:
                            Cluster#
Attribute    Full Data           0            1
               (549.0)      (279.0)      (270.0)
========================================
a1            7.1548     14.0789            0
a2               tcp         tcp          udp
a3           private        http      private
a4                SF          SF           SF
a5          732.2441   1343.2258     100.8963
a6         2128.0874   4052.5233     139.5037
a7                 0           0            0
a8                 0           0            0
a9                 0           0            0
a10            0.071      0.1398            0
a11                0           0            0
a12           0.4353      0.8566            0
a13           0.0036      0.0072            0
a14                0           0            0
a15                0           0            0
a16                0           0            0
a17                0           0            0
a18                0           0            0
```

Fig.3: Traffic Groping

4.2 Result of Naïve Bayes Clustering

	TP Rate	FP Rate	Precision	Recall	F-Measure	MCC	ROC Area	PRC Area	Class
	0.966	0.014	0.985	0.966	0.975	0.953	0.992	0.994	udp
	0.986	0.030	0.972	0.986	0.979	0.956	0.987	0.975	tcp
	1.000	0.002	0.800	1.000	0.889	0.894	0.999	0.888	icmp
Weighted Avg.	0.976	0.022	0.977	0.976	0.976	0.954	0.989	0.983	

Fig.4: Traffic Classification
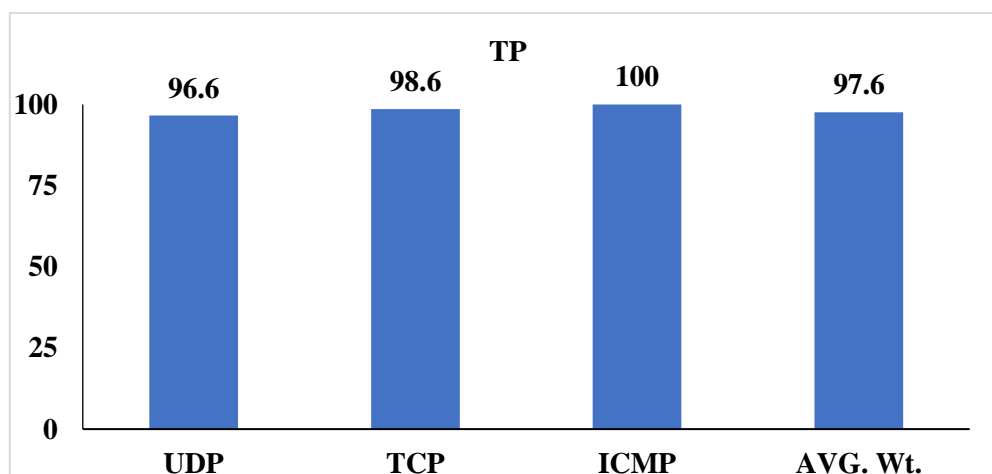
Fig.5: TP rate
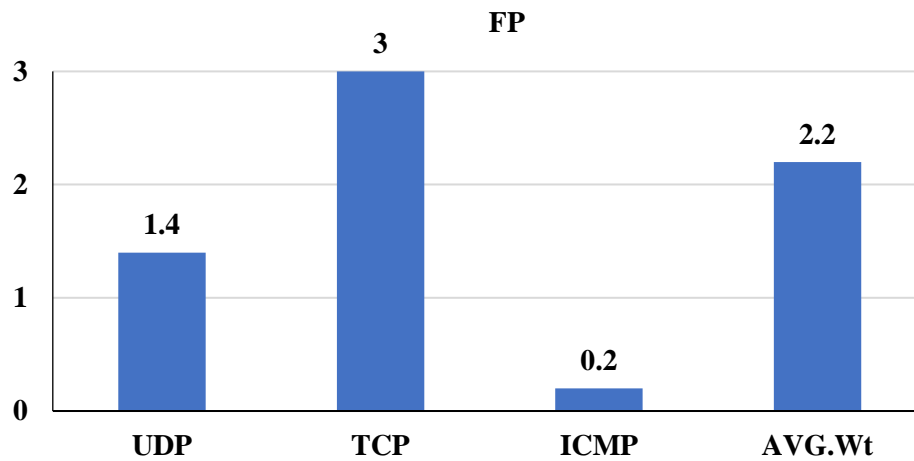
Fig.6: FP Rate
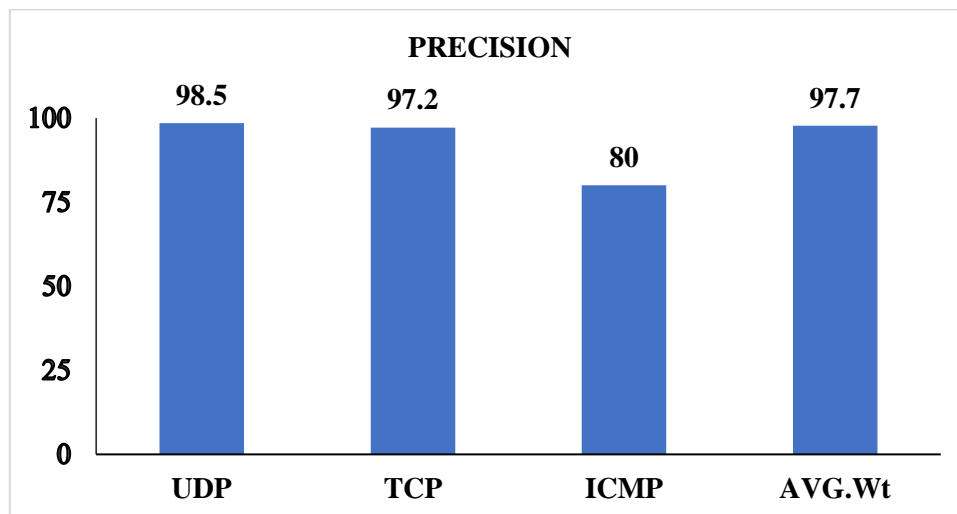
Fig.7: Precision
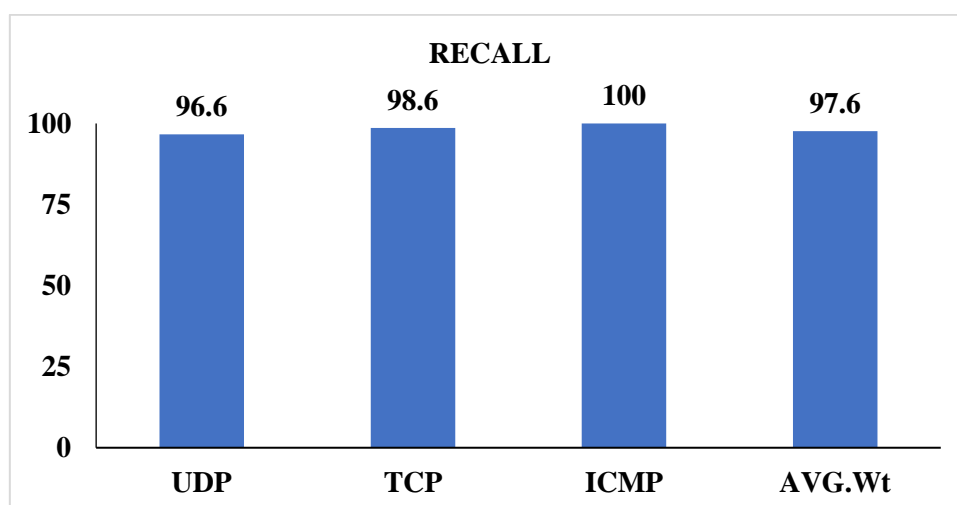
Fig.8: Recall
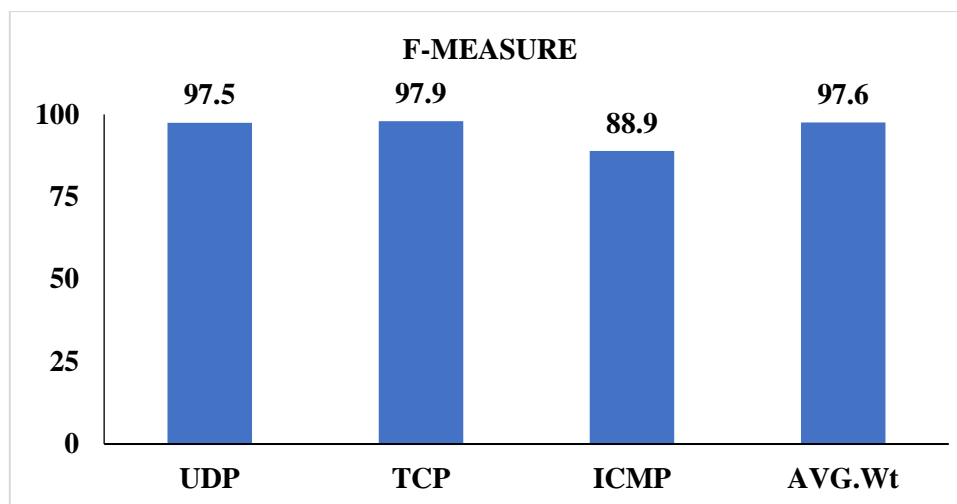
Fig.9: F-Measure

In this paper, the proposed system has 99% of UDP, 98% of TCP, 99% of ICMP efficiency. Comparing to other algorithms, naïve Bayes algorithm proposes a little high efficiency as shown in the above figure. True Positive rate, False Positive rate, precision, recall, f-measure values are calculated using this algorithm, and the graph of all those were figured above.

V. CONCLUSION

As there were several Algorithms in machine learning, in this paper, experiments were performed and tested to evaluate the efficiency and the performance of the following algorithms: Naïve Bayes algorithm and K-means clustering algorithm. The main objective of this paper is to detect the malicious attack by using those two algorithms and hence it was done successfully. Both the algorithms performed were based on the KDD intrusion detection dataset. The rate of the different attacks like DOS, R2l, U2R and PROBE can be found using the KDD dataset. 549 instances of records have been extracted as training data to define the training models for the selected machine learning algorithms. Several performance metrics were computed which are accuracy rate, precision, false negative, false positive, true negative and true positive. Further work will be based on some data mining algorithms applied to Intrusion Detection System to detect the attack.

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A study about Fourier series: Mathematical and graphical models and application in electric current and square oscillations

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Abstract— *The present work aims to study the Fourier series with the intention of creating a didactic and understandable text. There are several ways to introduce the Fourier series, the simplest and most pedagogical way, at least for beginners in the subject, is to explore intuitively the basic idea through graphics. This analysis facilitates the understanding of the methodology behind the series and the Fourier. The mathematical formulation will be a simple extension of the physical (geometric) image presented by the graphics. The popular saying goes that a figure is worth a thousand words. Mathematicians, in turn, argue that an equation is worth a thousand figures. Maybe that is why in Fourier's analysis books, mathematical formulation comes first, followed by the graphics.*

I. INTRODUCTION

The theory of Fourier series began marked by the attempt to solve heat conduction problems in a bar. In the mid-eighteenth century a big problem arose that helped both mathematical analysis and other areas, including physics. The problem was to write a certain function given as an infinite series of sine and cosine functions, more specifically a periodic function.

Many physical phenomena related to celestial mechanics, particle mechanics, wave, ballistics, heat transmission, and electrical circuits are translated into differential equations whose differential and integral calculus is not enough to solve them, arising the need for something more sophisticated, called Fourier equations.

The development and creation of this series is due to Jean Baptiste Joseph Fourier (1766-1830), French physicist and mathematician. Fourier used it to solve the

problem of heat conduction, which he explains in his work *Théorie Analytique de la Chaleur* in 1822, as the theory of heat diffusion in solid bodies.

According to KOHAUPT and LEE (2015), the Fourier series was originated in telecommunication engineering, specifically in the connection with the digitalization of data (signals) in order to transmit them.

Different from the current days where signals are digitalized, formerly, signals were transmitted in the superposition of continuous periodic time functions, in the form of waves.

Although Fourier's proposition that any function (continue or discontinuous) could be written as an infinite sum of the trigonometric functions cosine and sine had been written down earlier, his contribution was ground-breaking by the degree of attention given to the convergence of the functions (FOLKERTS et. al, 2020).

Still, according to AMORIM et. al (2019), although the work of Fourier had been heavily criticised by Lagrange, Laplace and Legendre, the fact that Fourier have observed that discontinuous functions are the sum of infinite series it was a great advance, for it explicit the shape of the series that represents this functions.

The applications of Fourier series are the most varied. In the matter of electric current and oscillations, Fourier series are vital to approximate a periodic waveform in electronics and electrical circuits. For the modern technology and engineering, is by the use of this series that it is possible to decompose periodic signals into sum of infinite trigonometrically series in sine and cosine terms (ANUMAKA, 2012).

In this work, we approach the Fourier series in three sections. In the first section, we deal with the subjects related to the definition of series, even and odd functions, periodic functions, as well as their properties. In the second, Fourier's trigonometric coefficients are determined, giving some examples of functions written in the form of the Fourier series. Finally, in the third section, we talk about some applications using odd and even function, and cases where the functions are neither even nor odd.

II. METHODOLOGY

In this chapter, we will study the definition of limits, derivatives, integrals, periodic functions, even functions, odd functions, sequences, series, their properties and their involvement with the series under study. We will now move on to formal settings.

2.1 Limits

We say that a function $f(x)$ has limit 'k' when $x \to a$, if for all $\varepsilon > 0$ there is $\delta > 0$ as demonstrated by MUNEM and FOLIS (1882):

$$0 < |x - a| < \delta \to |f(x) - k| < \varepsilon \tag{1}$$

Such 'k' number when it exists is unique and will be indicated by:

$$\lim_{x \to a} f(x) = k \tag{2}$$

2.1.1 Limits properties

For $f(x)$ and $g(x)$ functions of a real variable and K' belonging to IR. We consider:

$$\lim_{x \to a} f(x) = k \tag{3}$$

and

$$\lim_{x \to a} g(x) = k \tag{4}$$

Therefore:

i. $\lim_{x \to a} [f(x) + g(x)] = \lim_{x \to a} f(x) + \lim g(x) = k_1 + k_2;$

ii. $\lim_{x \to a} [f(x) . g(x)] = \lim_{x \to a} f(x) . \lim g(x) = k_1 * k_2;$

iii. $\lim_{x \to a} \left[\frac{f(x)}{g(x)} \right] = \frac{\lim_{x \to a} f(x)}{\lim_{x \to a} g(x)} = \frac{k_1}{k_2}, desde\ que\ k_2 \neq 0;$

iv. $\lim_{x \to a} [K^{\hat{}} * f(x)] = K^{\hat{}} . \lim_{x \to a} f(x) = k^{\hat{}} * k_1 .$

All demonstrations here omitted can be seen in GUIDORIZZI (2001).

2.2 Derivatives

Among limits, there is a special called derivatives, which is our next object of study. Be f a function and k a point of your domain. The limit:

$$\lim_{x \to a} \frac{f(x+h) - f(x)}{h} \tag{5}$$

When it exists and is finite, it is named derivative and is indicated by $f'(k)$. Therefore:

$$f'(k) = \lim_{x \to a} \frac{f(x+h) - f(x)}{h} \tag{6}$$

If the limit above exists, we say that such function is differentiable at the given point.

2.2.1 Derivatives Properties

Be f and g derivable in k and 'c' a constant. So we have to:

i. $(f + g)'(k) = f'(k) + g'(k)$

ii. $(f * g)'(k) = f'(k) * g(k) + f(k) * g'(k)$

iii. $[f(k) \div g(k)] = [f'(k)\ g(k) - f(k)\ g'(k)] \div [(g(k))^2]$, as long as $g(k) \neq 0$

iv. $(c\ f)'(k) = c * f'(k)$

All demonstrations here omitted can be seen in GUIDORIZZI (2001).

2.3 Integral

Given a function f defined in a range [a,b] and k is a given number. The sum bellow is the Reimam sum:

$$\sum_{i=1}^{n} f(c_i) \Delta X_i, \ onde \ c_i \in [X_i, X_{i-1}] \tag{7}$$

When doing $(máx \Delta x_1) \to 0$, naturally the sum will tend to K, then we will have the following:

$$\lim_{máx \Delta X_i \to 0} \sum_{i=1}^{n} f(c_i) \Delta X_i = K \tag{8}$$

By setting the limit, given $\varepsilon > 0$ there is $\delta > 0$ that it only depends on ε:

$$\left| \left(\sum_{i=1}^{n} f(c_i) \Delta X_i \right) - K \right| < \varepsilon \tag{9}$$

Such number K is indicated by:

$$\int_a^b f(x)\,dx \qquad (10)$$

So we refer to the equation below as the defined integral from *f* to [a,b].

$$K = \lim_{m\acute{a}x\,\Delta X_i \to 0} \sum_{i=1}^n f(c_i)\Delta X_i = \int_a^b f(x)\,dx \quad (11)$$

2.3.1 Integral properties

Be *f*, g integral in [a,b], and A a constant:

i. $\int_a^b [f(x) + g(x)]dx = \int_a^b f(x)\,dx + \int_a^b g(x)\,dx$

ii. $\int_a^b A * f(x)\,dx = A \int_a^b f(x)\,dx$

iii. $If\ f(x) \geq 0\ in\ [a,b], therefore\ \int_a^b f(x)dx \geq 0$

iv. If $C \in$ [a,b] and *f* integrable in [a,c] and in [c,d], therefore:

$$\int_a^b f(x)\,dx = \int_a^c f(x)\,dx + \int_c^b f(x)\,dx$$

2.3.2 Fundamental Theorem of Calculus

Be f integral in [a,b], if F is a primitive of *f* in [a,b] then:

$$\int_a^b f(x)\,dx = F(a) - F(b) \qquad (12)$$

Such theorem is only used in the case where the integral is said to be defined.

2.3.3 Integração por partes

Be *f* and g defined and derivable in a range I. Note that:

$$(f * g)'(x) = f'(x) * g(x) + f(x) * g'(x) \quad (13)$$

$$f(x) * g'(x) = (f * g)'(x) - f'(x) * g(x) \quad (14)$$

$$\int_a^b f(x) * g'(x)dx = \int_a^b [(f * g)'(x) - f'(x) * g(x)]\,dx \quad (15)$$

$$\int_a^b g'(x) * f(x)dx = f(x) * g(x) - \int_a^b f'(x) * g(x)dx \quad (16)$$

Doing u=f(x) and v=g(x):

du = f'(x) dx   and   dv = g'(x) dx

Therefore, integration by parts is:

$$\int_a^b u\,du = uv - \int_a^b v\,du \qquad (17)$$

2.4 Numeric Sequence

A sequence is a function whose domain is the set of natural numbers, that is, it is an endless succession of numbers.

For all n $\in$ N, traditionally, a sequence is written as:

$$X_n = (X_0, X_1, X_2, \dots ,X_i, \dots)$$

A sequence can converge or diverge. If the sequence converges to a real number ''k'' we say that it is represented by a limit, that is:

$$\lim_{x \to \infty} X_n = k$$

2.4.1 Propriedade de Sequências

The same operating rules used with function limits are valid for number sequences. See section 2.3.1 of this chapter.

2.5 Séries Numéricas

Given a sequence (Xn) n$\in$N, which may converge or not, we say that an infinite series is the sum:

$$X_o + X_1 + X_2 + ... + X_n ....$$

With the compressed writing:

$$S_n = \sum_{n=1}^{\infty} X_n \qquad (18)$$

If the series converges, we say that the limit of its sum exists and will be represented by a real S number, or rather:

$$\lim_{n \to \infty} S_n = \lim_{n \to \infty} \sum_{n=1}^{\infty} X_n = S \qquad (19)$$

2.6 Periodic Functions

We will begin the study of periodic functions, something fundamental to continue the understanding about the series under study. We say that a function f: $\mathbb{R} \to \mathbb{R}$ is periodic period t if f (x+t) = f (x) for all real x (Ávila, 1999).

The function cos (x) it is periodic of period 2π because:

Cos (x + 2π) = cos (x) * cos (2π) − sen (x) * sen (2π)

With cos (2π) = 1 and sen (2π) = 0, it follows:

Cos (x + 2π) = cos (x) * 1 − sen (x) * 0 = cos (x)

Be f and g functions of given period t, then f + g and f * g will also be periodic.

Demonstration:

(f + g)(x +t) = f (x + t) + g(x + t), because any functions enjoy the definition of sum of functions. By applying the periodic function definition, we have:

(f + g)(x+t)= f (x + t) + g(x + t) = f (x) + g(x) = (f + g)(x)

O que nos mostra que a soma de duas funções periódicas também e periódica. A outra demonstração será feita de modo análogo veja:

 (fg) = (x + t) = f (x + t)g(x + t) = f(x)g(x) = (fg)(x)

Which shows us that the product of two periodic functions is also periodic.

If function f is periodic period t, then kf(x) is periodic of the same period, where k is a natural other than zero.

Demonstration:

Be f [k(x + t)] = f [(x + t) + (x + t) + (x + t) + ... + (x + t)] = f (x + t) + f(x + t)+ f (x + t) + ... f (x + t) = f (x) + f (x) + f(x) +...+ f (x) = kf (x)

Which completes our demonstration.

If f is differentiable and periodic from period t, we will show that the derived function f is also periodic for the same period.

Demonstration:

Note that:

$$f'(x + t) = \lim_{h \to 0} \frac{f[(x + t) + h] - f(x + t)}{h} = \lim_{h \to 0} \frac{f(x + t) - f(x)}{h} = f'(x)$$

Be f: $\mathbb{R} \to \mathbb{R}$ a periodic function of period t, and integral in any range, we will show that:

$$\int_a^{a+t} f = \int_0^t f \qquad (20)$$

Where *a* it is any real number fixed.

Demonstration

By the fundamental theorem of calculus, we have the following equation:

$$\varphi(x) = \int_a^{a+t} f = F(a + t) - F(a) = F(a) - F(a) = 0$$

As

$$\varphi(x) = F(a + t) - F(a) = F(a) - F(a)$$

Therefore, $\varphi'(x) = 0$ we conclude that $\varphi(x) = c$ it is constant and $\varphi(a) = \varphi(0)$.

So:

$$\int_a^{a+t} f = \int_0^t f \qquad (21)$$

2.7 Even and Odd functions

A function f: $\mathbb{R} \to \mathbb{R}$ is even when f (x) = f (–x), for all real and odd x when f (x) = -f (–x), for all real x.

For example, the function f (x) = x² is even, because f (–x) = (–x)² = x² = f(x).

The function f (x) = x³ is odd, because f (-x) = (-x)³ = -x ³= -f(x).

2.7.1   Propositions

Now let's study some properties of even and odd functions. They are:

i.   The sum of two even functions is an even function, the sum of two odd functions is odd;

ii.   The product of two real even functions is an even function, and the product of two odd functions is an even;

iii.   The product of a real function odd by an even real function is odd;

iv.   Be f a real even function. The defined integral of f in [-l,l] is twice the defined integral of f in [0,l];

v.   Be f an odd and integrable real function, then the defined integral of f in [-l,l] is null;

vi.   Every real function f (x) can be decomposed into the sum:

f (x) = fp (x) + fi (x)

Where, fp (x) is an even function and fi (x) is an odd function, defined respectively by:

fp (x) = (f (x) + f (-x)) / 2

fi (x) = (f (x) - f (-x)) / 2

Demonstration:

Let's now demonstrate each item mentioned earlier.

i.   Be φ:R→R and ω:R→R even functions.

 (φ+ω)(-x) = φ(-x) + ω(-x) = φ(x) + ω(x) = (φ + ω)(x)

ii.   Be φ:R→R and ω:R→R even functions.

 (φ*ω)(x) = φ(x) + ω(x) = φ(-x)*ω(-x) = (φ*ω)(-x)

iii.   Be φ:R→R an even function and ω:R→R an odd function.

 (φ*ω)(x) = φ(x) + ω(x) = φ(-x)*ω(-x) = (φ*ω)(-x)

iv.   As we know we can decomminate the integration limits of any integral defined in a finite range, as follows:

$$\int_{-l}^{l} f = \int_{-l}^{l} f(x)\, dx = \int_{-l}^{0} f(x)\, dx + \int_{0}^{l} f(x)\, dx$$

Doing x = -y, you have:

$$-\int_{-l}^{0} f(-y)\,dy + \int_{0}^{l} f(x)\,dx = \int_{-l}^{0} f(x)\,dx + \int_{0}^{l} f(x)\,dx$$

Because f(x) is even. Like this:

$$\int_{-l}^{0} f(y)\,dy + \int_{0}^{l} f(x)\,dx = \int_{0}^{l} f(x)\,dx + \int_{0}^{l} f(x)\,dx = 2\int_{0}^{l} f(x)\,dx$$

Therefore:

$$\int_{-l}^{l} f(x)\,dx = 2\int_{0}^{l} f(x)\,dx$$

v. The demonstration will be made in a manner analogous to item (iv):

$$\int_{-l}^{l} f = \int_{-l}^{l} f(x)\,dx = \int_{-l}^{0} f(x)\,dx + \int_{0}^{l} f(x)\,dx$$

Doing x = -y, you have:

$$-\int_{-l}^{0} f(-y)\,dy + \int_{0}^{l} f(x)\,dx = \int_{-l}^{0} f(y)\,dy + \int_{0}^{l} f(x)\,dx = -\int_{0}^{l} f(x)\,dx + \int_{0}^{l} f(x)\,dx$$

Therefore:

$$\int_{-l}^{l} f(x)\,dx = 0$$

vi. Note that if f(x) is pair, you have:

$$f_p(x) = \frac{2f_p(x)}{2} = \frac{f_p(x) + f_p(x)}{2} = \frac{f_p(x) + f_p(-x)}{2} = \frac{f(x) + f(-x)}{2}$$

Because, fp (x) = f (x) = f (-x), by definition. If f(x) is odd, it has − if:

$$f_i(x) = \frac{2f_i(x)}{2} = \frac{f_i(x) + f_i(x)}{2} = \frac{f_i(x) - f_i(-x)}{2} = \frac{f(x) - f(-x)}{2}$$

Because, fi (x) = f(x)= -f (-x), by definition. From this, we conclude that:

$$f_p(x) + f_i(x) = \frac{f_p(x) - f_i(x)}{2} + \frac{f_i(x) + f_i(-x)}{2} = \frac{f(x) - f(-x)}{2} + \frac{f(x) + f(-x)}{2}$$

$$\frac{f_p(x) + f(-x) + f(x) - f(-x)}{2} = \frac{f(x) + f(x)}{2} = \frac{2f(x)}{2} = f(x)$$

Therefore:

$$f(x) = f_p(x) + f_i(x)$$

III. FOURIER SERIES

A Fourier series follows the form:

$$\frac{a_0}{2} + a_1 \cos(x) + b_1 sen(x) + a_2 \cos(2x) + b_2 sen(2x) + \cdots$$

Or otherwise:

$$\frac{a_0}{2} + \sum_{n=1}^{\infty} [a_n \cos(nx) + b_n sen(nx)] \tag{22}$$

It's called the Fourier series, with n=1,2,3,4,..., where:

$$a_n = \frac{1}{\pi} \int_{-\pi}^{\pi} f(x) \cos(nx)\,dx \tag{23}$$

$$b_n = \frac{1}{\pi} \int_{-\pi}^{\pi} f(x) sen(nx)\,dx \tag{24}$$

They are called Fourier coefficients, of the trigonometric series which will be explained in more detail. As we know a series can diverge or converge. If the series presented earlier converge sum, it will be a periodic function f(x) of period 2π, because sen (nx) and cos (nx), are periodic functions of period 2π. So that f (x+t) = f (x).

3.1 Determination of the trigonometric coefficients of Fourier

Be $f(x) = \frac{a_0}{2} + \sum_{n=1}^{\infty}[a_n \cos(nx) + b_n sen(nx)]$.

According to BUTKOV (1988) we have:

$$a_0 = \frac{1}{\pi} \int_{-\pi}^{\pi} f(x)\,dx \tag{25}$$

$$a_n = \frac{1}{\pi} \int_{-\pi}^{\pi} f(x) \cos(nx)\,dx \tag{26}$$

$$b_n = \frac{1}{\pi} \int_{-\pi}^{\pi} f(x) sen(nx)\,dx \tag{27}$$

3.1.1 Proposition

To demonstrate the Fourier coefficients we will make use of the following proposition. Suppose the functions are integrable in a range I where the series is evenly fit. So:

$$\int_{I} \left[\sum_{n=1}^{\infty} f_n(x) \right] dx = \sum_{n=1}^{\infty} [\int_{I} f_n(x)]\,dx \tag{28}$$

Demonstration:

Note that:

$$\int_l \left[\sum_{n=1}^{\infty} f_n(x)\right] dx = \int_l [f_1(x) + f_2(x) + \cdots + f_n(x)] dx$$

$$\int_l \left[\sum_{n=1}^{\infty} f_n(x)\right] dx = \int_l f_1(x) dx + \int_l f_2(x) dx + \cdots + \int_l f_n(x) dx$$

$$\int_l \left[\sum_{n=1}^{\infty} f_n(x)\right] dx = \sum_{n=1}^{\infty} \left[\int_l f_n(x)\right] dx$$

This demonstrates the theorem mentioned above. Now, let's deduce Fourier's coefficients. When a function is written in the form of a Fourier series, we have the following:

$$f(x) = \frac{a_o}{2} + \sum_{n=1}^{\infty} [a_n \cos(nx) + b_n sen(nx)] \tag{29}$$

The Fourier series can be integrated term-to-term in the range (-π.π) due to preposition 3.1.1. So we have:

$$\int_{-\pi}^{\pi} f(x) dx = \int_{-\pi}^{\pi} \frac{a_o}{2} dx + \int_{-\pi}^{\pi} \sum_{n=1}^{\infty} [a_n \cos(nx) + b_n sen(nx)] dx \tag{30}$$

Now, let's calculate each integral separately.

$$\int_{-\pi}^{\pi} \frac{a_o}{2} dx = \frac{a_0}{2} \int_{-\pi}^{\pi} dx = \frac{a_o}{2} = a_o \pi$$

$$\int_{-\pi}^{\pi} a_n \cos(nx) dx = \frac{a_n}{n} \int_{-\pi}^{\pi} \cos(u) du = \frac{-a_n}{n} [sen(n\pi) - sen(-n\pi)]$$

$$\int_{-\pi}^{\pi} a_n \cos(nx) dx = \frac{-a_n}{n} [sen(n\pi) - sen(-n\pi)] = 0$$

$$\int_{-\pi}^{\pi} b_n sen(nx) dx = \frac{b_n}{n} \int_{-\pi}^{\pi} sen(u) du = \frac{b_n}{n} [cos(n\pi) - cos(-n\pi)]$$

$$\int_{-\pi}^{\pi} a_n \cos(nx) dx = \frac{b_n}{n} [cos(n\pi) - cos(n\pi)] = 0$$

Going back to:

$$\int_{-\pi}^{\pi} f(x) dx = \int_{-\pi}^{\pi} \frac{a_o}{2} dx + \int_{-\pi}^{\pi} \sum_{n=1}^{\infty} [a_n \cos(nx) + b_n sen(nx)] dx$$

We have:

$$\int_{-\pi}^{\pi} f(x) dx = a_o \pi \Leftrightarrow a_o = \frac{1}{\pi} \int_{-\pi}^{\pi} f(x) dx \tag{31}$$

To determine Fourier's coefficients a_n and b_n, we will use the following auxiliary integrals, i.e., orthogonally relationships. If n and k are whole and if n≠k, you have:

$$\int_{-\pi}^{\pi} \cos(nx) \cos(nk) dx = 0$$

$$\int_{-\pi}^{\pi} \cos(nx) sen(nk) dx = 0$$

$$\int_{-\pi}^{\pi} sen(nx) sen(nk) dx = 0$$

Demonstration:

We will show the results presented by the auxiliary integrals.

$$\int_{-\pi}^{\pi} \cos(nx) \cos(nk) dx = \int_{-\pi}^{\pi} \frac{1}{2} [\cos(n+k) + \cos(n-k)] dx$$

$$\frac{1}{2} \int_{-\pi}^{\pi} \left[\cos(n+k) dx + \frac{1}{2} \int_{-\pi}^{\pi} \cos(n-k)\right] dx$$

$$u = (n+k)x \Rightarrow \frac{du}{dx} = (n+k) \Rightarrow du = (n+k) dx$$

and

$$w = (n-k)x \Rightarrow \frac{dw}{dx} = (n-k) \Rightarrow dw = (n-k) dx$$

Therefore:

$$\frac{1}{2(n+k)} \int_{-\pi}^{\pi} \cos(u) du + \frac{1}{2(n-k)} \int_{-\pi}^{\pi} \cos(w) dw$$

Integrating, we have:

$$\frac{1}{2(n+k)} sen(u)\Big]_{-\pi}^{\pi} - \frac{1}{2(n-k)} sen(w)\Big]_{-\pi}^{\pi} =$$

$$\frac{1}{2(n+k)} sen(n+k)\Big]_{-\pi}^{\pi} - \frac{1}{2(n-k)} sen(n-k)\Big]_{-\pi}^{\pi} =$$

$$\{\frac{1}{2(n+k)} [sen(n+k)\pi] - \frac{1}{2(n+k)} [sen(n+k)(-\pi)] -$$

$$\frac{1}{2(n-k)}[sen(n-k)\pi] - \frac{1}{2(n-k)}[sen(n-k)(-\pi)]\} =$$

$$\{\frac{1}{2(n+k)}[sen(n+k)\pi] - \frac{1}{2(n+k)}[sen(n+k)(\pi)] -$$

$$\frac{1}{2(n-k)}[sen(n-k)\pi] - \frac{1}{2(n-k)}[sen(n-k)(\pi)]\}$$

$$\{0+0\} = 0$$

$$\int_{-\pi}^{\pi} \cos(nx) sen(nk) dx = \int_{-\pi}^{\pi} \frac{1}{2}[\cos[(n+k)x] - sen[(n-k)x]] dx =$$

$$\frac{1}{2}\int_{-\pi}^{\pi} \cos[(n+k)x]\, dx - \frac{1}{2}\int_{-\pi}^{\pi} sen[(n-k)x]\, dx =$$

$$u = (n+k)x \Rightarrow \frac{du}{dx} = (n+k) \Rightarrow du(n+k)dx$$

$$w = (n-k)x \Rightarrow \frac{dw}{dx} = (n-k) \Rightarrow dw(n-k)dx$$

$$\frac{1}{2(n+k)}\int_{-\pi}^{\pi} sen(u)\, du + \frac{1}{2(n-k)}\int_{-\pi}^{\pi} sen(w)\, dw$$

$$\frac{1}{2(n+k)}[-cos(u)]_{-\pi}^{\pi} - \frac{1}{2(n-k)}[-cos(w)]_{-\pi}^{\pi} =$$

$$\frac{1}{2(n+k)}[-cos(n+k)x]_{-\pi}^{\pi} - \frac{1}{2(n-k)}[-cos(n-k)]_{-\pi}^{\pi} =$$

$$\{\frac{1}{2(n+k)}[cos(n+k)\pi] - \frac{1}{2(n+k)}cos[(n+k)(-\pi)] -$$

$$\frac{1}{2(n-k)}[cos(n-k)\pi] - \frac{1}{2(n-k)}cos[(n-k)(-\pi)]\} =$$

$$\{\frac{1}{2(n+k)}[cos(n+k)\pi] - \frac{1}{2(n+k)}[cos(n+k)(\pi)] -$$

$$\frac{1}{2(n-k)}[cos(n-k)\pi] - \frac{1}{2(n-k)}[cos(n-k)(\pi)]\}$$

$$\{0+0\} = 0$$

$$\int_{-\pi}^{\pi} sen(nx) sen(nk) dx = \int_{-\pi}^{\pi} sen[(n+k)x] dx + \int_{-\pi}^{\pi} sen[(n-k)x] dx$$

$$u = (n+k)x \Rightarrow \frac{du}{dx} = (n+k) \Rightarrow du = (n+k)dx$$

$$w = (n-k)x \Rightarrow \frac{dw}{dx} = (n-k) \Rightarrow dw = (n-k)dx$$

$$\int_{-\pi}^{\pi} sen(u)du + \int_{-\pi}^{\pi} sen(w)dw =$$

$$\frac{1}{2(n+k)}\int_{-\pi}^{\pi} sen(u)\, du + \frac{1}{2(n-k)}\int_{-\pi}^{\pi} sen(w)\, dw =$$

$$\frac{1}{2(n+k)}[-cos(u)]_{-\pi}^{\pi} + \frac{1}{2(n-k)}[-cos(w)]_{-\pi}^{\pi} =$$

$$\frac{1}{2(n+k)}[-cos(n+k)x]_{-\pi}^{\pi} + \frac{1}{2(n-k)}[-cos(n-k)x]_{-\pi}^{\pi} =$$

$$\{\frac{1}{2(n+k)}[cos(n+k)\pi] - \frac{1}{2(n+k)}cos[(n+k)(-\pi)] -$$

$$\frac{1}{2(n-k)}[cos(n-k)\pi] + \frac{1}{2(n-k)}cos[(n-k)(-\pi)]\} =$$

$$\{\frac{1}{2(n+k)}[cos(n+k)\pi] - \frac{1}{2(n+k)}cos[(n+k)(\pi)] -$$

$$\frac{1}{2(n-k)}[cos(n-k)\pi] - \frac{1}{2(n-k)}cos[(n-k)(\pi)]\}$$

$$\{0+0\} = 0$$

Now if n≠k, we have:

$$\int_{-\pi}^{\pi} cos^2(nx)dx$$

$$\int_{-\pi}^{\pi} cos(nx) sen(nx)dx$$

$$\int_{-\pi}^{\pi} sen^2(nx)\, dx \qquad (32)$$

Deducing equation (32) we have:

$$\int_{-\pi}^{\pi} cos^2(nx)dx = \int_{-\pi}^{\pi} \frac{1}{2}[1 + cos(2nx)]dx$$

$$\int_{-\pi}^{\pi} \frac{1}{2} dx + \frac{1}{2}\int_{-\pi}^{\pi} cos(2nx)\, dx$$

$$\frac{1}{2}x + \frac{1}{4n}sen(2nx)]_{-\pi}^{\pi} = [\frac{1}{2}(\pi - (-\pi) + [\frac{1}{4n}sen(2n\pi) + \frac{1}{4n}sen(2n(\pi))]$$

$$[\frac{1}{2}(\pi + \pi) + [\frac{1}{4n}sen(2n\pi) + \frac{1}{4n}sen(2n(\pi))]$$

$$[\frac{1}{2}(2\pi) + [\frac{1}{4n}sen(2n\pi) + \frac{1}{4n}sen(2n\pi)]$$

$$\pi + 2\frac{1}{4n}sen(2n\pi)$$

$$\pi + \frac{1}{2n}sen(2n\pi)$$

With $0 = sem(2\pi) = sen(2n\pi)$ and $\pi + (1/2n) * 0 = \pi$, therefore:

$$\int_{-\pi}^{\pi} cos^2(nx)\,dx = \pi \qquad (33)$$

$$\int_{-\pi}^{\pi} sen^2(nx)\,dx = \pi$$

Deducing the equation (33) we have:

$$\int_{-\pi}^{\pi} cos(nx)\,sen(nx)\,dx =$$

$$u = sen(nx) \Rightarrow \frac{du}{dx} = -ncos(nx) \Rightarrow du = -ncos(nx)dx$$

$$-\int_{-\pi}^{\pi} cos(nx) u \frac{du}{ncos(nx)} = \frac{1}{4n}[-sen(2n\pi) - sen(2n(\pi)) \int_{-\pi}^{\pi} sen^2(nx)dx - \frac{1}{n}\int_{-\pi}^{\pi} udu =$$

$$-\frac{u^2}{2n}\Big]_{-\pi}^{\pi} = -\frac{sen^2(nx)}{2n}\Big]_{-\pi}^{\pi} = \left\{-\left[\frac{sen^2(nx)}{2n} - \left[-\frac{sen^2(n(-\pi))}{2n}\right]\right]\right\}$$

$$\left\{-\frac{sen^2(nx)}{2n} + \frac{sen^2(n\pi)}{2n}\right\} = 0$$

Therefore:

$$\int_{-\pi}^{\pi} cos(nx)\,sen(nx)\,dx = 0 \qquad (34)$$

Deducing the equation (34) we have:

$$\int_{-\pi}^{\pi} sen^2(nx)\,dx = \int_{-\pi}^{\pi} \frac{1}{2}[1 - cos(2nx)]dx$$

$$\int_{-\pi}^{\pi} \frac{1}{2}\,dx + \int_{-\pi}^{\pi} \frac{cos(2nx)}{2}\,dx$$

$$\frac{1}{2}\{(\pi - (-\pi)] - + \frac{1}{4n}[-sen(2n\pi) + sen(2n(-\pi))]$$

$$\frac{1}{2}\,2\pi - + \frac{1}{4n}[-sen(2n\pi) - sen(2n(\pi))$$

$$\pi + \frac{1}{4n}[-2sen(2n\pi)$$

$$\pi - \frac{1}{2n}\,2sen(2n(\pi))$$

As $0 = sen(2\pi) = sem(2n\pi)$ e $\pi - (1/2n) * 0 = \pi$, therefore:

Now let's determine the coefficients a_n and b_n. Suppose $f(x)$ is periodic, can be represented in the form of Fourier.

$$f(x) = \frac{a_0}{2} + \sum_{n=1}^{\infty} [a_n cos(nx) + b_n sen(nx)]$$

Multiplying both members by cos (kx), with k 0, we have:

$$f(x)cos(kx) = \frac{a_0}{2}cos(kx) + \sum_{n=1}^{\infty} [a_n cos(nx)cos(kx) + b_n sen(nx)cos(nk)]$$

By Proposition (3.1.1), we have that the Fourier trigonometric series can be integrated term to term.

$$\int_{-\pi}^{\pi} f(x)cos(kx)\,dx = \int_{-\pi}^{\pi} \frac{a_0}{2}cos(kx)\,dx +$$

$$\int_{-\pi}^{\pi} \sum_{n=1}^{\infty} [a_n cos(nx)cos(kx) + b_n sen(nx)cos(nk)]dx$$

With n = k:

$$\int_{-\pi}^{\pi} f(x)cos(kx)dx = \int_{-\pi}^{\pi} \frac{a_0}{2}cos(kx)dx + \sum_{n=1}^{\infty} \int_{-\pi}^{\pi} [a_n cos^2(nx) + b_n sen(nx)cos(nk)]\,dx$$

$$\int_{-\pi}^{\pi} f(x)cos(kx)\,dx = \int_{-\pi}^{\pi} cos^2(nx)\,dx = a_k\pi$$

Therefore:

$$a_k = \frac{1}{\pi} \int_{-\pi}^{\pi} f(x)cos(kx)\,dx \qquad (35)$$

Now, multiplying the two members of the equality by without (nx) and integrating again over the range (-π, π), one obtains:

$$f(x)sen(kx)\,dx = \frac{a_0}{2}sen(kx)\,dx +$$

$$\sum_{n=1}^{\infty} [a_n \cos(nx) sen(kx) + b_n sen(nx) sen(nk)] dx$$

$$\int_{-\pi}^{\pi} f(x) sen(kx)\, dx = b_k \int_{-\pi}^{\pi} sen^2(kx)\, dx = b_k \pi$$

$$b_k = \frac{1}{\pi} \int_{-\pi}^{\pi} f(x) sen(kx)\, dx$$

3.2 The Fourier theorem

If an f(x) function is periodic or not written in the form of Fourier then it converges evenly to the midpoint of the function at each point. That is:

$$f(x) = \frac{a_0}{2} + \sum_{n=1}^{\infty} [a_n \cos(nx) + b_n sen(nx)] \tag{36}$$

Where:

$$a_0 = \frac{1}{\pi} \int_{-\pi}^{\pi} f(x) dx \tag{37}$$

$$a_n = \frac{1}{\pi} \int_{-\pi}^{\pi} f(x) \cos(nx) dx \tag{38}$$

$$b_n = \frac{1}{\pi} \int_{-\pi}^{\pi} f(x) sen(nx) dx \tag{39}$$

3.2.1 Examples of functions developed in the form of Fourier

Any function can be expressed in the form of Fourier. If the given function is periodic we have nothing to say but if it is not we will have to define it in a certain subset of your domain. Here are some examples of Fourier series development.

Example 1: A periodic 2π period f(x) function is set as follows:

$$f(x) = x; -\pi \le x \le \pi$$

In this way, we have:

$$a_0 = \int_{-\pi}^{\pi} x dx = \frac{1}{\pi} \frac{x^2}{2}]_{-\pi}^{\pi} = \frac{1}{\pi}\left[\frac{\pi^2}{2} - \frac{\pi^2}{2}\right] = \frac{1}{\pi} 0 = 0 \tag{40}$$

Therefore, $a_0 = 0$. Calculating a_k, we obtain:

$$a_0 = \frac{1}{\pi} \int_{-\pi}^{\pi} x\cos(kx) dx$$

By doing the part-by-part integration technique:

$$uv - \int v du$$

$$u = x \Rightarrow \frac{du}{dx} = 1 \Rightarrow du = dx$$

$$dv = \cos(kx)\, dx = x \Rightarrow \int dv = \int \cos(kx)\, dx$$

$$v = -\frac{1}{k} sen(kx)$$

$$-\frac{x sen(kx)}{k}]_{-\pi}^{\pi} - \int \frac{1}{k} sen(kx)\, dx =$$

$$-\frac{x sen(kx)}{k}]_{-\pi}^{\pi} - \int \frac{1}{k^2}\cos(kx)]_{-\pi}^{\pi} = 0$$

Calculating b_k:

$$b_k = \frac{1}{\pi} \int_{-\pi}^{\pi} x sen(kx)\, dx = \frac{1}{k}\{\frac{x\cos(kx)}{k}]_{-\pi}^{\pi} + \frac{1}{k} \int_{-\pi}^{\pi} \cos(kx)\, dx =$$

$$(-1)^{k+1} \frac{2}{k}$$

$$f(x) = 2\left[\frac{sen(x)}{1} - \frac{sen(2x)}{2} + \frac{sen(3x)}{3} - \frac{sen(4x)}{4} + \cdots (-1)^{k+1} \frac{sen(kx)}{k} \cdots\right]$$

$$f(x) = \sum_{n=1}^{\infty} (-1)^{k+1} \frac{sen(kx)}{k} \tag{41}$$

Example 2: Be f(x) = cos(3t). Calculate the coefficients a_0, a_n, b_n.

Calculating a_0:

$$a_0 = \frac{1}{\pi} \int_{-\pi}^{\pi} \cos(3t)\, dt \Rightarrow a_0 = \frac{1}{3\pi} \int_{-\pi}^{\pi} \cos(w) dw \tag{42}$$

$$a_0 = \frac{1}{3\pi} \int_{-\pi}^{\pi} \cos(w)\, dw]_{-\pi}^{\pi} \Rightarrow a_0 = \frac{1}{3\pi}[-sen(3\pi) - sen(-3\pi)]$$

$$a_0 = \frac{1}{3\pi}[-sen(3\pi) + sen(3\pi)] = 0$$

Because the sin(x) function is odd i.e.; -sin(x) = sin(-x).

Calculating a_n:

$$a_n = \frac{1}{\pi}\int_{-\pi}^{\pi} \cos(3t)\cos(nt)dt \qquad (43)$$

$$a_n = \frac{1}{\pi}\int_{-\pi}^{\pi}\frac{1}{2}[\cos(3-n)\,t + \cos(3+n)]t dt$$

$$a_n = \frac{1}{2\pi}\int_{-\pi}^{\pi}\cos(3-n)\,t dt + \frac{1}{2\pi}\int_{-\pi}^{\pi}\cos(3+n)\,t dt$$

$$a_n = \frac{-1}{2\pi(3-n)}sen(3-n)t]_{-\pi}^{\pi} - \frac{1}{2\pi(3+n)}sen(3+n)t]_{-\pi}^{\pi}$$

Applying the integration limits, you have:

$$a_n = \frac{-1}{2\pi(3-n)}\Big[sen[(3-n)\pi] - sen[(3-n)(-\pi)]\Big] -$$

$$\frac{-1}{2\pi(3+n)}\Big[sen[(3+n)\pi] - sen[(3+n)(-\pi)]\Big]$$

$$a_n = \frac{-1}{2\pi(3-n)}\Big[sen[(3-n)\,\pi] + sen[(3-n)\pi]\Big] -$$

$$\frac{-1}{2\pi(3+n)}\Big[sen[(3+n)\pi] + sen[(3+n)\,\pi]\Big]$$

$$a_n = \frac{1}{\pi(3-n)}sen[(3-n)\pi] - \frac{1}{\pi(3+n)}sen[(3+n)\pi]$$

Therefore:

$$a_n = \frac{2n\,sen(n\pi)}{\pi(3-n)(3+n)}$$

Calculating b_n:

$$b_n = \frac{1}{\pi}\int_{-\pi}^{\pi}\cos(3t)\,sen(nt)dt \qquad (44)$$

$$b_n = \frac{1}{2\pi}\int_{-\pi}^{\pi}[sen(3-n)t + sen(3+n)\,t]dt$$

$$b_n = \frac{1}{2\pi}\int_{-\pi}^{\pi}sen(3-n)\,t dt + \frac{1}{2\pi}\int_{-\pi}^{\pi}sen(3+n)\,t dt$$

$$b_n = \frac{1}{2\pi(3-n)}\cos(3-n)\,t]_{-\pi}^{\pi} + \frac{1}{2\pi(3+n)}\cos(3+n)\,t]_{-\pi}^{\pi}$$

$$b_n = \frac{1}{2\pi(3+n)}\cos[(3+n)\pi] - \frac{1}{2\pi(3+n)}\cos(3+n)(-\pi) -$$

$$\frac{1}{2\pi(3-n)}\cos[(3-n)\,\pi] - \frac{1}{2\pi(3-n)}\cos(3-n)(-\pi)$$

Because the function $\cos(x)$ is even, that is, cos (x) = cos (-x). We conclude that $b_n = 0$.

Therefore the Fourier series representing the given function will be:

$$f(t) = \sum_{n=1}^{\infty}\frac{2n\,sen(\pi n)}{\pi(3-n)(3+n)}\cos(nt) \qquad (45)$$

IV.   FOURIER SERIES APPLICATION

In order to present the applications of the Fourier series, we first have to analyse graphically the functions even and odd and the ones that are neither even nor odd.

4.1 Graphical Examples

To start, we will analyze three examples: the first includes an even function, the second an odd function, and the third a function neither even nor odd.

Example 1: Be the par and periodic function of period 2π:

$$\begin{cases} f(t) = t^2, -\pi < t \le \pi \\ f(t + 2\pi) = f(t) \end{cases}$$

We demonstrate graphically that this function can be synthesized in a sum of cosines of the type:

$$f(t) \sim \frac{\pi^2}{3} - 4\left(cost - \frac{1}{4}cos2t + \frac{1}{9}cos3t - \frac{1}{16}cos4t + \frac{1}{25}cos5t - \cdots\right)$$

Each cosine term in the series is called harmonic. The first harmonic is called fundamental harmonic. Therefore, cos(t) is the fundamental harmonic; cos(2t), the second harmonic; cos(3t), the third harmonic and so on. It should be noted that the amplitude of each harmonic is equal to $(-1)n * 4/n2$. So the amplitude of the twentieth harmonic will be 1/100. Also note that the angular frequency, defined by the number of period per unit of time and expressed in radian per second, of each harmonic grows linearly with the order of the harmonics.

Figure 1 illustrates the approximation of a par function by the sum of cosines.
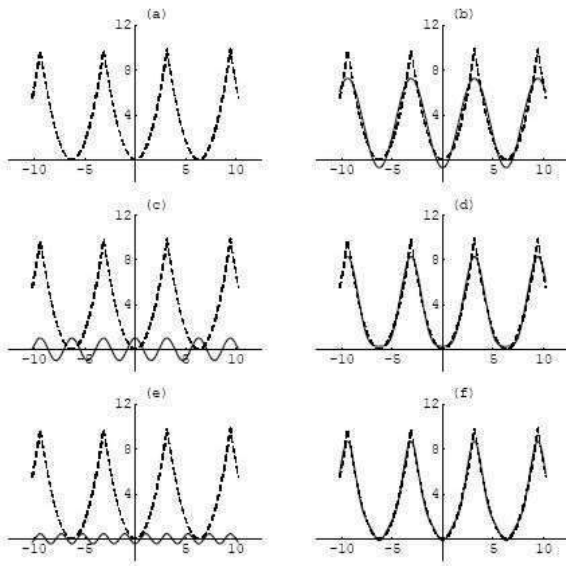
Fig. 1 approximation of a par function by the sum of cosines

In Figure 1, graph (a) represents the function f(t); graph (b) shows the first two terms of the sum overlapped with the graph of function f (t):

$$\frac{\pi^2}{3} - 4\cos(t)$$

(46)

In (c), the graphs of the function of the second harmonic, cos (2t); in (d) the graph of the first three terms overlapped with the graph of the f(t) function:

$$\frac{\pi^2}{3} - 4\cos(t) + \cos(2t)$$

(47)

The graph (e) plots the function and the third harmonic, and finally in (f) the graph of the first four terms overlaps with that of the function.

Examining these graphs, it is observed that with only three harmonics one already has a reasonable approximation of function. Note that the amplitude of each additional harmonic decreases while the frequency gradually grows. Thus, the small details in the function graphics are filled in by the higher-order harmonics.

Intuitively, we can say that as the number of harmonics grows, the approximation of the function, by the sum, becomes more and more perfect.

As it is well remembered by SILVA and PINEHIRO (2012), the analysis of harmonic signals using the time domain in most cases is of complex resolution and with many integrals. An easier way to analyse signals is by using the frequency domain using the Fourier Transform. The Fourier Transform (equation 48) is a useful tool, because through it differential and integral equations are reduced to simple algebraic equations. Its use is of great importance to know analysis of the total energy of the time series.

$$f(\omega) = \int_{-\infty}^{\infty} f(t)e^{-i\omega t}\, dt$$

(48)

Applying the Fourier Transform, we have a graph usually called the Energy Spectrum or Frequency with on the axis of the abscesses having the frequency and axis of the ordered energy. Each bar of a graphic is a phasor with certain frequency and amplitude. Using the frequency spectrum graph, we can represent a non-periodic signal as the sum of its phase components (SILVA and PINHEIRO, 2012).

Example 2: The function we just analysed is a periodic even function. Now, we're going to investigate an odd periodic function. Therefore, the following periodic function of period 2π:

$$\begin{cases} f(t) = -1, -\pi < t \leq \pi \\ f(t) = 1, \quad\ \ 0 < t \leq \pi \\ f(t + 2\pi) = f(t) \end{cases}$$

Similarly to the previous example, we draw the graphics of the function and the first harmonics. As this is an odd function let's now use sine harmonics. Such an approximation and provided by:

$$f(t) \sim \frac{4}{\pi}\left(sin t + \frac{1}{3}sin3t + \frac{1}{5}sin5t + \frac{1}{7}sin7t + \cdots \right)$$

Note that the amplitudes of the harmonics are expressed by 4/(2n + 1)π, with n ≥ 1 .

The graphic analysis in Figure 2 follows exactly the same script used in Figure 1. It is observed that with only three harmonics it is not possible to adjust this function as well as the previous even function. This means that convergence is slower in this case. In other words, much more harmonics will be needed to obtain the same degree of approximation obtained in the previous case. The reason for this is that this function is more uncompromising than the previous one because it is discontinued, whereas the previous one is a continuous function.
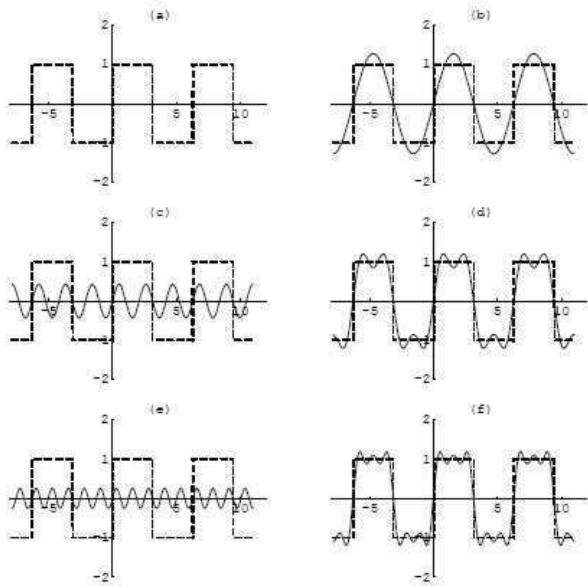
Fig. 2: Approximation of an odd function by sum of sines.

It is still surprising that even though it is a discontinuous function, it can be approximated by continuous functions (sine) with the degree of precision one wants. And only increase the number of harmonics.

At first mathematicians were very reluctant to accept this fact proposed by Fourier. At that time even the concept of function was not well defined yet. In fact, much of the advance of mathematical analysis in the 19th and early 20th centuries is due to this problem of convergence in the Fourier series.

Example 3: In the last two examples we have graphically seen that a pair function can be approximated by cosines and an odd function by sines. What if the function is neither even nor odd? We will soon see that any function (periodic or not) can be decomposed into an even component and an odd component. Therefore, a periodic function neither even nor odd can be approximated by cosines (even component adjustment) and sines (odd component adjustment) simultaneously. Be therefore the periodic function of period 2π:

$$\begin{cases} f(t) = e^t & -\pi < t \le \pi, \\ f(t + 2\pi) = f(t) \end{cases}$$

Similarly to the two previous examples, we show graphically that this function is approximated by a sum of sines and cosines of the type:

$$f(t) \sim 2\sinh 1 \left[\begin{array}{l} \frac{1}{2} - \frac{1}{1+\pi^2}(\cos t - \pi\sin t) + \frac{1}{1+4\pi^2}(\cos 2t - 2\pi\sin 2t) \\ -\frac{1}{1+9\pi^2}(\cos 3t - 3\pi\sin 3t) + \frac{1}{1+16\pi^2}(\cos 4t - 4\pi\sin 4t) - \ldots \end{array} \right]$$

With harmonic amplitude $(\cos(nt) - n\pi.\sin(nt))$ equal to $2\sinh(1)/(1 + n^2.\pi^2)$.
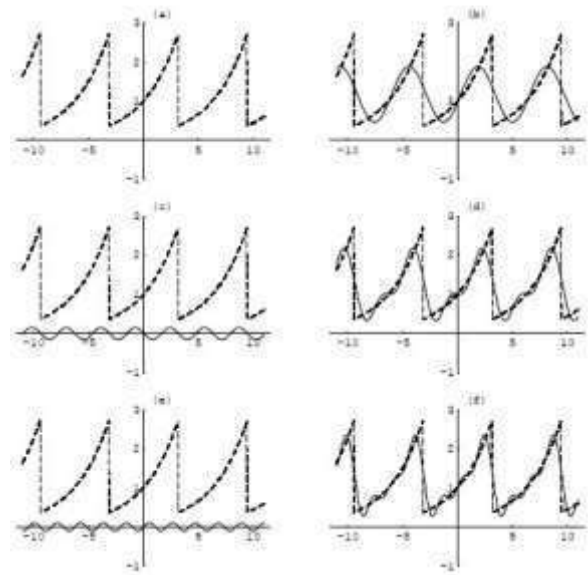
Fig. 3 Approximation of a function (neither even nor odd) by sum o cosines and sines.

As in the two previous examples, it is observed in Figure 3 that as the number of harmonics increases, the adjustment between the function graph and the sum of harmonics gradually improves.

A very important detail that should be highlighted in the three examples we have just seen is that in the first and third examples a constant term appears in front of the first harmonic: in the first example, the value $\pi^2/3$ is obtained, and in the third example $\sinh(1)$. In the second example, apparently this constant term does not exist. The point of this is that if the function is anti-symmetrical with respect to the axis of the abscissas, the constant term is identically zero. This is the case with the function of the second example. The functions of the first and third examples do not have this type of symmetry, and therefore the constant term is different from zero.

The constant term shifts the function vertically up or down. It is called the DC component of the signal, what stands for direct current. When you add continue current to an alternating current, you get a vertical offset of the alternating current. Hence the reason for the abbreviation DC. We'll get back to that later.

In the last example, the fact that the function was unfolded in an even component and another odd component was fundamental to be able to simultaneously use the sine and cosine in the approximation of the function. This is a general rule, that is, any function can effectively be decomposed into two components, one even and one odd.

4.2 Application in Electric Current

An alternating current i(t) = A.sen(x) has passed through a complete wave rectifier, which transmits the absolute (instantaneous) value of the current. We will show that the Fourier series that express is given by HALLIDAY (2003):

$$\frac{2A}{\pi} - \frac{4A}{\pi} \sum_{N=2,4,6,\ldots}^{\infty} \frac{\cos(nx)}{n^2 - 1} \tag{49}$$

If it were a half-wave rectifier it would be:

$$\frac{A}{2} + \frac{A}{2}\,sen\,(nx) - \frac{2A}{2} \sum_{N=1,3,5,\ldots}^{\infty} \frac{\cos(nx + x)}{n^2 - n} \tag{50}$$

However, first we must define the function that will be written under function of Fourier:

$$\begin{cases} f(t) = A.\,sen(x), & 0 \le t \le \pi, \\ f(t + 2\pi) = f(t), & \pi < t \le 2\pi \end{cases}$$

Calculating the coefficient a_0:

$$a_0 = \frac{1}{\pi}\int_0^\pi A\,sen\,(x)\,dx - \frac{1}{\pi}\int_\pi^{2\pi} A\,sen\,(x)\,dx$$

$$a_0 = \frac{A}{\pi}(-\cos(x)]_0^\pi + \frac{A}{\pi}\cos(x)]_\pi^{2\pi})$$

$$a_0 = \frac{4A}{\pi}$$

Calculating the coefficient b_n:

$$b_n = \frac{1}{\pi}\int_0^\pi A\,sen^2(nx)\,dx - \frac{1}{\pi}\int_\pi^{2\pi} A\,sen\,(x)\,sen(nx)\,dx$$

For n=1, you have:

$$b_1 = \frac{1}{\pi}\int_0^\pi A\,sen^2(x)\,dx - \frac{1}{\pi}\int_\pi^{2\pi} A\,sen^2(x)\,dx$$

$$b_1 = \frac{A}{2\pi}\int_0^\pi (1 - \cos(x))\,dx - \frac{A}{2\pi}\int_\pi^{2\pi} (1 + \cos(2x))\,dx$$

$$b_1 = \frac{A}{2\pi}]_0^\pi + \frac{sen(2x)}{2}]_0^\pi - x]_\pi^{2\pi} - \frac{sen(2x)}{2}]_\pi^{2\pi}$$

$$b_1 = \frac{A}{2\pi}(\pi - 2\pi + \pi) = 0$$

If we continue, we will see that all terms in sine are zero. Calculating the coefficient b_n:

$$b_n = \frac{1}{\pi}\int_0^\pi A\,sen\,(x)\cos(nx)\,dx - \frac{1}{\pi}\int_\pi^{2\pi} A\,sen\,(x)\cos(nx)\,dx$$

Note that it is enough to solve only one of the above integrals, because the only difference between them are the limits of integration. We will call the first integral (I) and resolve through part-by-party integration.

$$I = \frac{1}{\pi}\int_0^\pi A\,sen(x)\cos(nx)\,dx =$$

$$\frac{1}{n}\,sen\,(x)\,sen\,(nx) - \int_0^\pi A\,sen\,(nx)\cos(x)\,dx =$$

$$\frac{1}{\pi}\,sen\,(x)\,sen(nx) - \frac{\cos(x)\cos(nx)}{n^2} + \frac{I}{n^2}$$

$$I\left(1 - \frac{1}{n^2}\right) = \frac{1}{n}\,sen\,(x)\,sen(nx) - \frac{\cos(x)\cos(nx)}{n^2}$$

Applying the integration limits we will have:

$$I = \frac{n^2}{n^2 - 1}\left[\frac{1}{n}\,sen\,(x)\,sen\,(nx) - \frac{1}{n^2}\cos(x)\cos(nx)\right]_0^\pi$$

$$I = \frac{n^2}{n^2 - 1}\left[-\frac{1}{n^2}(-1)^n - \frac{1}{n^2}\right]$$

$$I = \frac{n^2}{n^2 - 1}[(-1)^{n+1} - 1]$$

Where, n=1,2,3,4, ... So the result of the integral is:

$$I = \frac{1}{\pi}\int_0^\pi A\,sen(x)\cos(nx)\,dx = \frac{-2}{\pi(n^2 - 1)}$$

Applying the integration limits of the second integral and summing both we have:

$$a_n = \frac{-4A}{\pi(n^2 - 1)}$$

Where, n=2, 4, 6, 8, ... Therefore the function representing the function will be:

$$g(x) = \frac{2A}{\pi} - \frac{4A}{\pi} \sum_{n=2,4,6,\ldots}^{\infty} \frac{\cos(nx)}{n^2 - 1} \tag{51}$$

The function written in the form of Fourier will be:

$$f(x) = \begin{bmatrix} A\,sen(x), se\ 0 \leq x \leq \pi \\ 0, sen \leq x \leq 2\pi \end{bmatrix}$$

Calculating the coefficient a_0:

$$a_0 = \frac{1}{\pi}\int_0^\pi A\,sen(x)\,dx + \frac{1}{\pi}\int_0^\pi 0\,dx$$

$$a_0 = \frac{A}{\pi}\int_0^\pi sen(x)\,dx =$$

$$\frac{-A cos(x)}{\pi}\Big]_0^\pi = \frac{2A}{\pi}$$

Calculating the coefficient b_n:

$$b_n = \frac{1}{\pi}\int_0^\pi A\,sen(x)\,sen(nx)\,dx$$

Where n=1, you have:

$$b_1 = \frac{1}{\pi}\int_0^\pi sen^2(x)\,dx = \frac{1}{2}\pi\int_0^\pi (1+cos(x))\,dx = \frac{1}{2}+\frac{sen(2\pi)}{4} = \frac{1}{2}$$

Therefore, the first term in sine will be:

$$\frac{A}{2}sen(x)$$

If we continue we will see that all terms in sine will cancel out, except the first.

Calculation of a_n:

$$a_n = \frac{1}{\pi}\int_0^\pi A\,sen(x)\cos(nx)\,dx$$

By the previous demonstration we have the result of this integral.

$$a_n = \frac{-2}{\pi(n^2-1)}$$

Doing n=k+1 in a_n:

$$a_k = \frac{-2}{\pi(k^2-2k)}$$

Therefore:

$$\frac{A}{2}+\frac{A}{2}sen(nx) - \frac{2A}{\pi}\sum_{n=1,3,5,\dots}^{\infty}\frac{cos(nx+x)}{n^2+n}$$

ARAÚJO and MÁRQUEZ (2015) examines a linear differential equation that represents a simples electric circuit of the type resistor inductor (RL), of which the electrical tension is expressed by a function E (t) impossible to be resolved analytically. In this particular case, the solution have not been expressed by a combination of elementary functions due to the nature of the function. However, by the use of the Fourier Transform and complex integration, it was possible to obtain an explicit expression involving the model parameters presented earlier in this paper, to represent the intensity of the electrical current of the examined circuit as a function of time.

4.3 Application in square oscillations

Another Fourier application to analyse is the square oscillation that can occur in an electronic circuit designated to guide the rise of the pulses. Suppose the oscillation is defined by:

$$f(x) = \begin{bmatrix} 0, se -\pi \leq x \leq \pi \\ h, se, 0 \leq x \leq \pi \end{bmatrix}$$

Using the equations for the calculation of Fourier coefficients, we have:

$$a_n = \frac{1}{\pi}\int_0^\pi h\,dt = h$$

$$a_n = \frac{1}{\pi}\int_0^\pi h cos(nt)\,dt = 0$$

$$b_n = \frac{h}{\pi}\frac{1}{n}$$

If n is odd:

$$b_n = 0$$

If n is even, the result is:

$$f(x) = \frac{h}{2}+\frac{2h}{\pi}\left[\frac{sen(x)}{1}+\frac{sen(3x)}{3}+\frac{sen(5x)}{5}+\dots\right]$$

Note that all terms in cosine disappear in the range (-π.π), that the terms that will represent the interpolated function will all be sine, and that this type of application is related to the following reasoning: As our electric current

is of the sine type, but there are machines that do not work with this current (a good example of this are the pulse motors), the current arrives at the machine with a sine behaviour and the rectifier transforms it into the current that the machine needs. This transformation was described above through the Fourier series.

A Fourier series can also be represented as a spectrum of frequency. In a graphic, amplitude vs. frequency, as proposed in Figure 4 by ANDRADE (2003), the relative amplitude of every frequency of square wave are represented by simple lines.
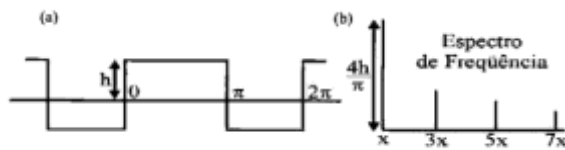
Fig. 4 (a) square wave representation followed by its frequency spectrum (b) (ANDRADE, 2003).

It is also demonstrated by Andrade (2003), how simple it is to explore theoretical aspects of physics and mathematics utilizing oscillating circuits in laboratory. In his experiment, it was obtained the Fourier coefficients applying to the circuit a tension with the shape of a square wave and frequency ω_0. Although a square wave is applied in the circuit, the electric current circulating is sinusoidal with maximum intensity in this shape. Therefore, it is conclude that a square wave is composed by an infinite series of harmonic waves with determinate frequencies and in consequence is possible to create a Fourier spectrum for the wave.

For the numeric solution of different equations in the context of analysis of oscillators amplitude, whenever is applied the Fourier transform the results a simple and precise (CARLOS EDUARDO, 2018). In the case of resonance the Fourier transform is again an important tool.

V.   CONCLUSION

We hope that the reader has understood the process of expanding a defined function in a range in an even or odd periodic function. The choice of the series in terms of sines (odd expansion) or cosines (even expansion) depends on the nature of the problem that one wants to solve.

It should be in mind that the periodic expansion of a function restricted to a range serves only as a support to use the Fourier series technique; and that once the expansion is done, the values outside the definition range

of the function become irrelevant, and therefore disposable. Only the approximation of the function, by the Fourier series, within the definition range of the function is of interest, the rest, I repeat, is disposable. It is good to know that, in practice, non-periodic functions defined in a range are more important and frequent than the periodic functions themselves.

So far, the impression one has is that any periodic function allows to be approximated by a series of Fourier. Is this true? The definitive answer to this question is subtle and is outside the objectives of this work. However, we can ensure that all periodic functions found here, in particular in electromagnetism can be developed by Fourier series. Technically, they meet Direchlet's conditions, which are sufficient conditions for a periodic function to be expanded in Fourier series.

Periodicity is one of the prerequisites for Fourier serial development. This leads us to ask the following question: If the function is non-periodic, is it still possible to speak in Fourier series? Roughly speaking, the answer is affirmative. There are two possibilities to be analysed: (a) functions restricted to a finite range of the line and (b) not-periodic functions defined in any straight or semi-straight.

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Monitoring experiences in the follow-up of autistic children: Report of pedagogical workshops

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Abstract— *Objective: to describe the pedagogical strategies and training experiences developed during the monitoring stage in the follow-up of autistic children, focusing on reaching their levels of potential development, using Vygotsky's socio-historical theory as a basis for reflection, which states that human development takes place through the social relationships that the individual establishes throughout his life, that is, that the teaching-learning process also develops through the interactions that unfold throughout his life. Method: This article consists of an experience report of the implementation of pedagogical workshops in the monitoring internship at a Child Psychological Care Center (CAPSi), located in the municipality of Ananindeua, State of Pará, Brazil, from September to November 2015, outlined using descriptive,*

Remedial Teaching.

observational and participatory methods. Results: We highlight some cases of evolution in relation to social interaction, which is the most compromised aspect in autistic people, emphasizing the importance of intervention for the full development of these people since childhood. Conclusion: Learning and the result of applying these methodologies are important records in the daily practice of health professionals, as they develop a more acute look around people with special needs, valuing their potential inside and outside the school environment, with a view to promote human emancipation, which is the true exercise of citizenship.

I.   INTRODUCTION

This study reports the experiences of monitoring the follow-up of autistic children during the teaching-learning process, which involved students, teachers and professional assistants, during the application of pedagogical workshops in the routine of a Child Psychological Care Center (CAPSi), city Ananindeua, State of Pará, Brazil. In the current scenario of education, it is recurrent for people with disabilities and their families to report the meanings attributed to care from their experiences and the importance of school, managers and teachers promoting in their practice the true inclusion.

As for this discussion, about the organization of the school, the appropriate care to be offered to People with Disabilities, mainly related to the training of teachers who develop or will develop pedagogical activities, in the common classrooms, to include all students, the article 27 of Law No. 13,146 / 15 guides and ensures that: "Education is the right of people with disabilities, ensuring an inclusive educational system at all levels of learning throughout their lives", so it is possible to achieve the maximum development, both of their talents and physical abilities, as well as sensory, intellectual and social, respecting their characteristics, interests and learning needs[1]. The laws historically constructed in the country have corroborated the sense of producing major changes in the Brazilian educational context[2-3]. This situation can be seen in the data from the School Census in relation to special education, showing an evolution in the number of enrollments, which went from 337,326 in 1998 to 900,000 in 2014, expressing a 300% growth in the number of students enrolled in regular education. Regarding the entry into common classes, it was found in 1998 that 13% of enrolled students were attending regular classes in regular education, and in 2014, the data showed that this percentage increased to 79%[4].

Implementation of the Berenice Piana Law (Law No. 12.764 / 12), which institutes the right of people with Autism Spectrum Disorder, is one of the first steps towards their insertion in the school environment. This law ensures in Article 2, the incentive to the training and qualification of professionals specialized in the care of people with autism spectrum disorder, making it mandatory and emphasizing the training of professionals[5-6].

According to the Ministry of Education, "teacher education and training are the main goals to be achieved in the realization of the educational system that truly includes everyone"[7].

The Ministry of Education compared data from the 2003 and 2013 School Census, and pointed to a 177% growth in the training of teachers in special education. In 2013 the census counted 93,371 educators, contrasting with the data for 2003, which was only 33,691 trained teachers[4].

The reported data refer to a reflection; there is a real increase in the number of students in regular schools, that is, they have had access to schools, which is positive, however some questions arise: how is the quality of education offered to these students? How are teachers being trained? Are schools really prepared? These questions cannot be quantified, but observed and analyzed, so that we can know their evolution within society. The choice of this theme is justified as a way of contributing to studies on the inclusion of autistic children in the education network of the Northern Region of Brazil, sharing the monitoring experience, in which, we present and describe some interventionist methodologies and guidelines in relation to reception of autistic people, more specifically children. Thus, we aim with this study to describe the pedagogical strategies and training experiences developed during the monitoring stage in the monitoring of autistic children, as well as to propose some guidelines for the relationship with autistic children and to describe the pedagogical resources used by the professionals of the Psychological Care Center Infantile (CAPSi) in the interaction with autistic children.

II.   METHOD

Description of the experience

Experience report, which describes aspects experienced by the authors, in the opportunity of a

monitoring internship at the Child Psychological Care Center (CAPSi), located in the municipality of Ananindeua, State of Pará, Brazil, from September to November 2015, after prior authorization from the coordination and direction of the service. It is a qualitative look, which approached the problem outlined using descriptive, observational and participatory methods.

CAPSi assists children with intellectual disabilities, cerebral palsy, Global Developmental Disorder (TGD), hyperactivity and attention deficit free of charge. Promoting diagnosis and continued treatment, having a multidisciplinary team in its assistance body, aiming to assist children in all their needs, both physical and psychological, and promote their full development.

The experience report is a tool of descriptive research that presents a reflection on an action or a set of actions that address a situation experienced in the professional sphere of interest to the scientific community8 .

The research project was not submitted to the Research Ethics Committee because it is an account of the authors' experience, with the consent of the place where the non-mandatory curricular internship took place and guarantees of data confidentiality. The following data collection techniques were used: field diary, structured observation (participating researcher), consultation with the clinical care form, participation in activities (pedagogical workshops). Personal data were not used, only those of interest to the study, but without mentioning data that could identify the research participants.

III.   RESULTS AND DISCUSSION

Monitoring steps

During the monitoring, we monitor the activities of the psychologist and pedagogue responsible for the preparation and application of the workshops. Upon arriving at the site, the psychologist received the students and teachers, which favored familiarization with the environment and enabled knowledge about the dynamics of activities, opening hours and proposed learning objectives.

The workshops were offered three times a week, on Monday, Tuesday and Wednesday, from 9:00 am to 12:00 pm. The monitoring was divided into three moments, which will be described below:

Step 01: preparation

At this time, non-systematic research was carried out on articles and relevant literature, whose themes were strategies to include autistic children and young people at different levels of education, with the main focus on basic

education. The researches were carried out during the period of two months that preceded this experience in the databases SCIELO, LILACS, PUBMED, Cochrane, Google scholar and some repositories of dissertations in Brazil, with the objective of deepening the knowledge on the subject to subsidize the actions in the monitoring.

Step 02: observation

During this period, only the actions taken by the psychologist and the pedagogue were observed, without interference. This step took place over two weeks.

Stage 03: intervention

At this stage, the participation of students and professors in the workshops actually started, applying the proposed activities together with the multidisciplinary team responsible for the service. This moment was able to provide a better relationship with the children and their legal guardians, allowing the authors to verify an improvement in the communication between the participants and an increase in the interaction of the children, an aspect more compromised in autistic people. The last step was marked by the collection of information about the strategies. All proposed activities had an objective that was explained to those involved before the workshop started and recorded in a field diary.

Guidelines and methodology

The groups attended during the workshops were formed by children between 5 to 10 years old, mostly boys. All CAPSi patients, diagnosed with autism, varying from mild degrees to more severe conditions.

The workshops attended an average of 15 children per day, due to the number of people available to minister them. Children were separated by age into three groups, in equal numbers, attended at different and predetermined times. Each workshop lasted an hour, and in some cases, the children's guardians participated in the moment. These measures aimed to organize and avoid direct exposure to diverse and intense stimuli, as such stimuli could overload them by saturation of information, leading them to to present a disorganized behavior, due to the difficulty in communicating their needs[9].

The workshop had two moments, the first being the reception of children. This stage was marked by socialization between them. The second moment was the application of stimulating activities, such as free drawing, painting, among others. The two moments had different mediation instruments, but with the same objective, to improve the interaction of children with the environment. In this context, according to the socio-historical approach, learning and development are intrinsically related processes and act through a dialectical process[10-11], which

we believe to be essential in the teaching and learning process.

First moment

The first moment consisted mainly of welcoming the children, and signaling the beginning of activities, important steps for the relationship with autistic people, since they are ritualized, have difficulties in interacting with their peers and often have difficulties in changing their routine[12].

This stage aims to insert the children in that new moment, trying to calm them down to the maximum. At this time, we put on children's songs, happy and known by many of them, which encouraged them to sing and dance with us and with their peers, that is, we promoted their interaction with the environment, because interaction is an essential field of socially shared reality. , providing the intersubjective context for the symbolization process[13].

Second moment

After the reception, we started the stimulating activities. Each child had a different degree of autism, and as the workshop was a continuity of treatment, the psychologist knew the profile of the patients and their needs at that time, that is, each child performed a specific activity, designed for him and that would contemplate some of your therapeutic needs. Here, taking Vygotsky's approach as a reference[11], we worked precisely in the children's Proximal Development Zone (ZDP), seeking through activities to reach the highest levels of potential development of these children.

We can cite as an example the case of one of the children who started the workshops in the same period of monitoring, so we can follow her evolution with the group in more detail. He, initially with very little interaction, after three months, already held the hand of his colleagues during the wheel games and accepted our touch.

In the case above, we can say that at the initial moment, the real level of development of these children was low interaction, but through mediation (play), we were reaching their level of potential development, that is, increasing ability to interact with their pairs. As Vygotsky[11] believed, the individual characteristics and even their individual attitudes are impregnated with exchanges with the collective, therefore, even what we consider to be the most individual of a human being was built from his relationship with the individual and his environment.

At the end of all the workshops, the children were encouraged to keep the toys and / or objects with which they had played during the activities, aiming to promote

their sensory discipline and organization inside and outside that environment. This attitude is important due to the fact that autistic children respond well to organized systems, therefore, the teacher or mediator must organize the environment to be able to teach students and they can develop their skills[14].

Resources

During the workshops, several resources were used as mediating instruments, and below we present some of them and their objectives.

Some proposed activities: making paintings and drawings using gouache paint, colored pencils and brush; collage with crepe paper; music therapy, using children's songs; use of educational toys such as puzzle, lego and memory game to stimulate reasoning, use of the rubber ball to stimulate confidence and balance; use of the sensory tree with different textures; use of the "make believe" strategy, to stimulate the imagination of the autistic child, as he / she perceives the concrete more easily.

Free drawing (Figure 01) was a resource used to stimulate fine motor development, since autistic children have difficulties with hand movement, also influencing their writing. They used the magnetic board and pilot pen or sheets of A4 paper in white and colored pencils to make their drawings.

Fig.1: Drawing done by a patient from the Center. (Personal Collection).

The activity called "Pretend" (Figure 02) aimed to stimulate children's creativity, considering that people with autism have difficulty with non-literal language. Thus, we stimulated his imagination, inventing stories and simulating everyday situations (vignettes), such as cooking, going to the beauty salon, among others.

Fig.2: "Pretend" activity. (Personal Collection).

One of the dialogues between one of the children and me during the activity:

"-What is that? Is it a hamburger?"

It responds with a positive nod.

"- And Do we eat this?"

The child responds by making gestures, putting hand to its mouth.

"Let's take Barbie to the salon!"

I pick up the hairbrush and hand it to the child, and then she starts combing the doll.

Methodological instruments made from E.V.A were used to teach children colors (Fig. 03), numbers (Fig. 04), gender and facial expressions (Fig. 05). This methodology becomes very effective, since visual elements, such as figures and drawings, provide better learning to autistic people.

Fig.3: Resource made of EVA to teach colors. (Personal collection).

Fig.4: Resource made by E.V.A to teach numbers. (Personal Collection).

Fig.5: Resource made by E.V.A to teach gender and facial expressions. (Personal Collection).

Due to the fact that people with autism have sensitivity to certain textures, such as rough, for example, this resource was developed, called "Tree of the senses" (Figure 06), where we provided children with the touch of different types of textures, aiming to decrease the discomfort caused by any of them.

Fig.6: The tree of the senses. (Personal Collection).

People with autism have impaired global and fine motor development, basically reflexes, balance and gait. With the objective of stimulating the improvement of these aspects and increasing your confidence, we use the trampoline and the rubber ball.

IV.   CONCLUSION

We present some guidelines, methodologies and resources used during the workshops at CAPSi, basing our work processes on Vygotsky's Socio-Historical Theory. We highlight some cases of evolution in relation to interaction, an aspect most compromised in autistic people, emphasizing the importance of these pedagogical strategies for the full development of the autistic person since childhood.

Monitoring, being an activity to support the teaching-learning processes and preparation for future teacher training, allows the acquisition of experiences and

knowledge, both in the aspects of popular knowledge and in technical-scientific knowledge.

The demands of the market impose on the teacher the concern with the characteristics of the students, mainly in relation to students with special educational needs, since, we are not really prepared to serve them during graduation. The importance of this experience cannot be measured, but learning and living with these methodologies will be important records in daily professional practice, nurturing you with a more acute look around people with special needs.

Monitoring seeks further academic improvement in view of the opportunity for experiences, theoretical and practical activities. It is expected that this study will contribute to raising awareness around inclusive education, understanding and the importance of these types of experiences, in addition to providing a reflection on the stigmas and stereotypes in relation to people with disabilities, valuing their potential inside and outside the world. school environment with a view to promoting human emancipation, which is the true exercise of citizenship.

We believe it is necessary to extend the study to other realities. Studies are also needed to allow the monitoring of similar experiences in order to identify other difficulties and / or facilities in this process.

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Loneliness and the Feeling of abandonment, related to Age, as Factors of Risk to Life

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Abstract— Formal operations, according to the theory of Jean Piaget (1896-1980) is the phase where the human being reaches the balance of his intellectuality that will last throughout his life, reaching his stage of maturation at around 40 years of age. Freud (1856-1939) shows that the adult phase is the result of events in childhood, which define its structure, categorizing it as neurotic, psychotic or perverse. Thus, the cognitive structures are formed, beforehand, and undergoing the necessary environmental changes to improve their maturation process, transforming the individual as a result of the environment. All of these interactions can form behaviors in the individual that evade normality, such as suicide. Biological, social and psychological factors associated with the economy emerge as causes of self-extermination. Objective: Create a strategic awareness of knowledge that, within certain age groups, the levels of risk of self-extermination are higher, directing psychotherapeutic work towards a more incisive investigation on the topic, as a prophylactic action. Methodological Approach: An electronic questionnaire of 8 (eight) questions, with closed answers, was made available through social networks, sent randomly to people of all ages, from 15 years of age onwards. 108 people signed up to the invitation. The answers would be: YES, NO and in just 3 there was a MAYBE that aimed to measure the hesitation before the question. After 63% of the people surveyed answered, the survey started to be developed, using the same form, personally. Results: research shows that those aged 15 to 25 and those aged 40 to 60 years have a strong tendency to risk self-extermination. Comparing their responses, it can be seen that those in this age group claim that they have already felt alone. And when asked if they ever thought about giving up on life, the data were mostly positive. Final Considerations: Analyzing the results, it can be inferred that loneliness, from the point of view of those aged between 15 and 25 and 40 to 60 years, is something that has meaning and open doors for suicidal ideas. This opens the way to carry out more detailed studies in order to identify prophylactic strategies to reach these individuals so that the gaps can be perceived and, within a psychotherapeutic process, this will be a fact that is seen as a priority for the prevention of self-extermination. Comparing their responses, it can be seen that those in this age group claim that they have already felt alone. And when asked if they ever thought about giving up on life, the data were

mostly positive. Final Considerations: Analyzing the results, it can be inferred that loneliness, from the point of view of those aged between 15 and 25 and 40 to 60 years, is something that has meaning and open doors for suicidal ideas. This opens the way to carry out more detailed studies in order to identify prophylactic strategies to reach these individuals so that gaps can be perceived and, within a psychotherapeutic process, this will be a fact that is seen as a priority for the prevention of self-extermination. Comparing their responses, it can be seen that those in this age group claim that they have already felt alone. And when asked if they ever thought about giving up on life, the data were mostly positive. Final Considerations: Analyzing the results, it can be inferred that loneliness, from the point of view of those aged between 15 and 25 and 40 to 60 years, is something that has meaning and open doors for suicidal ideas. This opens the way to carry out more detailed studies in order to identify prophylactic strategies to reach these individuals so that gaps can be perceived and, within a psychotherapeutic process, this will be a fact that is seen as a priority for the prevention of self-extermination. Final Considerations: Analyzing the results, it can be inferred that loneliness, from the point of view of those aged between 15 and 25 and 40 to 60 years, is something that has meaning and open doors for suicidal ideas. This opens the way to carry out more detailed studies in order to identify prophylactic strategies to reach these individuals so that gaps can be perceived and, within a psychotherapeutic process, this will be a fact that is seen as a priority for the prevention of self-extermination. Final Considerations: Analyzing the results, it can be inferred that loneliness, from the point of view of those aged between 15 and 25 and 40 to 60 years, is something that has meaning and open doors for suicidal ideas. This opens the way for more detailed studies to identify prophylactic strategies to reach these individuals so that gaps can be perceived and, within a psychotherapeutic process, this will be a fact that is seen as a priority for the prevention of self-extermination.

I. INTRODUCTION

Exponential cases of suicide are observed around the world. Some of them by a more cultural route, which the social sciences have been busy pondering on the issue and anthropology can make its inferences on the subject in very precise details, such as those that still happen in Japan, such as the incentives given to women in India, when they were widowed, even those involved in depressive states due to the oppression of China, in limiting pregnancies, transforming the place as the only one in which the suicide rate of women exceeds that of men (COUTINHO, 2010).

There are data stating that subsequent suicide attempts are successful and that they occur within the next 2 years after the first attempt showing that those who have tried are more likely to die than those who have never had a similar action.

In a study involving more than 40,000 participants (2,614 of whom were assisted by attempted suicide) from 1995 to 2001, the probability of dying from suicide in five years was sixty times higher among those who attempted suicide than among those with no history of attempt (VIDAL, 2013).

The intervals between one attempt and another started to decrease (VIDAL, 2013). Research points out that there are incidences at certain ages, as well as, it considers the issue of sex and, although women present themselves as the ones who try the most, men are the ones who have the greatest successes in their acts of self-extermination.

The gravity of the issue is known, placing it as a public health issue, as well as preventive interventions instruments such as: educational and awareness programs

for the general public and for professionals, identification of possible methods have already been created. of attempts, treatment of mental disorders, restriction of access to lethal means and the focus of the reports that appear in the media about suicide (ABREU, 2010).

An interesting piece of information is that the health teams were or are close to those who are going through the act of self-destruction.

> It was identified that more than 75% of suicide victims sought a primary health care service in the year of their death and 45% in the month that they committed suicide. Therefore, for the prevention of suicidal behavior, public health professionals play a fundamental role in the early detection of risk factors (ABREU, 2010).

Formal operations, according to the theory of Jean Piaget (1896-1980) is the phase where the human being reaches the balance of his intellectuality that will last throughout his life, reaching his stage of maturation at around 40 years of age. Freud (1856-1939) shows that the adult phase is the result of events in childhood, which define its structure, categorizing it as neurotic, psychotic or perverse. Thus, the cognitive structures are formed, beforehand, and undergoing the necessary environmental changes to improve their maturation process, transforming the individual as a result of the environment. In other words: the interactions that a person has with the environment, from its conception, lead him to the behaviors that one has. Those that are considered abnormal give science the name of pathological and these biological factors,

Depression has been the gateway as the main cause of suicide. However, considering what leads to this pathological state can make a big difference, from a psychotherapeutic perspective.

GOMES (2015) lists some risk factors such as: presence of mental disorders, suicidal ideation, history of suicide attempts, hopelessness and lack of life projects, anxious conditions, negative life events, family and social support (deficient), stress and method availability. In addition, Dalgalarrondo (2008) asserts that suicidal ideation should always be investigated in patients with a sad mood and that risk factors involve, among others, adolescents, middle-aged men and the elderly.

This study perceived the risk in the first two age groups: 15 to 25 and 40 to 60.

objective:

Make a comparison of the relationship between feeling of loneliness and hopelessness, observing specific ages and their maturation within human development. Create a strategic awareness of knowledge that, within certain age groups, the levels of risk of self-extermination are higher, directing psychotherapeutic work towards a more incisive investigation on the topic, as a prophylactic action, considering that the sooner it can be identified the threat of suicide, the more diligent the intervention may be. That would be a protective factor.

II.   METHODOLOGICAL APPROACH

An electronic questionnaire of 8 (EIGHT) questions (one of which only sought age), with closed answers, was made available through social networks, sent randomly to people of all ages, from 15 years of age onwards. 108 people signed up to the invitation. The answers would be: YES, NO and in just 3 there was a MAYBE that aimed to infer the hesitation before the question.

The study presented here came from results raised in a research that sought other data. When questions were made available, it was sought to know, within the psychotherapeutic approach, the extent to which people were confident in seeking psychological help. The questions were as follows:

1. Have you ever felt alone, even surrounded by people?
2. Did you have anything personal to talk to someone about, but there was no one to trust the matter with?
3. Is there anything unresolved that you would need to "vent" with someone?
4. Do you feel alone now?
5. Have you had any therapy?
6. Would you trust a Psychologist with something very personal?
7. Have you ever thought about giving up life?

After 63% of the people surveyed responded privately, the survey started to be developed, using the same form, personally. The researchers approached individuals on the street or at a gathering such as parties and churches. The main data sought was directly related to the needs foreseen in questions 1, 2, 3, 4, 5 and 7 with that of number 6, which would measure the willingness to seek psychological support.

When the data had already been collected, it was noticed that, in addition to what was proposed at the beginning of the work, there was a relationship between

questions 1, 2, 3, 4 and that of number 7. ages, comparing the dispositions of each age with the question number 7. Thus, it was noticed a configuration unrelated to that for which the fieldwork had been proposed, leading researchers to take advantage of the data for the study exposed here.

III. RESULTS

	Question 01	Question 02	Question 03	Question 04	Question 05	Question 06	Question 07
15 to 25 = 49							
YEA	92%	71%	51%	10%	31%	47%	49%
NO	8%	29%	49%	57%	69%	12%	43%
PERHAPS		0		33%		41%	8%
25 to 40 = 39							
YEA	74%	67%	44%	5%	15%	51%	36%
NO	26%	33%	56%	90%	85%	21%	54%
PERHAPS				5%		28%	10%
40 to 60 = 16							
YEA	94%	75%	44%	13%	37%	33%	44%
NO	6%	25%	56%	81%	63%	20%	50%
PERHAPS			0	6%		47%	6%
Above 60 = 4							
YEA	50%	75%	25%	0	75%	50%	25%
NO	50%	25%	75%	100%	25%	0	75%
PERHAPS				0		50%	0

- QUESTION 01 - Have you ever felt alone, even surrounded by people?
- QUESTION 02 - Did you have anything personal to talk to someone about, but there was no one to trust the matter with?
- QUESTION 03 - Is there anything unresolved that you would need to "vent" with someone?
- QUESTION 04 - Do you feel alone now?
- QUESTION 05 - Have you had any therapy?
- QUESTION 06 - Would you trust a Psychologist with something very personal?
- QUESTION 07 - Have you ever thought about giving up life?

When asked: "Have you ever felt alone even surrounded by people?" answered yes, 92%, aged between 15 and 25 years; 74% from 25 to 40; 94% from 40 to 60. Over 60 years were 50% for yes and no. In the question: "Is there anything unresolved that I would need to talk to someone about?", Answered NO 49% from 15 to 25, 56% from 25 to 40, 56% from 40 to 60 and 75% those over 60 years of age. When asked if they felt alone at the moment,

it was 57%, 90%, 81% and 100% for NO, respectively. In the question: "Have you ever thought about giving up on life?" All, except those over 60, had very expressive graphics, but what stood out was the results of those aged 15 to 25 years, in which 49% said YES, 43% said NO and 8% said MAYBE.

When asked about past experiences, most say they felt alone, making up 84.3%, even when surrounded by other people.

However, loyalty to the group was perceived by those in the 15 to 25 age groups, when asked if they felt alone at the moment. And these corresponded to 45.4% of the interviewees. None refused to answer the questionnaire, but there was hesitation in the answers when they were accompanied by another of the same age group. The responses were well thought out, increasing the number of "maybe", unlike when asked when they were alone.

Thus, these results are consistent with information that attests that "in Switzerland, the main cause of death up to the age of 25 is suicide" COUTINHO, AHS

IV. CONSIDERATIONS

Analyzing the results, it can be inferred that loneliness, from the point of view of those aged between 15 and 25, is something that has meaning only for the past, considering that when asked if they felt alone, at the moment, his objective responses were negative. Although the large number of "MAYBE", in this matter, shows a certain level of avoidance, it is due to the fact that they are accompanied by one of their peers. This makes the study more meaningful considering that those who would be in your class, are not aware of the real needs they have, aggravating their emotional state due to the absence of speech. And this emptiness can be a reason for negative considerations when they are alone. Gomes (2015) points out that a satisfactory social life is an important protective factor.

Due to the degree of severity, it is believed that there is also a risk group, those aged between 40 and 60 years. These have an accent on the past that seems to be delicate, which is as serious as those of 15 to 25 years old, because comparing the answers of when they were asked if they had already thought about giving up on life, it can be said that it is as serious as . While 49% of those aged 15 to 25 years said that yes, 44% of those aged 40 to 60 marked positively as well, where there could be a technical tie. Thus, these are the two ages of risk, for possible hopelessness, according to the results of the data presented here.

This opens the way to carry out more detailed studies in order to identify prophylactic strategies to reach these individuals so that gaps can be perceived and, within a psychotherapeutic process, this will be a fact that is seen as a priority for the prevention of self-extermination. One could also narrow investigations in order to understand, within these phases, what kind of prevalence of suicide there is, according to Durkheim's postulate, if it would be the selfish, the altruistic, the anomic or fatalistic. It would even be possible to taper each track to theoretical observations such as Kolberg's morality, in view of the Conventional internship and in cases involving teenagers and Martin EP Seligman's Theories of Helplessness for both age groups. In the case of those of a subsequent age group (40 to 60).

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Orthodontic treatment of anterior open bite

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Abstract— It is increasingly common for orthodontists to perform compensatory treatments for the correction of malocclusions presented by their patients, through a mechanism that is efficient and enables good results and long-term stability. An open vertical bite is defined as an open bite between the upper and lower incisal borders. It is one of the malocclusions of greater functional aesthetic impairment, with several etiological factors involved. It is emphasized that it is a discrepancy in the vertical direction, making it more difficult to correct and with less stability in its final results. Given the above, the objective of this article is to review the literature on orthodontic treatment in anterior open bite. The methodology used was an integrative literature review. In the first stage of the study, 227 articles were found, which referred to the orthodontic treatment of the anterior open bite (MAA). After reading the titles of the selected articles, 112 articles were selected. After reading the abstracts, only 55 studies were selected to be included in the critical and integral reading. Finally, 13 studies met the inclusion criteria. In clinical situations where a diagnosis is anterior open bite, during the mixed dentition period, the treatment option is the indication of the removable acrylic with Hawley's arch, the expander screw and palatal grid. However, it is important to note that success treatment in this case is also due to the cooperation of the patient.

I. INTRODUCTION

The term "open bite" was used by first time by Caravelli, in 1842, as a distinct classification of malocclusion, which can be defined in different ways. Some authors consider open bite, or tendency to open bite, when overbite is less than than the one considered normal. Others consider open incisal relationships to be an open bite. Still others specify that there is a need to lack of incisal contact to diagnose a open bite (ANTOUN et al., 2018).

The anterior open bite (MAA) is defined as absence of positive vertical overlap between teeth upper and lower anterior. It is a great challenge for professionals, to carry out the treatment of this malocclusion in adult patients, because in addition to the functional correction, it is necessary to obtain a satisfactory facial aesthetics and stability of the results . The anterior open bite can be classified into skeletal or dental (BONA et al., 2016).

The treatment of skeletal open bite, carried out in adulthood, presents great difficulty, since that its correction, in most cases, is associated surgical therapy. However, many patients and their families they are reluctant to accept surgical treatment, whether for financial reasons or for fear of the risk inherent in the surgical procedure. Therefore, and considering the need for treatment of these patients, orthodontics compensatory

action, has stood out as an alternative viable treatment. The anterior open bite (MAA) should be considered a complex and multifactorial malocclusion, being thus, numerous factors contribute to its occurrence and severity. It is worth noting that this bad occlusion can be associated with any facial pattern, however, vertical, long-faced patients have worse prognosis (FONSECA et al., 2019).

Jaw surgery should be rated higher in cost and risk than elastics for lengthen the incisors or occlusal reduction of the posterior teeth. On the other hand, if the less difficult procedures would provide little real benefit to the patient, while the jaw surgery would promote considerable benefit, cost-risk / benefit analysis it can also favor the most difficult procedure (ANTOUN et al., 2018).

We recognize that due to the advances achieved in recent years by orthognathic surgery, this therapy has greater predictability regarding the correction of malocclusion. The treatment occurs through counterclockwise rotation of the mandible which has the consequence of decrease in lower anterior facial height. However, some patients reject it as a way of treatment for socioeconomic issues and or even for the phobia of surgery.

In these patients, orthodontists are left with the application of orthodontic mechanics as a therapeutic procedure in order to improve these patients functionally and aesthetically.

There are few published studies on the orthodontic treatment of open bite in adult patients. When referring to this theme, several authors approach it, but referring to growing patients. This can be explained by the fact that, in adult patients, a malocclusion characterized by an open bite can be one of the most difficult problems to correct itself through orthodontic treatment. Thus, the patient adult would be left with surgical correction or orthodontic compensation.

Given the above, the objective of this article is to review the literature on orthodontic treatment in anterior open bite.

II.   HELITERATURE REVIEW

The basic etiological factors of anterior open bite are related to heredity and to environmental factors. In the phases of deciduous and mixed dentition, the factors most common etiological factors are environmental: tonsil hypertrophy, mouth breathing and especially deleterious mouth habits. The skeletal impairment is small in these cases. For that reason it is very important that environmental aetiological factors are stopped early, because in the permanent dentition phase, the involvement

skeletal-alveolar becomes larger, mainly if aggravated by a associated vertical growth pattern. Therefore, treatment in late stages is much more complex and unstable, involving, in some cases, cases, orthognathic surgery (JANSON; VALARELLI, 2015).

In the normal development of denture, a vector set of forces of the same intensity are directed at the teeth and their alveolar components in two directions: from lingual to vestibular and vice versa. The language consists of a powerful set of muscles that exerts very intense force on the teeth. Opposed to it, there is the action of a "muscular belt", which involves the dental arches externally and that was named by BRODIE as "Buccinator mechanism". In a normal situation, these forces are neutralize, so that the teeth and adjacent structures remain in balance (ALMEIDA, 2013).

However, any factor that interferes with this homeostasis in the growth and development of facial structures, can alter the morphology and function of the stomatognathic system. As triggering factors are deleterious oral habits, hypertrophic tonsils and mouth breathing. Furthermore, the development and intensity of open bite are related to facial growth pattern (BOB et al., 2014).

Alveolar teeth and bones are exposed to antagonistic forces and pressures arising mainly from muscle function, which in part can determine dental position. On the other hand, the forces of the lips and tongue at rest generate the condition of balance for the position of the teeth. By definition, balance exists when a resting body is subjected to forces in several directions but does not accelerate; or, in the case of teeth, it does not undergo displacement (FABRE et al., 2014).

Every time this balance is changed, changes occur, such as, for example, the contraction of dental arches in animals submitted to glossectomies, when compared to animals control. That way, when a tooth is extracted, its antagonist continues the process of passive eruption, indicating that the eruption remains basically unchanged when life and that the teeth seek contact occlusal or incisal until they reach equilibrium (VERRI et al., 2017)

Based on this idea of balance, countless etiological factors linked to oral function were associated with MAA, such as, for example, habits suction, presence of hypertrophic lymphoid tissues, mouth breathing, atypical phonation and swallowing, and anterior tongue posture at rest. It should be noted, however, that not all of these etiological factors have a causal relationship and absolutely clarified effect (VIEIRA et al., 2018)

For a correct diagnosis, it must first be understood that every malocclusion has a dental and a skeletal component;

It is the predominance of one of these components that determines its main characteristic: dental or skeletal (JANSON; VALARELLI, 2015).

According to MOYERS, in 1991, the open bite can be (1) simple, when it shows interference in the eruption of the anterior teeth and in the alveolar growth; and (2) skeletal, when vertical skeletal dysplasias occur. When the cephalometric analysis reveals normal values in the vertical direction and the problem is concentrated in the teeth and alveolar process, the open bite is simple (VIEIRA et al., 2018).

It is considered as an open bite skeletal is that which presents characteristics such as rotation of the palatal process in a counterclockwise direction, associated with an increase in height anteroinferior facial (AFAI), rotation jaw down and back, obtuse goniac angle and shortened mandibular ramus (ANTOUN et al., 2018).

Due to the numerous etiological factors described in the literature, different types of treatment have been proposed for the correction of MAA, there is still a consensus on what would be the best treatment for this malocclusion. Basically, different types of treatment can include: (a) behavior modification to elimination of abnormal habits or functions; (B) orthodontic movement through extrusion anterior teeth or molar intrusion; and (c) surgical treatment of bone bases. The only consensus that seems to exist is that the treatment of MAA is difficult and of little stability (FONSECA et al., 2019).

Myofunctional therapy is used for modifying function and consists of a set of exercises to re-educate the orofacial muscles in swallowing, phonation and postural resting position. It is believed that voluntary activities such as swallowing and phonation are more easy correction using myofunctional exercises, while involuntary activities such as postural language habits are difficult to automate (VIEIRA et al., 2018).

Another way to correct functional habits is to through mechanisms that prevent the language rest on your teeth. The most known are palatal or lingual grids and active tips or spurs. There is a consensus that these devices must be fixed, with the intention of re-educating the function until the automation of the movement is obtained QUINTÃO et al., 2017).

Palatal or lingual grids aim to correct the MAA by preventing the language from leaning on the teeth. They need to be long to prevent the tongue is positioned below them. However, as they are smooth structures, they allow the tongue lean on them in such a way that, in in some cases, this prevents their functional re-education. In these cases, the tongue returns to its original position, as demonstrated by the cinefluoroscopic method, thus causing MAA to recur (DOMANN et al., 2016).

The palatal grid is described as the best device for the correction of the alveolar anterior open bite. This device is used in the arc superior and can be fixed or removable, depending on the degree of collaboration of the patient. It is a passive device, with an effect restricted to the incisors, acting only as a mechanical obstacle, which not only prevents the digital suction or pacifier, but keeps the tongue in a more withdrawn position. Vertically, the palatal grid should extend up to the lingual region of the lower incisors, providing a seal of the area of the open bite. Containment can be performed with the device itself, for 3 to 6 months. Preferably, the fixed palatal grid is used, because, in addition to not depending on the patient collaboration, provides faster and safer results (ANJOS et al., 2018).

III.   METHODOLOGY

Integrative review, with a qualitative approach, whose data collection was carried out in January 2021, developed in six stages. In the first two stages, the justification, the question and the objective of the research were outlined. In the third stage, the Scielo, Pubmed and Lilacs databases were defined as research sources.

In the fourth stage, the inclusion criteria were: articles focused on orthodontic treatment of the anterior open bite (MAA), recorded from January 2015 to December 2020, containing the words "Orthodontics", "Open Bite", and " Previous Open Bite ", or in the title, abstract or keywords. In the fifth stage, a critical evaluation was carried out through a data collection script with the following information: author, year, objective, methodology and main results. In the sixth and last stage, the results were obtained, using content analysis for theoretical evaluation.

IV.   RESULTS AND DISCUSSION

In the first stage of the study, 227 articles were found, which referred to the orthodontic treatment of the anterior open bite (MAA). After reading the titles of the selected articles, 112 articles were selected. After reading the abstracts, only 55 studies were selected to be included in the critical and integral reading. Finally, 13 studies met the inclusion criteria, as shown in Figure 1.
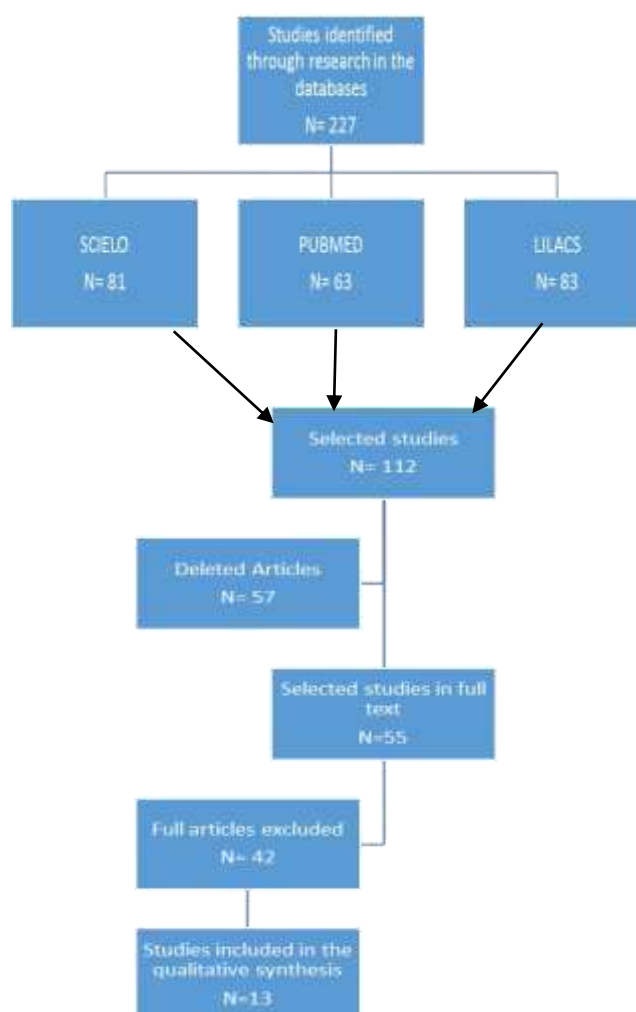
Fig. 1: Selection of studies for review.

This review consists of 13 articles published from January 2015 to December 2020. Of the selected sample, four were literature reviews, eight were clinical cases and one cross-sectional study, as shown in Table 1.

Table.1: References used in this review.

Authors	Year	Methodology	Objective	Main results
Fonseca et al.	2019	Literature review	Check if the deleterious habits of pacifier sucking, bottle feeding and finger sucking have any influence on the changes found in the stomatognathic system of the patient with a bite previous open.	Such results expressed that there is no significant differences between nozzle suction, orthodontic and conventional nozzles present the same rate of influence on the implications for the stomatognathic system. And that there is no possibility of conclude the existence of differences regarding the consequences to the stomatognathic system caused by by conventional or orthodontic nipples of both pacifiers and bottles.

Passos et al.	2019	Clinical case	To describe a clinical case of an adult patient with skeletal MAA treated with an orthosurgical approach with multisegmentation of the maxilla.	Considering the patient's age, skeletal changes and history recurrence, orthosurgical treatment was chosen, with advancement, intrusion and expansion of the maxilla, as well as correction of the inclination of the palatal plane. The treatment time was 24 months. At the end of treatment, the patient improved occlusion and aesthetics facial and smile. One year after the end of the treatment, the results were stable.
Tavares e Allgayer	2019	Clinical case	Discuss the treatment modalities of MAA, its advantages and implications.	The standard approach to treat adult patients with dentofacial deformities is the surgical-orthodontic treatment. By careful diagnosis and treatment, the problems diagnosed could be treated effectively and efficiently. The success and stability of treatment of severe AOB depend on an integrated multidisciplinary approach.
Anjos et al.	2018	Clinical case	To report the importance of orthodontic / orthopedic devices, in the period of facial cranial growth and the action of these devices in the treatment of anterior open bite, whose etiology was related to the habit of digital sucking.	With the intervention of these devices, we observed that the techniques used orthodontic / orthopedic, are being efficient in expanding the upper dental arches and inferior, both in the transversal and sagittal directions. He can- one can also observe the rebalancing of the lingual posture, thus obtaining the closure of the anterior open bite, rebalancing the patient's entire stomatognathic system.
Antoun et al.	2018	Literature review	Review articles about the previous open bite	Health professionals need to identify early the presence of habits deleterious oral health, as prevention results in a better quality of life for the patient, favoring adequate conditions for feeding, breathing and speech, improving harmony and facial balance.
Vieira et al.	2018	Literature review	Make an analysis of the treatment of anterior open bite (MAA), through a literature review.	Therefore, we seek to bring a better understanding of the subject, bringing a theoretical framework for health professionals on the exposed situation, highlighting the treatments most used in patients with occlusion problems that can have quite satisfactory results.
Arroyo et al.	2017	Clinical case	Present through a clinical case that sought the FAIPE	Vertical discrepancies are one of the biggest

				orthodontic specialization clinic, with maxillary atresia, anterior open bite and thumb sucking habit.	challenges to the clinic orthodontic, because those patients who have a vertical growth pattern must be treated with the utmost care. Environmental factors such as habits non-nutritive suction and mouth breathing, are one of the main causes of poor occlusion. Intercepting open bite cases can often seem simple, but it requires extreme care.
Quintão et al	2017	Clinical case		Describe the treatment of an anterior and lateral open bite associated with the congenital absence of permanent teeth.	The planning of the case involved a non-surgical treatment, with vertical growth control, obtaining correct overbite and closing of the upper spaces. The case ended with a good intercuspation, contemplating facial and dental aesthetics.
Verri et al.	2017	Clinical case		Describe the treatment established for a 13-year-old patient, presenting an anterior open dentoalveolar bite, caused by the habit of digital sucking until the age of 9, which triggered a lingual interposition and difficulty in proper phonation.	The proposed treatment was simple and effective orthodontics through the extrusion of anterior teeth using intermaxillary elastics, supported by a pre-adjusted metallic fixed orthodontic appliance (Andrews Prescription, slot 0.022 ") and clinical control showing stability after 2 years. The orthodontic treatment performed was satisfactory, but it is necessary to highlight the importance of the participation of speech therapists so that there was stability of the occlusion and return of muscle functions to normal.
Bonna et al.	2016	Clinical case		To report the clinical case of a patient with anterior open bite (MAA) associated with the harmful oral habit (HBD) of digital sucking and the importance of interaction between professionals in comprehensive treatment	The MAA intervention requires a multidisciplinary approach in order to reestablish the occlusion, providing an improvement in the child's self-esteem and, consequently, in the quality of life.
Domann et al.	2016	Clinical case		To establish a guide for the differential diagnosis between anterior open dental bite and anterior open skeletal bite.	There was an improvement in the clinical picture with closure of the bite previous open. Early treatment of this condition should always be indicated, with in order to prevent the development of a more complex malocclusion in the future, the that would make the treatment more extensive and costly. Decreasing the possibility of recurrence and increasing the stability index.
Miotto et al.	2016	Cross-sectional study		To verify the prevalence of anterior open bite and possible associations with sociodemographic variables, non-nutritive	A prevalence of 16% was found anterior open bite, associated with the male gender ($p = 0.008$), digital suction ($p = 0.011$), with the use of

			sucking habits and bottle feeding in children aged 3 to 5 years.	baby bottles (p = 0.026) and pacifiers (p <0.001). The prevalence of open bite in preschool children was considered important and significantly associated with sucking habits.
Nakao et al.	2016	Literature review	Conduct a narrative review of the harmful oral habits that cause MAA	Orthodontists need to know harmful oral habits, because the concept of prevention results in the best quality of through the establishment of adequate conditions for feeding, breathing and speech, favoring harmony and balance between skeleton, soft tissue, morphology and dental volume, which have direct interference on the occlusion. This malocclusion when diagnosed and intercepted early, increases the likelihood of success of the orthodontic therapy.

The anterior open bite is one of the malocclusions greater functional aesthetic impairment. This is defined by the presence of a negative vertical overlap between the incisal edges of the upper and lower anterior teeth (FONSECA et al., 2019; BONNA et al., 2016).

This causes dental and skeletal changes, making it difficult to seizure and cutting of food, in addition to harming the enunciation of certain phonemes, which can create conditions unfavorable psychological conditions (PASSOS et al., 2019; ARROYO et al., 2017).

The anterior open bite requires professionals to immediate intervention, after the age of five, before irruption of permanent teeth, because the sooner the treatment is carried out, the faster and more stable the results. Early treatment, although relatively simple there is a need for a multidisciplinary approach, involving quite different areas, such as psychology, speech therapy, otolaryngology and orthodontics (TAVARES; ALLGAYER, 2019; ANJOS et al., 2018).

Orthodontic treatment planning differs according to the etiology and diagnosis of the bite open. Thus, the differential diagnosis between anterior open dental and skeletal bite is of fundamental importance. Radiographic cephalometry is an excellent instrument for diagnosis of these anomalies, which greatly helps in determine the most appropriate procedures for treatment. Steiner (1953) stated that the cephalometric tracings, even though they are not mathematically and geometrically accurate, provide a good interpretation of the results obtained, a more scientific guidance for diagnosis and planning orthodontic treatment

(VIEIRA et al., 2018; QUINTÃO et al., 2017; NAKAO et al., 2016).

The palatal grid is described by several authors as the best device for the correction of the anterior alveolar open bite. This device is used in the arc superior and can be fixed or removable, depending on the degree of collaboration of the patient. It is a passive device, with an effect restricted to the incisors, acting only as a mechanical obstacle, which not only prevents digital or pacifier sucking, but it also keeps the tongue in a more withdrawn position, preventing its interposition in the anterior teeth (MIOTTO et al., 2016; ANTOUN et al., 2018).

Palatal or lingual gratings are indicated to correct the MAA, because they require the tongue to rest on the teeth, they need to be long to prevent the tongue from positioning itself below them. However, they are smooth structures and allow the tongue to stay supported on the grid. The spurs force a change in the resting posture of the tongue, which modifies the sensory perception of the brain, thus obtaining a new motor response. That answer can be permanently printed in the brain, which explains the possible permanent change in the lingual posture produced by the spurs (ANJOS et al., 2018; DOMANN et al., 2016).

V.   CONCLUSION

In clinical situations where a diagnosis is anterior open bite, during the mixed dentition period, the treatment option is the indication of the removable acrylic with Hawley's arch, the expander screw and palatal grid. However, it is important to note that success treatment in this case is also due to the cooperation of the patient.

Clinical studies on MAA are, in general, experimental case-control models with small samples and the absence of a control group. This makes the information we have about this malocclusion are incomplete and therefore inconclusive. Further studies should be carried out with more significant samples.

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Educational action as a care technology aimed at raising awareness of Sexually Transmitted Infections for Adolescents

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Abstract— Objective: *report an experience regarding the development of an educational action on Sexually Transmitted Infections (STIs) for high school students from a public school in Belém (PA) – Brazil. Method: A descriptive research, an experience report type, was carried out by nursing and medical academics from a Private Teaching Institution, aimed at 61 high school teenagers from a public school in Belém, which was subdivided into three moments, the first related to the orientation of the theme and organization of materials for the dynamics, the second referring to a lecture on the most prevalent STIs and the third regarding the use of the didactic resource. Results: it was clearly perceived their unawareness on the part of numerous infections demonstrated. In addition, they were focused and participative, having presented relevant doubts that were resolved shortly after the lecture was presented. The educational game presented to the participants allowed a dynamic consolidation of the knowledge previously exposed, based on a methodology of memorization and repetition to fix the subjects. Conclusion: The educational action allowed to develop a process of reflection on the observed reality, realizing the need to lead adolescents to a new knowledge about sexuality and demystifying erroneous ideas, favoring the empowerment of young people regarding infections.*

I. INTRODUCTION

Sexually transmitted infections (STIs) are infectious diseases caused by bacteria, viruses or other microorganisms, transmitted by sexual contact (vaginal, anal and / or oral) without using a condom with an infected individual. In addition, there is a strong relationship between individuals with mental health, violence, sexual behavior and substance use (Shannon, CL & Klausner, JD, 2018).

Diseases arising from STIs have been a global phenomenon, currently presenting themselves as one of the most significant public health problems, due to their high severity and prevalence. Studies report that more than 1 million individuals get an STI daily and it is estimated that, each year, 500 million people acquire one of the curable STIs (syphilis, gonorrhea, chlamydia and trichomoniasis) (Moura, SLO, et al, 2021).

Infections can be recognized through common signs and symptoms, which constitute the syndromic diagnoses that commonly manifest themselves through genital ulcers, vaginal and urethral discharge, discomfort or pelvic pain, and verrucous lesions. In this way, the affected individual is often embarrassed by such symptoms, and they often do not perform adequate prevention (Steiner, R.J, et al, 2019).

The systems for sharing information from the use of the Internet have increased in search of advice on the diagnosis of STIs. There is a large participation of social media to increase the engagement of individuals, including the acceptance of individuals to perform STI tests (Tucker, JD, et al, 2020).

In principle, these infections happen in specific groups of the community, however, a deviation in the dynamics of incidence has been attempted, where young people start to have emphasis, being responsible for most of the occurrences nowadays. Studies have confirmed that the number of adolescents infected with STIs has increased in recent years, confirming the need to understand the behavior of this group so that comprehensive actions between health and education can be planned to interfere in this reality (Oliveira, L, 2015).

According to the World Health Organization (WHO), adolescence is the period between 10 and 19 years old - it is the phase of human development that marks the transition between childhood and adulthood. It is characterized by changes at the physical, psychological and social levels, and it is in this phase that the discovery of sexuality, knowledge of your body, and the search for pleasure occurs (Moura, SLO, et al, 2021).

Sexual relations in adolescence have started at an increasingly early age, stimulated by curiosity and reinforced by the need to declare their autonomy. Thus, the sexual practices of this population start without adequate knowledge and necessary guidance regarding the sexual act in a safe manner, which makes them an easy target for STI involvement (Oliveira, L, 2015).

The youth population has low adherence to the main infection prevention device, which is the condom. This is easily acquired and made available free of charge by health services, however, there is often resistance to adopt it in sexual practices, due to the aversion to its use, trust in the partner, lack of knowledge about its purpose and benefits (Passos, TS, et al, 2017).

In this context, the school environment is essential for guiding an adequate sexual life and educational activities must be carried out for this group, because the school is characterized as a space of commitment and social responsibility, open to the most varied types of dialogues and discussions. Thus, studies prove that the school is a favorable space for the dissemination of sexual education and, through the health education actions implemented, the school can interact directly with students (Ramos, FBP, et al, 2019).

Health education is a fundamental aspect in the prevention and treatment of sexually transmitted infections, and it is very important that health professionals advise patients on the relevance of the use of condoms related to the prevention of these infections (Passos, TS, et al, 2017).

II.   METHOD

In this sense, the present work aims to report an experience regarding the development of an educational action on STIs for high school students from a public school in Belém (PA), Brazil.

A descriptive research, an experience report type, was carried out by nursing and medical students from a Private Educational Institution, which took place on November 18, 2019. The target audience was high school teenagers from a state school in Belém (PA), where they were 61, divided into 36 men and 25 women, in a prevalent age group between 15 and 17 years old.

In this way, the work was organized by students and professors in the field of care, including medical and nursing students and 1 nurse, thus elaborating the educational action in three moments, where it was necessary to direct the adolescents to a room that would allow the realization of a dynamic and an educational lecture.

In the first moment, there was a meeting to plan activities and build intermediary didactic materials and, subsequently, to carry out STI prevention awareness and awareness activities. Thus, during an organization stage considered as characteristics of the target audience, adolescents, for an approach more directed to the context of vulnerabilities.

In the second moment, a lecture was held on the most common STIs - such as HIV (Human Immunodeficiency Virus)/AIDS (Acquired Immunodeficiency Syndrome), HPV (Human Papillomavirus), Chlamydia, Gonorrhea, Syphilis, Hepatitis B and C, among others. In this sense, the most frequently present factors were presented, including epidemiology, clinical aspects, recommended treatment, and prophylactic measures, with emphasis on the latter aspect due to the possibilities of controlling related morbidity and mortality.

In the third moment, a didactic resource directed to the reality of the participants developed by the organizers was used, entitled "Memory game", an easily understood technology organized in 20 pairs of cardboard cutouts that contained images and concepts on the previously discussed subject, so that students could recognize the figures and relate to the respective concepts.

The purpose of the game was to encourage understanding through a playful resource, thus making the environment more attractive for the activity, in addition to serving as motivation and stimulus for learning, given the greater assimilation of the information passed on during the playful dynamics.

III.   RESULTS AND DISCUSSION

During the initial presentation of the STIs to the students of the institution, it was noticed their lack of knowledge on the part of numerous infections demonstrated, referring to prevention measures, drugs currently used, more frequent and rapid diagnostic methods, and clinical signs which were not so clear, even with a piece of certain knowledge about the subject addressed.

According to Shannon, CL & Klausner, JD (2018), sexually transmitted infections are a growing concern among young people, with routine screening and treatment being essential points for the control of comorbidities. Therefore, priority should be given to preventive work, such as vaccination against Human Papillomavirus. Many current STI literature does not address the uniqueness of sexually transmitted diseases in adolescents, so there is an urgent need for additional research on effective strategies for the prevention and treatment of sexually transmitted diseases for adolescents.

Also, it was found that they were focused and participatory, having presented relevant doubts that were resolved shortly after the presentation of the lecture. It is worth noting that accessible terms to the age group and the level of scientific knowledge were used, allowing for an easier understanding of the subjects exposed, also favoring the elaboration of questions by the participants as the subject was presented in the dynamics.

According to Fisher, CB, et al (2018), more than half of young people are concerned about reporting their sexual orientation to providers because of fear of heterosexist prejudice, that their sexual health information is released to parents, and generally believe that young people from sexual minorities are not treated fairly and avoid communicating with service providers about sexual orientation and sexual health issues.

In addition, Ramos, FBP, et al (2019) emphasize, in a study on knowledge and preventive measures conducted with public school adolescents, the importance of discussing, debating, and emphasizing sexually transmitted infections in a clear and objective way. It was found that adolescents knew about the male condom, but did not know how to use it, in addition to not using it frequently. This highlights the need for educational actions aimed at young people, which can take the form of dialogue and action more attractive and conducive to the use of condoms during sexual relations.

Thus, the educational game presented to the participants allowed them to present, in a playful way, a dynamic consolidation of the knowledge previously exposed, using a methodology of memorization and repetition to fix the subjects. The students ensured the fixation of fundamental subjects such as serological exams, more frequent signs and symptoms, and, mainly, the prophylactic measures to prevent infections.

For Passos, TS, et al (2017), one of the fundamental themes for carrying out critical and reflective educational activities is the prevention of Sexually Transmitted Infections, mainly because more than 1 million people worldwide are infected with some STI all days, so it becomes very important to expand the organization of the prevention space, which includes posters and folders explaining about infections, preventive measures, lubricants and condoms for men and women in order to raise awareness of the people belonging to that community on the topic.

According to Ramos, FBP, et al (2019), the integration between education and health enables the formulation of action plans and activities with the population in the development of prevention goals. Health students are group information that has the ability to empower themselves on the subject and to improve their skills and guide the population, especially young people, on the importance of preventing, diagnosing STIs early.

According to Steiner, R.J, et al (2019), adolescence is recognized as a period of fundamental development in the formation of the personal trajectory until adulthood. During adolescence, many young people engage in risky behaviors or experience adverse events that lead to adverse health outcomes and reduced life opportunities. However, according to Salas-Wright, C. P., et al (2019) the participation of young people in programs to prevent health risk behaviors may be decreasing, compromising the control of new STI cases.

In addition, it is worth noting the presence of cyber sexual harassment among adolescents and its consequences on interpersonal relationships. In a study by Reed, E, et al (2019) at a health clinic in a low-income urban area in southeastern San Diego County, California, it was found that, in some subgroups, cyber sexual harassment appears to be affecting most girls, resulting in cases of depression and anxiety when exposed victims.

For Weisman, J, et al (2020), adolescents who report high-risk sexual behaviors are less likely to identify primary care physicians and are more inclined to adopt emergency care and visited the Emergency Room more often. However, in these cases, asymptomatic young people rarely took tests or reported their sexual histories, thus missing opportunities to examine high-risk adolescents who may not have access to preventive care.

In comformity with Oliveira, L (2015), the interaction between academics and the population can prove that the university, through health education, can positively impact the exchange of values in the community. Thus, for health promotion to effectively take place with the instrumentalization of health education, in addition to understanding the theme, concepts, and aspects it covers, it is essential to associate this practice with communication, information, continuity, education, and qualified listening.

IV. CONCLUSION

It was observed that it is necessary to alert adolescents more about the care they should take in relation to reproductive health in adolescence. It is essential to build critical knowledge of young people in relation to their health, favoring them the promotion of autonomy to take care of themselves, making them responsible for preserving their health and preventing STIs.

In this context, it is noted that for this to occur, it is necessary to disseminate information to improve knowledge, with educational activities being the most appropriate tool for health promotion and disease prevention. Through educational activities, there was a significant contribution for people to acquire autonomy to identify and apply the means and ways to care for and improve their quality of life.

The educational action allowed to develop a process of reflection on the observed reality, realizing the need to lead adolescents to new knowledge about sexuality and to

demystify erroneous ideas. Thus, health education is fundamental and indispensable because it enables the community to acquire knowledge that promotes adolescents' autonomy and empowerment over sexually transmitted infections.

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BASIC STEFFENSEN'S METHOD OF HIGHER-ORDER CONVERGENCE

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Abstract: In this paper, we introduce a new analog of a variant of Steffensen's method of fourth-order convergence for solving non-linear equations based on the q-deference operator.

1. INTRODUCTION

Finding the zeros of a nonlinear equation, $f(x) = 0$, is a classical problem of numerical analysis. Analytic methods for solving such equations rarely exit, and therefore, one can hope to obtain only approximate solutions by relying on iteration methods. For a survey of the most important algorithms, some excellent textbooks are available, see [4, 8, 10]. The classical Newtons method

$$x_{n+1} = x_n - \frac{f(x_n)}{f'(x_n)}, \quad n = 0, 1, 2, \ldots. \tag{1.1}$$

Being quadratically convergent, Newton's method is probably the best known and most widely used algorithm. Time to time the method has been derived and modified in a variety of ways. One such method derived from Newton's method by approximating the derivative with non-derivative term of difference quotient is Steffensen's method [9, 11]. The method requires two evaluations of function and is quadratically convergent. The interesting iterative scheme is Steffensen's method that has the following form:

$$x_{n+1} = x_n - \frac{f^2(x_n)}{(f(x_n + f(x_n)) - f(x_n))}, \quad n = 0, 1, 2, \ldots. \tag{1.2}$$

In order to control the approximation of the derivative and the stability of the iteration, a Steffensen's type method has been proposed in [2], this approach is based on a better approximation to the derivative $f'(x_n)$ in each iteration. It has the following form:

$$x_{n+1} = x_n - \frac{f(x_n)}{(f(x_n + \alpha_n|f(x_n)|f(x_n)) - f(x_n))/\alpha_n|f(x_n)|f(x_n)}. \tag{1.3}$$

After that, the paper [1] has extended the above result on Banach spaces, obtained its local and semi-local convergence theorems, and made its applications on boundary-value problems by multiple shooting methods.

A family of fourth order methods free from any derivative, satisfying the highest convergence order were established in [12–14].

2. q-Calculus

In the following, q is a positive number, $0 < q < 1$. For $n \in \mathbb{N} = \{0, 1, \ldots\}$, $k \in \mathbb{Z}^+ = \{1, 2, \ldots\}$ and $a, a_1, \ldots, a_k \in \mathbb{C}$, the q-shifted factorial, the multiple q-shifted factorial and the $q-$binomial coefficients are defined by

$$(a; q)_0 := 1, \quad (a; q)_n := \prod_{j=0}^{n-1}(1 - aq^j), \quad (a_1, a_2, \ldots, a_k; q)_n := \prod_{j=1}^{k}(a_j; q)_n, \tag{2.1}$$

and

$$\begin{bmatrix} a \\ 0 \end{bmatrix}_q := 1, \text{ and } \begin{bmatrix} a \\ n \end{bmatrix}_q := \frac{(1 - q^a)(1 - q^{a-1})\cdots(1 - q^{a-n+1})}{(q; q)_n}, \tag{2.2}$$

respectively. The limit, $\lim_{n\to\infty}(a; q)_n$, is denoted by $(a; q)_\infty$. Moreover $(a; q)_n$ has the representation, cf. [5],

$$(a; q)_n = \sum_{k=0}^{n}(-1)^k \begin{bmatrix} n \\ k \end{bmatrix}_q q^{k(k-1)/2}a^k. \tag{2.3}$$

The $q-$Gamma function, [5, 6], is defined by

$$\Gamma_q(z) := \frac{(q; q)_\infty}{(q^z; q)_\infty}(1 - q)^{1-z}, \quad z \in \mathbb{C}, \ |q| < 1, \tag{2.4}$$

where we take the principal values of q^z and $(1 - q)^{1-z}$. In particular

$$\Gamma_q(n + 1) = \frac{(q; q)_n}{(1 - q)^n}, \quad n \in \mathbb{N}.$$

Let $\mu \in \mathbb{C}$ be fixed. A set $A \subseteq \mathbb{C}$ is called a $\mu-$geometric set if for $x \in A$, $\mu x \in A$. Let f be a function defined on a q-geometric set $A \subseteq \mathbb{C}$. The q-difference operator is defined by the formula

$$D_q f(x) := \frac{f(x) - f(qx)}{x - qx}, \quad x \in A - \{0\}. \tag{2.5}$$

If $0 \in A$, we say that f has q-derivative at zero if the limit

$$\lim_{n\to\infty} \frac{f(xq^n) - f(0)}{xq^n}, \ x \in A \tag{2.6}$$

exists and does not depend on x. We then denote this limit by $D_q f(0)$. The q-integration of F. H. Jackson [7] is defined for a function f defined on a q-geometric set A to be

$$\int_a^b f(t)\, d_q t := \int_0^b f(t)\, d_q t - \int_0^a f(t)\, d_q t, \ a, b \in A, \tag{2.7}$$

where

$$\int_0^x f(t)\, d_q t := \sum_{n=0}^{\infty} xq^n(1 - q)f(xq^n), \quad x \in A, \tag{2.8}$$

provided that the series converges. A function f which is defined on a q-geometric set A, $0 \in A$, is said to be q-regular at zero if

$$\lim_{n\to\infty} f(xq^n) = f(0), \quad \text{for every } x \in A.$$

The rule of $q-$integration by parts is

$$\int_0^a g(x)D_qf(x)\,d_qx = (fg)(a) - \lim_{n\to\infty}(fg)(aq^n) - \int_0^a D_qg(x)f(qx)\,d_qx. \qquad (2.9)$$

If f, g are $q-$regular at zero, the $\lim_{n\to\infty}(fg)(aq^n)$ on the right hand side of (2.9) will be replaced by $(fg)(0)$. The two variable polynomial $\varphi_n(x,a)$, $x,a\in\mathbb{C}$, are defined to be

$$\varphi_0(x,a) := 1, \quad \varphi_n(x,a) := \begin{cases} x^n\,(a/x;q)_n, & x\neq 0, \\[2mm] (-1)^n q^{\frac{n(n-1)}{2}}a^n, & x=0. \end{cases} \qquad (2.10)$$

In [3], Annaby and Mansour gave q-Taylor series in the following forms

$$f(x) = \sum_{k=0}^{n-1}\frac{D_q^k f(a)}{\Gamma_q(k+1)}\varphi_k(x,a) + \frac{1}{\Gamma_q(n)}\int_a^x \varphi_{n-1}(x,qt)D_q^n f(t)\,d_qt. \qquad (2.11)$$

$$\begin{aligned} f(x) &= \sum_{k=0}^{n-1}(-1)^k q^{-\frac{k(k-1)}{2}}\frac{D_q^k f(aq^{-k})}{\Gamma_q(k+1)}\varphi_k(a,x) \\ &\quad + \frac{1}{\Gamma_q(n)}\int_{aq^{-n+1}}^x \varphi_{n-1}(x,qt)D_q^n f(t)\,d_qt, \end{aligned} \qquad (2.12)$$

3. A q-STEFFENSEN-SECANT METHOD

In the following we set $e_n = x_n - a$, $e_n^* = y_n - a$, $z_n = x_n + qf(x_n)$, $y_n = x_n - f(x_n)/f[x_n,z_n]$, where $f[a,b] = \frac{f(a)-f(b)}{a-b}$,

$$A = \frac{D_qf(a)}{\Gamma_q(2)} + \frac{a(1-q)D_q^2f(a)}{\Gamma_q(3)} + \frac{a^2(1-q)^2(1+q)D_q^3f(a)}{\Gamma_q(4)}, \qquad (3.1)$$

$$B = \frac{D_q^2f(a)}{\Gamma_q(3)} + \frac{a(1-q)(2+q)D_q^3f(a)}{\Gamma_q(4)}, \qquad (3.2)$$

and

$$C = \frac{D_q^3f(a)}{\Gamma_q(4)}. \qquad (3.3)$$

Now, we state and prove our q-Steffensen-secant Theorem with fourth order convergence.

Theorem 3.1. *Let $f:\mathcal{D}\to\mathbb{R}$ be a real-valued function with a root $a\in\mathcal{D}$, $\mathcal{D}\subset\mathbb{R}$, and let x_0 be closed enough to a. If $D_q^k(x)$, $k=1,2,3$ exist, and $D_q(a)\neq 0$, then*

$$x_{n+1} = y_n - \frac{f[x_n,y_n]-f[z_n,y_n]+f[z_n,x_n]}{f^2[x_n,y_n]}f(y_n), \quad n\in\mathbb{N}, \qquad (3.4)$$

is fourth-order convergent, and satisfies the following error equation

$$e_{n+1} = A^{-1}B(1+qA)\left[A^{-1}C(1+qA) - A^{-2}B(3+2qA+2q^2A^2)\right]e_n^4 + \mathrm{O}(e_n^5), \quad n\in\mathbb{N}. \qquad (3.5)$$

Proof. Using the Taylor expansion in (2.11), we have

$$
f(x_n) =
$$

$$
\frac{D_q f(a)}{\Gamma_q(2)}(x_n - a) + \frac{D_q^2 f(a)}{\Gamma_q(3)}(x_n - a)(x_n - qa) +
$$

$$
\frac{D_q^3 f(a)}{\Gamma_q(4)}(x_n - a)(x_n - qa)(x_n - q^2 a) + \frac{1}{\Gamma_q(4)}\int_a^{x_n}\varphi_3(a, qt)D_q^4 f(t)d_q t. \tag{3.6}
$$

Rearranging the above equation again gives:

$$
f(x_n) = Ae_n + Be_n^2 + Ce_n^3 + \mathrm{O}(e_n^4), \tag{3.7}
$$

that is

$$
f(z_n) = f(x_n + qf(x_n)) =
$$

$$
\frac{1}{\Gamma_q(4)}\int_a^{x_n + qf(x_n)}\varphi_3(a, qt)D_q^4 f(t)d_q t + \frac{D_q f(a)}{\Gamma_q(2)}(x_n - a + qf(x_n))
$$

$$
+ \frac{D_q^2 f(a)}{\Gamma_q(3)}(x_n - a + qf(x_n))(x_n - qa + qf(x_n)) +
$$

$$
\frac{D_q^3 f(a)}{\Gamma_q(4)}(x_n - a + qf(x_n))(x_n - qa + qf(x_n))(x_n - q^2 a + qf(x_n))
$$

$$
= \mathrm{O}(e_n^4) + \frac{D_q f(a)}{\Gamma_q(2)}(e_n + qf(x_n)) \tag{3.8}
$$

$$
+ \frac{D_q^2 f(a)}{\Gamma_q(3)}(e_n + qf(x_n))(e_n + qf(x_n) + a(1 - q)) +
$$

$$
\frac{D_q^3 f(a)}{\Gamma_q(4)}(e_n + qf(x_n))(e_n + qf(x_n) + a(1 - q))(e_n + qf(x_n) + a(1 - q^2))
$$

$$
= A(e_n + qf(x_n)) + B(e_n + qf(x_n))^2 + C(e_n + qf(x_n))^3 + \mathrm{O}(e_n^4).
$$

Thus,

$$
f(z_n) =
$$

$$
A[1 + qA]e_n + B[1 + 3qA + q^2 A^2]e_n^2 +
$$

$$
\left[C[1 + 4qA + 3q^2 A^2 + q^3 A^3] + 2qB^2[1 + qA]\right]e_n^3 + \mathrm{O}(e_n^4). \tag{3.9}
$$

Moreover,

$$
f[z_n, x_n] = \frac{f(x_n + qf(x_n)) - f(x_n)}{qf(x_n)}
$$

$$
= A + B[2 + qA]e_n + \left[C[3 + 3qA + q^2 A^2] + qB^2\right]e_n^2 + \mathrm{O}(e_n^3). \tag{3.10}
$$

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Therefore,

$$g(x_n) := \frac{f(x_n)}{f[z_n, x_n]} =$$
$$O(e_n^4) + e_n - A^{-1}B[1 + qA]e_n^2 +$$
$$\left[A^{-2}B^2[1 + qA][2 + qA] - qA^{-1}B^2 - A^{-1}C[2 + 3qA + q^2A^2] \right] e_n^3. \tag{3.11}$$

Consequently,

$$f(y_n) = f(x_n - g(x_n)) =$$
$$\frac{D_q f(a)}{\Gamma_q(2)}(x_n - a - g(x_n)) + \frac{D_q^2 f(a)}{\Gamma_q(3)}(x_n - a - g(x_n))(x_n - qa - g(x_n))$$
$$+ \frac{D_q^3 f(a)}{\Gamma_q(4)}(x_n - a - g(x_n))(x_n - qa - g(x_n))(x_n - q^2a - g(x_n))$$
$$+ \frac{1}{\Gamma_q(4)} \int_a^{x_n - g(x_n)} \varphi_3(a, qt) D_q^4 f(t) d_q t$$
$$= O(e_n^4) + \frac{D_q f(a)}{\Gamma_q(2)}(e_n - g(x_n)) + \tag{3.12}$$
$$\frac{D_q^2 f(a)}{\Gamma_q(3)}(e_n - g(x_n))(e_n + qf(x_n) + a(1 - q)) +$$
$$\frac{D_q^3 f(a)}{\Gamma_q(4)}(e_n - g(x_n))(e_n - g(x_n) + a(1 - q))(e_n - g(x_n) + a(1 - q^2))$$
$$= A(e_n - g(x_n)) + B(e_n - g(x_n))^2 + C(e_n - g(x_n))^3 + O(e_n^4).$$

This means

$$f(y_n) = O(e_n^4) + B[1 + qA]e_n^2 -$$
$$\left[A^{-1}B^2[1 + qA][2 + qA] - qB^2 - C[2 + 3qA + q^2A^2] \right] e_n^3, \tag{3.13}$$

and

$$e_n^* = O(e_n^4) + A^{-1}B[1 + qA]e_n^2 -$$
$$\left[A^{-2}B^2[1 + qA][2 + qA] - qA^{-1}B^2 - A^{-1}C[2 + 3qA + q^2A^2] \right] e_n^3. \tag{3.14}$$

On the other hand

$$f[x_n, y_n] = \frac{f(x_n) - f(y_n)}{g(x_n)}$$
$$= A + Be_n + \left[C + A^{-1}B^2[1 + qA] \right] e_n^2 + O(e_n^3). \tag{3.15}$$

Hence

$$f^2[x_n, y_n] = O(e_n^4) +$$
$$A^2 + 2ABe_n + \left[2AC + B^2[3 + 2qA] \right] e_n^2 + \left[2BC + 2A^{-1}B^3[1 + qA] \right] e_n^3. \tag{3.16}$$

But

$$f[z_n, y_n] = \frac{f(z_n) - f(y_n)}{qf(x_n) + g(x_n)} =$$

$$A + B(1 + qA)e_n + \left[C(1 + qA)^2 + A^{-1}B^2(1 + 4qA + 2qA^2)\right]e_n^2 + \mathrm{O}(e_n^3). \tag{3.17}$$

So that

$$H(x_n) = \frac{f[y_n, x_n] - f[z_n, y_n] + f[z_n, x_n]}{f^2[y_n, x_n]} =$$

$$A^{-1} + \left[A^{-2}C(1 + qA) - A^{-3}B(3 + 2qA + 2q^2A^2)\right]e_n^2 + \tag{3.18}$$

$$\left[-2A^{-3}BC(2 + qA) + A^{-4}B^2(5 + 3qA + 4q^2A^2)\right]e_n^3 + \mathrm{O}(e_n^4).$$

If we multiply $H(x_n)$ by $f(y_n)$ we get

$$H(x_n)f(y_n) = H(x_n)f[y_n, a]e_n^* =$$

$$\left[1 + \left[A^{-1}C(1 + qA) - A^{-2}B(3 + 2qA + 2q^2A^2)\right]e_n^2 + \tag{3.19}$$

$$\left[-2A^{-2}BC(2 + qA) + A^{-3}B^2(5 + 3qA + 4q^2A^2)\right]e_n^3 + \mathrm{O}(e_n^4)\right]e_n^*.$$

Taking in consideration that x_{n+1} is nothing but $y_n - H(x_n)f(y_n)$ we get

$$x_{n+1} = y_n - H(x_n)f(y_n)$$

$$= x_n - \left[1 + \left[A^{-1}C(1 + qA) - A^{-2}B(3 + 2qA + 2q^2A^2)\right]e_n^2 + \tag{3.20}$$

$$\left[-2A^{-2}BC(2 + qA) + A^{-3}B^2(5 + 3qA + 4q^2A^2)\right]e_n^3 + \mathrm{O}(e_n^4)\right]e_n^*.$$

Thus

$$e_{n+1} = \left[A^{-1}C(1 + qA) - A^{-2}B(3 + 2qA + 2q^2A^2) + \mathrm{O}(e_n)\right]e_n^2 e_n^*$$

$$= A^{-1}B[1 + qA]\left[A^{-1}C(1 + qA) - A^{-2}B(3 + 2qA + 2q^2A^2)\right]e_n^4 + \mathrm{O}(e_n^5). \tag{3.21}$$

This completes the proof. $\qquad\square$

In order to compare our new method with Steffensen's method, we give the following example.

Example: In this example we take

$$f(x) = \cos(x) - x.$$

The root of $f(x)$ is $a = 0.7390851332$. Then the sequence $\{x_n\}_n$

$$x_{n+1} = y_n$$

$$- \frac{qf^2(x_n)\left[\left(\cos(y_n) - x_n\right)E_q(x_n) + qf^2(x_n)\right]}{\left[E_q(x_n) + f(x_n)\right]\left[\left(\cos(y_n) - \cos(x_n)\right)E_q(x_n) + qf^2(x_n)\right]}$$

$$+ \frac{qf^4(x_n)\left[\left(\cos(y_n) - x_n\right)E_q(x_n) + qf^2(x_n)\right]}{\left[E_q(x_n) + f(x_n)\right]\left[\left(\cos(y_n) - \cos(x_n)\right)E_q(x_n) + qf^2(x_n)\right]^2} \quad,$$

is fourth-order convergent, where

$$E_q(x_n) = \cos\left(q\cos(x_n) + (1-q)x_n\right) - (1+q)\cos(x_n) + qx_n \quad,$$

$$y_n = x_n - \frac{q\left(\cos(x_n) - x_n\right)^2}{E_q(x_n)} \quad.$$

Taking $x_0 = 0$, for $q = 0.5$, we find

	x_1	x_2	x_3	x_4
Our's	0.8617217519	0.7399567610	0.7390851885	0.7390851332
Steffensen's	2.175342650	0.76343368	0.7613122807	0.7595358304

Taking $x_0 = 1.1$, for $q = 0.9$, we find

	x_1	x_2	x_3	x_4
Our's	0.7063822168	0.7388491909	0.7390851206	.7390851333
Steffensen's	0.8296038833	0.8040964255	0.7902498570	0.7814206993

Taking $x_0 = 1.35$, for $q = 0.001$, we find

	x_1	x_2	x_3	x_4
Our's	0.8144712303	0.74139713209	0.7390873914	0.7390851090
Steffensen's	0.7429374052	0.7428816874	0.7428275625	0.7427749629

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Vehicle Routing Problem with time and path flexibility an approach with GIS-T

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Abstract— Urban traffic planning plays an important role in the planning, construction and management of urban areas. However, due to the boost in commercial relations that has occurred over the years, the demand for deliveries has been increasing in cities, and, in the case of small companies, solutions that optimize routes and transportation costs have made a difference in a market that has shown to be highly competitive. As a result, the need to adopt managerial measures to reduce logistical costs has become one of the key factors for increasing the competitiveness of small companies. In this way, solutions that allow for the adaptation and re-planning of cargo distributions are part of this new routine. For these reasons, this work aimed to present an approach to the practical resolution of the Vehicle Routing Problem in small companies, using Geographic Information System for Transport. Traffic characteristics and parameterizations were raised through on-site visits and the results of the calibration of the traffic flow estimate suggest that the differences between the estimated and actual flows are 16.4%. Thus, this work can be used by researchers, students, entrepreneurs, managers and transport planners to test improvement scenarios and study performance.

I. INTRODUCTION

Impacts generated by the COVID-19 pandemic in activities converging to the Supply Chain (SC) have acquired visibility in the contemporary scenario in view of the need to mitigate the intercadency of supply and favor the sustainability of the entire garrison system at global levels (Sarkis, 2020). However, due to the current circumstances, themes related to the behavior of the SC in the face of the challenges of the global health crisis, have presented a limited scope in the literature, as well as work aimed at solving problems involving vehicle routing (Hackl & Dubernet, 2019, Tan, Cai, & Zhang, 2020).

In view of the restrictive scenario, positive and / or negative impacts on commercial relations are observed due to the transformations driven by factors related to the economy, politics and infrastructure. In this context, transport logistics affects and is affected as a result of these external interferences. And, with the worsening of the pandemic generated by the Sars-CoV-2 virus, restrictions such as, for example, regarding the circulation of vehicles, exposed the vulnerability regarding the efficiency of supply chains (Chen, Pan, Chen, & Liu, 2020).

Considering this reason, among others, that makes up the current society, which has been gathering in urban centers, Vehicle Routing Problems (VRP) play a decisive role in distribution and transportation logistics and, in view of this, several variants have been widely studied in the literature (Laporte, Gendreau, Potvin, & Semet, 2000, Alonso-Mora, Samaranayake, Wallar, Frazzoli & Rus, 2017, Oyola, Arntzen & Woodruff, 2017, Oyola, Arntzen & Woodruff, 2018, Ferreira, Steiner & Junior, 2020).

Thus, as the main axis of this work, he devoted himself to deterministic problems, in which all parameters (dimensions and variables) are, in some way, connected to the data of the problem and, therefore, known in advance (Houlihan, 1985, Pisinger & Ropke, 2007, Ferreira *et al.*, 2020).

However, in the real market everyday it is common for incidences of uncertainty, which, even with a short time to deliberate, decision makers must take into account. In this context, small companies are highly susceptible to the weather in the market, needing solutions that are adaptable to their daily lives. Thus, the motivation of the VRP studied in this work originates from the urban movement of cargo transportation, in which route decisions are complex and, in most cases, determined by delays that can significantly affect routing plans and delivery times (Fisher & Jaikumar, 1981, Davis, 1993, Thomas & Griffin, 1996, Oyola *et al.*, 2018).

For Szczepański, Żak, Jacyna-Gołda and Murawski (2017), VRP must be seen as a broad issue involving several aspects, including technical, economic and social issues. In the opinion of these authors, the determination of the goods delivery plan in the urban area should take into account the questions presented, considering that to solve the tasks, the use of appropriate planning methods is required, as well as verification and confirmation of the results obtained.

Corroborating this view, Brotcorne, Perboli, Rosano and Wei (2019) point out that since the 2000s, with the advent of e-commerce and other widespread information technologies, the way of understanding cargo logistics and transportation has changed extremely. According to these authors, with the increase in deliveries for the Business-to-Consumer (B2C) modality in urban areas, associated with the competition fostered by the platforms of e-commerce giants, raised the market's leveling parameters to deal with growing orders for fast deliveries and decreasing costs.

Therefore, this work presents a practical approach to VRP resolution based on the use of a Geographic Information System for Transport (GIS-T), which, being based on the principle of adaptive search, is capable of providing excellent quality solutions for small companies.

companies. To test this approach, an application was made to solve a routing problem in a small coffee processing company.

II. THEORETICAL REFERENCE

Min, Zhongming, Xiaolan, Jiajie and Xueqiang (2017) address the perspective of integrating Geographic Information Systems (GIS) within logistics as a tool to aid VRP and, it has been disseminated as Geographic Information Systems for Transport (GIS-T) since the 1990s with the works of Miller (1999) that present characteristics such as frameworks for transport modeling, data storage and preparation and graphical visualization through coordinates.

According to Loidl *et al*. (2016) in the scope of GIS-T, with regard to transport modeling, there is similarity in mobility behaviors that depends on the proximity and spatial grouping of the respective agents and their origins and destinations. For Ribeiro, Ribeiro and Aquino (2019), this work is significant because it represents a large part of the flow of vehicles for good distribution in cities, seeking a solution for VRP.

Other works that also stimulate this spatial analysis are those by Toledo, Cats, Burghout, and Koutsopoulos (2010) and Caldas and Sacramento (2016), which describe the traffic flow, according to these authors there are three models to consider, being they are the microscopic that usually accompany the destination of each vehicle individually, the macroscopic that takes into account the behavior of a set of vehicles and the mesoscopic that is a combination of dynamic aspects of the previous models.

Over time, there has been a significant development of historical databases. Recent research (Zhou *et al*., 2020) use tools such as Big Data in conjunction with GIS and show trends that make it possible to manage all variables within a given space, in almost real time. Crawford, Watling and Connors (2017), for example, relate transportation with data from mobile devices, smartphone registrations and Bluetooth data, while Tamblay, Galilea, Iglesias, Raveau and Muñoz (2016) associate with electronic ticket data for transportation public. Chow (2016) and Hu and Jin (2017) present tools such as fixed sensor data, Global Positioning System (GPS) and automatic vehicle identification technology (AVI), loop detectors, automatic traffic counters, Trafficmaster cameras, reconnaissance automatic number plates (ANPR) and also the use of location-based social networks network data.

Therefore, these models presented demonstrate how the combination of VRP and GIS concepts contribute to a

broader and more precise work and, through current tools, are more effective for very complex situations, which is the case of the COVID-19 pandemic. However, according to Shaw, Kim and Hua (2020) although the pandemic was global, the responses were local, as decision-making depends on the governmental, socioeconomic and cultural context. According to these authors, this analysis must be associated with the sensitivity of the data in different perspectives, thus allowing to illustrate the behavior of SC for better decision making.

III. METHODOLOGICAL APPROACH

VRP has been widely studied in the literature (Laporte *et al*., 2000, Oyola *et al*., 2017, Oyola *et al*., 2018, Ferreira *et al*., 2020), however, as pointed out by Brotcorne *et al*. (2019) there is a need to present proposals that make VRP resolution feasible in the small business operating environment. For this reason, the methodological approach of this work was elaborated for this purpose and, also, that it is adaptable to different situations and scenarios of the urban daily life.

To this end, based on the premises indicated by Miguel (2007), Lohmann, Lacerda, Camargo and Dresch (2019) and Hina, Szmerekovsky, Lee, Amin and Arooj (2020), a conceptual-theoretical structure based on the planning of operationalization and simulation actions, considering casual relationships between control and performance variables, which were analyzed and tested.

As a research unit, the product distribution schedule of a coffee processing company located in the extreme north of the state of Espírito Santo (Brazil) was used. Thus, in agreement with the company's managers, in order to serve as initial parameters for data collection, quantitative items were listed that would be delivered in a given week, in addition to the full addresses of the respective customers, available fleet and routes used.

Thus, the methodological approach was developed through 4 steps (Fig. 1), based on the principles: characterization, modeling, simulation and analysis of results (Miguel, 2007, Lohmann *et al*., 2019, Hina *et al*., 2020). In addition, a georeferenced map of the region to be served was used. The realization of this map was based on the concomitant use of the search and visualization service for maps and satellite images of the Earth - Google Maps and the Google Earth Pro software - version 7.3.
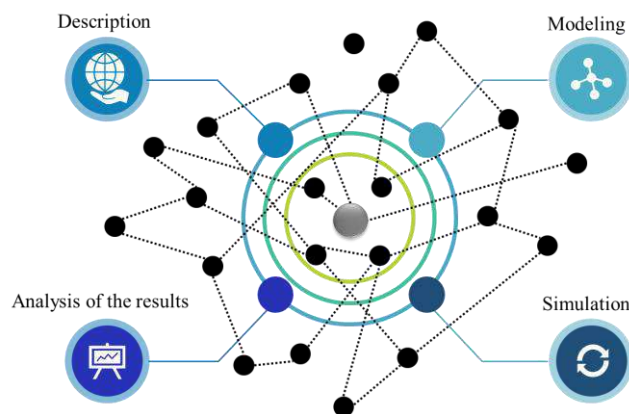
Fig. 1: Synthesis of the methodological approach.

The first stage of the methodological approach carried out the characterization of the VRP considering the local particularities and limitations and, from that, elements were obtained that subsidized for the modeling of scenarios. Afterwards, these scenarios were inserted in a Geographic Information Systems for Transportation (GIS-T), based on a georeferenced map of the region to be served (second stage).

Subsequently, simulations were carried out considering the conditions verified with the company, the service capacity, demand and in loco (third stage). These simulations consisted of using a routing method based on a computational application performed using GIS-T.

Finally, the results obtained were checked for the relevance of service to the company and customers, as well as the adaptability to variations in local conditions (fourth stage). Using GIS-T to analyze routes, in order to minimize the total distance traveled, when comparing routes defined by the empirical method used and the computational solution.

In addition, to help operationalize the proposed methodological approach and, considering that VRP at specific points in the urban environment is an arc routing problem (Laporte *et al*., 2000), this work used a GIS-T for the development of routes (Yona, Birfir, & Kaplan, 2021), using TransCAD (Transportation Planning Software - Version 6) which uses arc routing algorithm to model and optimize routes on roads using minimum path and less time.

IV. RESULTS

The target company of this work has a purity and quality seal from the Brazilian Coffee Industry Association and its main processes are refining, baling and distribution. Currently, it works with 2 types of products, Conilon

coffee type 6 and type 7, which are packed in 500-gram packages and subsequently distributed in bales of 10 units.

The distribution of products is carried out in some municipalities in the north of the state of Espírito Santo (Conceição da Barra, Pedro Canário, Pinheiros, Nova Venécia, Jaguaré, Linhares and São Mateus) covering retailers, from small establishments to medium-sized companies, located in urban area, however, in a decentralized way. Due to its geographical location and social and economic importance for the development of the region, the municipality of São Mateus was selected, as it also hosts the company that is the object of the research unit. At the time this work was carried out, it had a structure composed of an office, a refining station and two vans (Volkswagen Kombi) to operationalize the distribution of products.

However, due to the company's marketing and sales strategies, the vans have different functions, one is intended to provide prompt delivery in small establishments, and the other to telemarketing, in order to guarantee weekly deliveries of quantities. requested, with each order adjusted via the company's communications channels. Within this context, the telemarketing delivery system was used as a research unit, due to the fact that it fits as a VRP when it has fixed locations for service, something that does not happen with the distribution through prompt delivery, in that demand is variable, thus making it impossible to develop optimal routes.

The first stage of the methodological approach started considering the particularities of the company, and so the present work sought to elaborate routes that help in solving a problem about vehicle routing and, with this, aimed to optimize the total distance covered and, consequently, the time and the costs associated with transport in the distribution network. Thus, when previously analyzing the locations and possible routes to serve the company's weekly customers, it was possible to notice that the sequence of stops significantly influences the distances and times (Table 1).

Table 1: Compilation of fixed calls to be made.

Customer	Address
Sup Vila Nova	Rua Colômbia, 56, Vila Nova
Sup Santo Antônio	Rodovia BR-101, 2063, km 64, Santo Antônio
Extrabom C	Av. Jones dos Santos Neves, 504, Centro
Extrabom BR	Hwy. BR-101, 2063, km 64, Santo Antônio
Sup Zampirolli	Av. José Tozzi, Centro
Sup Casagrande	Av. Jones dos Santos Neves, 616, Sernamby
Sup Carioca	St. Arlindo Sodré, 260, Ideal
Rondelli	St. Monsenhor Guilherme Schmitz, Sernamby

Legend: Supermarket (Sup). Center (C). Avenue (Av.). Street (St.). Highway (Hwy.).

Supply movement operations in the urban environment, according to Rodrigues, Rocha, Alves, Junior and Junior (2016) and Najaf, Thill, Zhang and Fields (2018), can take different forms and, with this, different strategies to be implemented, for example, traditional collections known in the literature as direct collection or collection, and consolidated collection (milk run). In this work, the milk run strategy was selected to be used, as it provided conditions to operate with more than one collection point related to a single vehicle for the modality studied (Ramos, 2015).

At first, to prepare the modeling of the company's current distribution scenario, the fixed services (Table 1) were inserted in a map (Fig. 2) in order to subsidize the survey of parameters and characteristics of the roads (Yona *et al.*, 2021).

In addition, considering that customer service is provided by the main routes and vicinal, through a GPS and on-site observations, the following were raised: conditions of the road infrastructure; travel generating hubs; average speed; number of traffic lights and average time per stop.

However, it is worth noting that the survey carried out in loco provided visualization in addition to the geometric and spatial conditions and parameterization of roads, being possible to verify that the total average order in a cycle of the delivery process is 945 kilograms, less than the capacity of the vehicle, approximately 1000 kilograms, something equivalent to 200 bales of coffee. Therefore, this delivery process does not constitute a restriction on the distribution process, being considered in the inputs for the modeling (Fig. 3).

To assist in the modeling of the VRP, a georeferenced map of the urban region of the municipality of São Mateus (Espírito Santo - Brazil) was prepared using Google Maps and the Google Earth Pro software (Fig. 2), in order to support the modeling and scenarios (second stage of the methodological approach).

Fig. 2: Geographic positioning of customers. Adapted from Google Earth.

In this way, the routing matrix was formed from the parameters of the dataview - Customers (Fig. 3). Thus, the distance between each customer was used in the analyzes. Based on this definition, and when using the Facility Location tool from TransCAD, simulations considered the grouping of customers at random, taking into account that all would need to be compared with each other.

Fig. 3: Dataview parameters - Customers.

ID	Longitude	Latitude	NUMBER	[NOME FANTASIA]	[DEMANDA]	OPEN_TIME	CLOSE_TIME	SERVICE_TIME
2	-87408949	30499670	2	SUP. VILA NOVA	60.00	14.00	17.00	6.00
3	-87412067	30500262	3	SUP. SANTO ANTON	110.00	14.00	17.00	18.00
10	-87409784	30500274	10	SUP. EXTRA BOM B	110.00	14.00	17.00	15.00
11	-87403848	30500640	11	SUP. EXTRA BOM C	180.00	14.00	17.00	20.00
6	-87404012	30501030	6	SUP. ZAMPIROLLI	70.00	14.00	17.00	8.00
7	-87404037	30500130	7	SUP. CASAGRANDE	245.00	14.00	17.00	27.00
8	-87401938	30498919	8	SUP. RONDELLI	130.00	14.00	17.00	20.00
9	-87401289	30501386	9	SUP. CARIOCA	40.00	14.00	17.00	6.00

Source: TransCAD.

However, the development of optimal routes for the distribution process (meta-heuristic problem), used the optimization of the distance covered as a resolution of the VRP. It is worth mentioning that due to security conditions, a high rate of robberies and thefts in the region, the circulation of the van was established through the main access roads of the city.

According to Min *et al*. (2017) and Yona *et al*. (2021) to use a GIS-T, it is necessary to know the location of each client on time and, from that, build scenarios that can optimize routes that consider time and distance traveled. Thus, considering the initial data entry preparation (Table 1, Fig. 2 and Fig. 3) and the georeferenced map of the area under study, geographic characterizations (Fig. 4), routes, directions (hand and opposite direction) were verified), speed limits, company warehouse location and delivery points (customers), as well as information on demand and supply time restrictions (Open Time and Close Time).

Achieving an economy in the distribution of products that expands the range of results of the studied company, depends on several dimensions and variables present in the "universe" of urban mobility that, although they are present in the daily business, for several moments, do not present themselves in a deterministically and neither are they interrelated in order to provide consistent analyzes to assist in decision making (Castillo *et al*., 2018).

Apparently, the current route used by the company was well balanced in terms of ease of use and delivery options. However, for calibration and validation of the modeling, 1-hour assignments were used as they provide important information for adjusting network and / or land use errors. This premise was adopted according to Chow (2016), Szczepański *et al*. (2017) and Brotcorne *et al*. (2019), considering that any signage (vertical and/ or horizontal), bulkhead or "centroid connector" that does not have a direct function to regulate traffic can be important for traffic analysis or incorrect use of the soil. Another point

to be highlighted is that this premise helped in the counting reconciliation process, thus, the matrix estimation procedure was replicated until a set of acceptable attributions was obtained.
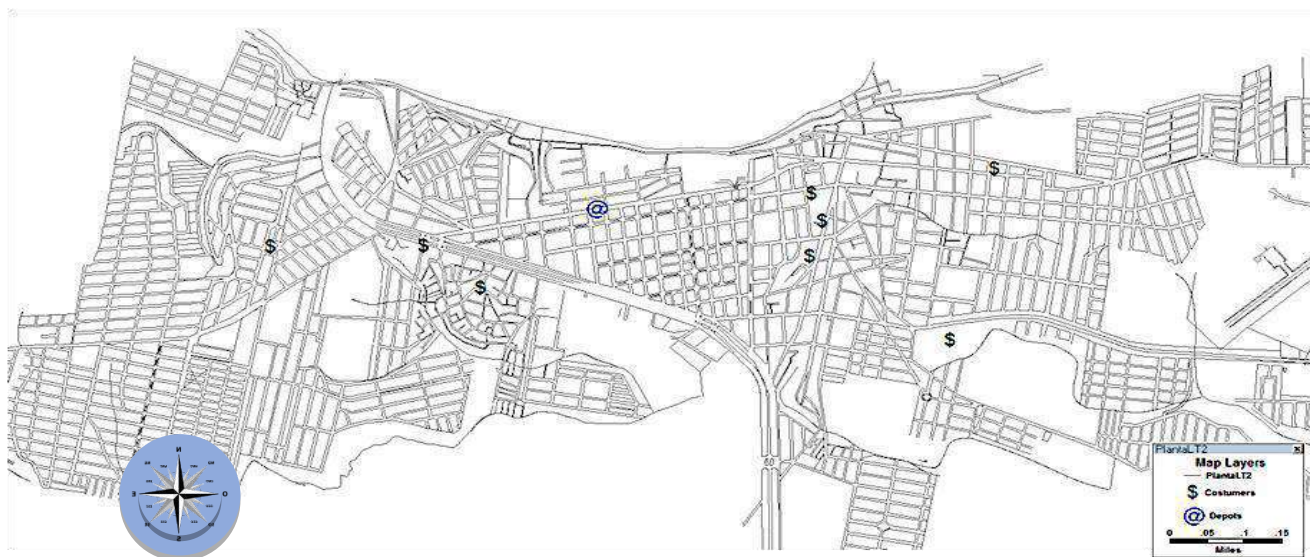
Fig. 4: Location of the company and customers for use in TransCAD.

Source: TransCAD.

Then, the TransCAD routing routine was used to solve the VRP, creating optimized routes for the vehicles of the company's fleet. Thus, for the operationalization of this routine, time windows were considered to meet the demand, that is, to operate loading and unloading of goods on Mondays to Fridays from 8:00 pm to 8:00 am; on Saturdays from 2pm and on Sundays and holidays throughout the day (São Mateus, 2017), and from employees. In addition, travel time restrictions, collective headway (time interval between departure and arrival by bus) and time for loading and unloading operations for employees and goods were also considered.

From this context, the characterizations of the base scenario presented so far, sought to reproduce the current pattern of distribution of goods used by the small coffee processing company. On the other hand, according to Zhou *et al*. (2020), to help obtain the optimal route, 3 scenarios were generated in order to identify the one that provides satisfactory results and optimize the route in terms of distance traveled. Thus, the first scenario considered the mandatory return of vehicles to the company's deposit in the event of the possibility of discontinuing the service of 2 or more customers, maintaining the same parameters established in the base scenario; in the second scenario, the use of multiple bases was introduced, that is, data from alternative routes in case of physical obstructions, to operate the van, without returning the vehicle to the base. All parameters of the base scenario being maintained and, finally, the third scenario also uses multiple bases,

however, with the determination to return the vehicle to the base in case of discontinuity of operation for some reason, also considering the parameters of the base scenario.

Based on the scenarios presented above, a comparative analysis between them was carried out through TransCAD. The first scenario in which the return of the van is necessary, 5.43 km traveled in 4.12 hours, when confronted with the base scenario, in which this obligation does not exist, it was observed that there is an increase in the total distances and times of trip compared to the base scenario (3.20 km traveled in 3.18 hours - measurements obtained in monitoring delivery when the data collection stage was performed). These differences can be attributed to the distance traveled being greater and, therefore, the return to the deposit.

When evaluating the reason for the increase in the total travel time in the first scenario, higher than the second scenario (6.27 km covered in 3.35 hours), it was observed that this occurs, among other possible causes, due to the increase in time and travel distance of the van for mandatory return to the deposit. Confronting the second scenario, which uses multiple bases in the preparation of the routing (without returning the van to the warehouse), and the base scenario, which uses a single base, it is noted that there is an increase in the distance traveled and travel times for the second scenario in relation to the base scenario. The explanation for this increase may be related

to the poor conditions of the circulation routes used (Bartholomeu & Caixeta Filho, 2008, Moreira, Freitas Júnior, & Toloi, 2018, Brotcorne *et al*., 2019), as well as, in the high number of vehicles in a precarious situation used on these roads.

After this verification, a comparison was made between the second scenario and the third scenario (2.75 km covered in 2.33 hours), in which the difference between both is the mandatory return of the vehicle to the base in case of discontinuity of operation. for some reason (third scenario), for this reason, there was a proportional increase in distances and travel times.

Regarding the service time, considering the stop time and bus stops nearby, there was no difference between the scenarios tested. This fact can be attributed to the rigor of inspection and, also, to the observation and attendance of

fixed times for each bus stop (about 1.5 minutes on average) and, for each boarding or disembarkation (9 seconds on average).

Thus, considering the comparative analyzes and the result of the optimal route that minimizes the total distance to be traveled among the scenarios (Fig. 5), the results indicate that the best alternative for the company's goods transportation is the third scenario, that is, the one that adopts multiple bases without return of the van. The optimal route consists of leaving the vehicle from the warehouse to make the distribution according to the route and numbering that can be seen in Figure 4, in which: (1) Santo Antônio Supermarket, (2) Extrabom BR, (3) Vila Nova, (4) Rondelli, (5) Carioca, (6) Zampirolli, (7) Extrabom Centro and (8) Casagrande. At the end of the journey, the delivery vehicle returns to the warehouse.
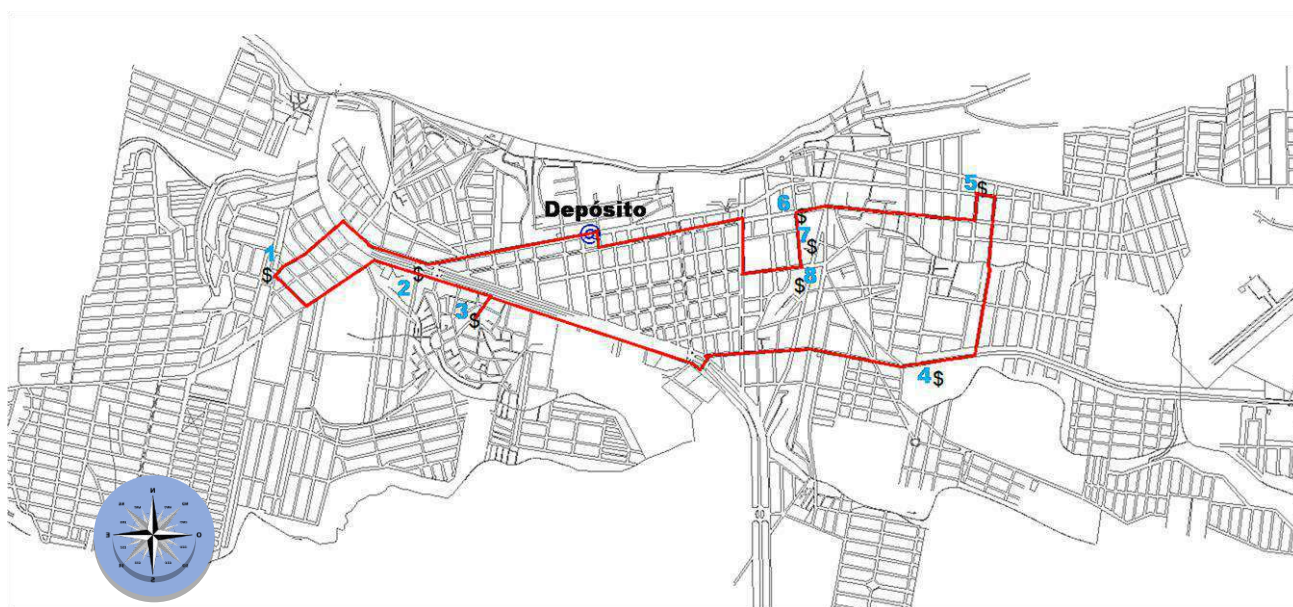
Fig. 5: Map of the optimal route of the distribution operation.

Source: TransCAD.

It is important to highlight that the adoption of a single base for the distribution operation is the only viable alternative and this is confirmed by the shorter distances and shorter travel times used in these operations. Thus, according to the result presented by TransCAD, the solution for the VRP has an optimum distance of 1.71 miles or 2.75 km, compared to the value of the route previously carried out, which has a distance of 3.20 km, resulting in savings of 16.4%. In this way, the variable cost of transportation per kilometer of the company in the distribution by telemarketing will also benefit from this savings. In this way, the variable cost of transportation per kilometer of the company in the distribution by

telemarketing will also benefit from this savings. This fact was also confirmed by Luo *et al*. (2017) in their work by highlighting that the approach to a new vehicle routing problem involves simultaneously windows of time, split delivery, related costs, among other dimensions and variables specific to each case. In the opinion of these authors, the cost of travel per unit of distance is a linear function of the vehicle's weight and the customer's demand that can be met by one or more vehicles, solving the VRP effectively.

This economy and the possibility of enhancing gains also include the use of a GIS-T being the least need for manpower to prepare routes manually, in addition to

allowing the reduction of working hours in terms of training personnel for this purpose. As well as expanding horizons regarding the planning of distribution logistics. And, from that, it becomes possible to provide improvements in the company's operational efficiency, as well as in the sector's supply chain.

V.   FINAL CONSIDERATIONS

This work presented a methodological approach that can contribute to the planning and operation of deliveries in new daily situations of small companies, as well as, in terms of implementation and improvement for local development and other surrounding municipalities. In order to adapt to the new and constant market changes, small companies will need to have solutions that allow them to be competitive and that these solutions work efficiently in at least a year and a half.

In this way, it reached the main objective of presenting an approach for use in the practical resolution of small business VRP, employing a GIS-T in the elaboration of routes. The presented solution allows an adaptation to different scenarios and conditions, in addition to specific parameterizations that become necessary. For example, the company that served as a research unit did not have a computational solution for the elaboration of routes, and the distribution activities took place in an exclusively empirical way.

Therefore, with the presentation and initial implementation of the proposed approach, it was possible to improve efficiency in terms of deliveries and other activities related to product distribution. Today, all routes are previously analyzed, planned and defined, with this, managers now have a resource that allowed them to be financially sustainable, that is, the constant optimization of costs.

However, during the simulations it was noted that the arc routing was not ideal for the locations served. Also, it was not for locations where customers do not have physical service conditions within the dimensioned schedules, that is, they do not have a fit to the needs of adequacy, diversified or alternative schedules - such as time windows, for cost optimization.

The results obtained thus contribute proactively to the planning of distribution and deliveries in an urban environment. The responses with the use of GIS-T compared to that presented by the company, reinforce and highlight the importance of using computational tools to optimize distribution services and delivery routes.

The use of GIS technology has been moderately explored, with regard to small enterprises and in terms of urban transport planning in Brazil, although several actions involving georeferenced maps, information technology and heuristics for VRP resolution are also used in commercial activities frequently. Thus, this work presented some of the difficulties faced by small companies and, certain benefits resulting from the daily use of GIS-T.

Finally, the aim is not to exhaust the topic, but to exalt the use of computational resources that assist in the elaboration of solutions for VRP in the daily life of small companies. Likewise, it was intended to demonstrate to public managers that it is plausible to adopt current concepts of transport planning at different levels of use of the urban environment. Considering trends and variations in market behavior, globalization of commercial relations, among other dimensions and variables that directly and indirectly involve VRP.

It is suggested that the next researches may consider and analyze the existing multivariate relationships between the component elements of this work and, multicriteria analysis to assist in the selection of alternatives.

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Analysis of the epidemiological profile of patients with traumas: A literature review

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Abstract— Trauma is a public health problem, with a high morbidity and mortality profile that generates high costs for health systems all over the world. Several factors can trigger the different types of trauma, which may require specific treatments, often even surgical procedures, and may also cause incapacity for work. In light of this, this research was intended to evaluate the epidemiological profile of patients with traumas in different regions of the world. To this end, a systematic literature review was performed by searching the Scielo database, using the descriptors "trauma" and "epidemiology", finding a total of 270 articles. Subsequently, filters were applied, which allowed 92 scientific articles to be obtained. The titles and abstracts of these articles were analyzed; and, from that, 15 articles were selected, which were read in full and then discussed. The literature analysis allowed us to characterize the epidemiological profile of traumas in Brazil and in other countries around the world, detecting that most trauma affects men at a young age, which can affect the labor system; that the low level of education can influence the trauma profile; and that factors such as car and motorcycle accidents, falls and physical aggressions are the main etiological factors of cranioencephalic, maxillofacial, thoracic, upper limbs and lower limbs traumas, among others. Thus, there is a need to formulate better preventive measures and pre- and in-hospital treatments, aiming at reducing the impact on trauma morbidity and mortality.

I. INTRODUCTION

Trauma is an injury characterized by structural changes or physiological imbalance, resulting from acute exposure to various forms of energy, including mechanical, electrical, thermal, chemical or radioactive (American College of Surgeons Committee on Trauma, 2009; Peralta and Curiel, 2019), which can trigger several types of trauma, including orthopedic, abdominal, thoracic, cranioencephalic, spinal, among others (da Silva *et al*., 2017).

In addition, trauma is a worldwide public health problem. Its high morbidity and mortality profile implies

extremely significant problems, especially in underdeveloped and developing countries, where about 90% of deaths from trauma take place. Additionally, the costs generated are another major challenge, since studies highlight that trauma accounts for 12% of all disease expenditures (Yeung and Graham, 2010; Zanette, Waltrick and Monte, 2019).

Regarding mortality due to trauma, traffic accidents and aggressions correspond to the main external causes of death. In this sense, data from the Informatics Department of the Unified Health System (DATASUS, as per its Portuguese acronym) show that, in Brazil, only in 2017, traffic accidents and aggressions were responsible for 36,430 and 63,748 deaths, respectively (da Silva *et al.*, 2017).

The epidemiological profiles of the population most affected by trauma are young men, between 16 and 30 years of age, and with a low level of education. In the United States, automobile accidents, falls, physical aggressions and sports practice are the main causes of traumas. According to the *Revista do Colégio Brasileiro de Cirurgiões*, thoracolumbar fractures are caused, in greater proportion, by general falls. In turn, the thoracic spine is affected, in most cases, in traffic accidents (Campos and Pinto, 2012; Lentsk, Sato, Mathias, 2019).

In this context, this study is intended to evaluate the epidemiological profile of trauma victims in different regions of the world, due to the need to formulate better preventive measures and pre- and in-hospital treatments, aiming at reducing the impact on trauma morbidity and mortality.

II.   MATERIAL AND METHODS

This study is a systematic literature review, with an exploratory and descriptive nature, which intends to investigate the main epidemiological characteristics related to trauma. Accordingly, a survey of the literature was conducted in an electronic database, in order to analyze articles that addressed the topic.

Thus, a search was performed in the Scielo database, using the following descriptors in English: "trauma" AND "epidemiology". Through the Boolean operation, a total of 270 studies were found.

The following filters were applied: free and full abstract and text, collections from all countries and in all languages, publication year between 2016 and 2020, and with the type of literature focused exclusively on scientific articles, thus obtaining 92 results.

Nevertheless, after this search, the titles and abstracts of these scientific works were analyzed, and a total of 15 articles were selected because they showed themselves with greater relevance and affinity with the proposed theme (inclusion criterion), thus excluding articles that were not focused specifically on the epidemiological profile of trauma. After these filters, the 15 selected articles were analyzed in full and the data were classified by subject, being then grouped and categorized.

III.   RESULTS AND DISCUSSION

Trauma is considered a worldwide public health problem, mainly due to its high profile of morbidity and mortality. According to the World Health Organization (WHO), nine people die every minute from trauma, and these ills are still responsible for an expense equivalent to 12% of total illnesses (Zanette, Waltrich and Monte, 2019; Potlablathin and Kanala, 2016).

The study of the global burden of diseases, injuries and risk factors (Global Burden of Disease – GBD), in 2017, estimated that non-fatal traumas, involving falls and traffic accidents, generated disabilities in 226.2 million people. Additionally, fatal injuries accounted for 8% of mortality worldwide, making 4.48 million victims, with an increase of 2.3% over 2007 data and a global mortality rate of 57.9 per 100,000 inhabitants (GBD, 2017).

Thus, it is important to outline the main epidemiological characteristics involving trauma in Brazil and around the world. Table 1 shows the summary of the selected articles with their respective authors, published journal and publication year (Table 1).

Table 1 – Studies that address epidemiology and trauma.

Title (in its original language)	Authors	Journal (in its original language)
Análise epidemiológica de 736 pacientes que sofreram trauma facial no Brasil.	Marano *et al.*	Revista Internacional de Odontostomatologia

Interpersonal violence, circumstances of aggressions and patterns of maxillofacial injuries in the metropolitan area of Campina Grande, State of Paraiba, Brazil (2008-2011).	Bernardino *et al.*	Ciência & Saúde Coletiva
Aspectos epidemiológicos e deontológicos da mortalidade no trânsito de Roraima.	Ferreira, de Souza and Flório.	Revista Bioética
Trauma em Curitiba: avaliação multifatorial de vítimas admitidas em um hospital universitário.	Guizzo *et al.*	Revista do Colégio Brasileiro de Cirurgiões
Perfil epidemiológico do trauma torácico em um hospital referência da foz do Rio Itajaí.	Zanette, Waltrick and Monte.	Revista do Colégio Brasileiro de Cirurgiões
Fraturas de esterno emu ma unidade de tratamento intensivo especializado em trauma.	Pereira *et al.*	Revista do Colégio Brasileiro de Cirurgiões
Epidemiologia de lesões traumáticas dos membros superiores em um Hospital Universitário.	Ribak *et al.*	Acta ortop.
Aspectos epidemiológicos do Trauma Cranioencefálico do Hospital Municipal de Cuiabá.	Vasconcelos *et al.*	Revista Internacional de Odontostomatologia
Estudo epidemiológico do trauma ortopédico em um serviço público de emergência.	Santos *et al.*	Cadernos Saúde Coletiva
Factors related to motorcycle accidents with victims: an epidemiological survey.	Greve *et al.*	Medical Express
Caracterización epidemiológica y neurológica del traumatismo cranioencefálico frontal durante cinco años en Villa Clara.	De Mendaro *et al.*	Centro de Mídia Eletrônica
Epidemiology of spine fractures in motorcycle accident victims.	De Oliveira *et al.*	Coluna
Burden and profile of spinal pathology at a major tertiary hospital in the Western Cape, South Africa.	Miseer, Mann and Davis	Sa Ortopédico Journal
Epidemiologia de fraturas e lesões do anel pélvico.	Cação *et al.*	Revista Brasileira de Ortopedia

Several studies bring facial trauma with etiology aimed at traffic accidents, falls, violence, sports injuries, and those caused in the work environment, besides the economic and socio-cultural condition of the population and the analyzed period (Shankar *et al.*, 2012).

The study by Marano *et al.* (2020) showed the main characteristics of maxillofacial fractures in a hospital in the state of Espírito Santo. In a period of 5 years, 428 patients had a facial fracture, of which 80.8% were men, who had an average age of 38.3 years. Facial fractures were divided into the group involving the middle and

upper thirds of the face (67%), another involving only the mandible (22%), and still the group that suffered from both types (11%).

Analyzing both groups, motorcycle accidents were the most common type associated with a fracture, followed by car and bicycle accidents, and also accidents in which the patient was run over. Nevertheless, when patients were separated by gender, car accidents were considered to be more prevalent among women than motorcycle accidents. Regarding fractures involving the middle and upper thirds of the face, factors such as falls (24.8%), physical aggression (19.5%), sports injuries (7.7%), gunshot wounds (4.4%) and injuries in the workplace (3.2%) were also related to the etiology of these fractures.

Conversely, Bernardino *et al*. (2017), when determining the circumstances of the aggressions and the patterns of maxillofacial traumas, observed another profile. These authors identified three groups with different victimization profiles. The first group was formed mainly by men, of different age groups, victims of community violence, resulting in fracture of facial bones or dentoalveolar fracture. In turn, the second group was composed mainly of adolescents (10-19 years old), of both genders, victims of interpersonal violence and who did not show a specific pattern of trauma. Finally, the third group, which brought together women, adults (≥ 20 years old), victims of domestic violence, resulting in injury to soft tissues of the face or in other regions of the body.

It is worth underlining that fractures that affect the maxillofacial complex are classified as very serious and are often associated with disfigurement, functional impairment, severe morbidity and high costs for health services, which may require complex therapeutic modalities for their management (Rallis *et al.*, 2015; Whitesell *et al.*, 2015).

Ferreira, Souza and Flório (2020) evaluated traffic mortality in Roraima between the years 2011 and 2015, and also detected a majority of men (85.2%), aged between 15 and 34 years (54.9%), and the main cause of death was head trauma (43.4%). It is worth underlining that Brazil ranks the 3rd place for the highest traffic mortality in the Americas and the 5th for traffic accidents in the world (PAHO, 2016).

The profile of the victims analyzed in the study by Guizzo *et al*. (2020) is similar to other surveys that show that men (70%), young people (39.4 years), victims of traffic accidents, with the motorcycle collision representing 24.3%, are the majority in traumas. Aggressions were also a relevant trauma factor in this research, and the use of alcohol was described by 57% of

patients. Regarding the severity of traumas, it was observed that the traumas considered as serious on the Glasgow Scale were more frequent at night and on weekends. It is underlined once again that the economically active population, therefore, is the most affected, thus entailing a high cost for society.

In turn, Zanette, Waltrick and Monte (2019) described the epidemiological profile of thoracic trauma (TT) in the Foz do Rio Itajaí region, located in Santa Catarina. They analyzed 119 medical charts of TT victims and found that 70.5% of victims were men, with an average age of 39.8 years. Most consultations took place during the day period (67.9%). As for admission examinations, most victims were submitted exclusively to chest X-rays (67.2%), with a prevalence of blunt thoracic trauma (89%), with motorcycle accidents as the main cause (35.2%), and the predominant injury was rib fracture (42%).

Studies with TT are important, since TT represents 10% to 15% of the total traumas in the world. In the United States, it corresponds to the 3rd most lethal type of trauma, second only to cranioencephalic trauma and extremity trauma. In Brazil, this rate corresponds to 7.3% of occurrences, being the second most frequent type of trauma, behind only extremity trauma. Moreover, TT represents approximately 25% of deaths from traumas, in addition to being a contributing factor in another 25% (Potablathin and Kanala, 2016; Silva *et al.*, 2017).

Another study that sought to evaluate the epidemiological profile of TT was conducted in an Intensive Care Unit (ICU) in São Paulo by Pereira *et al*. (2019). They observed that, in the analyzed period (January 2012 to April 2016), 57% of the patients admitted to the ICU for surgical emergencies were victims of trauma, 28.8% of whom had TT and approximately 3% had sternum fracture.

These authors also noted that sternum fractures were more present in men (84.6%), with an average age of 32 years, and the main causes of these fractures were motor vehicle accidents (46%), falls from height (32%) and people being run over (15%).

Another type of traumatic injury that is quite frequent in emergencies are upper limb injuries, which also have an impact on the patient's life and an economic burden, since these traumas often lead to incapacity for work. In light of the foregoing, Ribak *et al*. (2018) sought to evaluate the epidemiology of traumatic injuries of the upper limbs treated at a university hospital and to identify the causes, types of injuries and their risk factors.

Thus, Ribak and collaborators found that, of the 613 patients with traumas, 67.9% were men, with an

average age of 31 years, with domestic accidents being responsible for 66.6% of traumas, followed by traffic accidents (20.6 %) and occupational accidents (12.8%). In addition, it was possible to observe the existence of a correlation between the level of education and the type of accident.

Unlike the aforementioned works, Greve *et al.* (2018) evaluated the factors associated with traffic motorcycle accidents and found that fractures in the lower limbs (17%) were more common than in the upper limbs (12%). They also observed that the victims were mostly young (92%), used the motorcycle for work (23%) and 23% were unlicensed motorcyclists, 67% of whom had serious injuries. Moreover, 21% of victims were under the influence of alcohol (7%) and drugs (14%). Most accidents took place as a result of recklessness (88%), during the day (67%) and in dry weather conditions (94%).

Santos *et al.* (2016) also detected a higher prevalence of fractures in the lower limbs when analyzing 1,390 medical charts from the Emergency Hospital in Teresina. The analysis regarding the epidemiological profile showed that most victims of orthopedic trauma hospitalized were men (81%) and young people between 18 and 38 years old (61.9%). Traffic accidents were the most frequent trauma mechanisms (60.2%), and the lower limbs were the most affected, with emphasis on the knee/leg segment (23.2%). Surgery was necessary in 89.8% of trauma patients, with a greater prevalence among motorcycle accident victims (45.8%). In addition, during the studied period, Sunday was the day of the week when there was a greater number of trauma patients (18.9%).

A study conducted in Bahia that sought to analyze the incidence of spinal injuries, between 2000 and 2010, due to a motorcycle accident and its relationship with the increase in motorcycle sales in that period, was able to identify that the increase in the incidence of these injuries took place in the same period in which there was an increase in motorcycle sales in the country (de Oliveira *et al.*, 2016).

In addition, the authors observed that, between these years, there was an almost five-fold increase in the incidence of patients who suffered spinal injuries due to a motorcycle accident, with 51.4% showing cervical spine injuries, 37.2% in the thoracic spine and 11.4% in the lumbar region. Only 34.3% of patients had no neurological deficit at admission, and patients with fractures in the thoracic spine had a higher incidence and severity of spinal cord injury. The average age of these patients was 30 years.

Another study, conducted in Africa between October 2016 and September 2017, showed that traumas related to the spine represented 75% of the analyzed cases, with automobile accidents and falls contributing 48% and 26% of traumas, respectively. Moreover, a predominance was also observed for men (67%) and that tuberculosis contributed to 87% of spinal infections, where 44% had HIV co-infection (Miseer, Mann and Davis, 2019).

In turn, Vasconcelos *et al.* (2018) sought to evaluate the main epidemiological aspects of victims of cranioencephalic trauma/traumatic brain injury (TBI) treated at the Municipal Hospital of Cuiabá. Medical charts of 669 victims were analyzed, of which 84.7% were male and had an average age of 32.8 years. In this study, the most prevalent cause of trauma was the motorcycle accident (26.6%), the neurological severity of TBI was mild in 32.5% of cases and 71.6% of patients progressed without death.

TBI involves the combination of neural and vascular injuries and their respective effects on the brain, skull and scalp (Huddleston and Ferguson, 2006). Its cause involves external physical factors that eventually result in brain injuries and lead to permanent or temporary functional or psychological damage, which may progress to death in certain circumstances (Farage *et al.*, 2002; Huddleston and Ferguson; David, 2006). In addition, TBI is a worldwide public health problem that is closely related to accidents. According to DATASUS, in 2015 alone, 37,306 victims died as a result of traffic accidents in Brazil (*Ministério da Saúde*, 2015).

Studies conducted in other countries also show that TBI is truly a public health problem. In the United States, for example, a TBI takes place every seven seconds, and every five minutes a person dies from it. In Cuba, accidents are the main cause of death among citizens from 15 and 49 years old, and the fourth cause in relation to other health problems (Leitgeb *et al.*, 2013; Dhandapani *et al.*, 2012; Seu *et al.*, 2014; Cicerone, 2013).

In light of this, de Mendaro *et al.* (2017) conducted a descriptive, cross-sectional and epidemiological study between January 2011 and December 2015, in order to analyze the 150 patients classified as frontal cranioencephalic traumas treated at Hospital Milián Castro, located in Cuba.

The results showed a predominance of men and an average age of 42.2 years. Traffic accidents (53.3%) were the most common cause, followed by falls (33.3%) and robberies (13.3%). Approximately one third of the surveyed patients had ingested alcoholic beverages. As for traumas, a higher incidence of minor trauma was found, with the right hemisphere, limited to the frontal lobe, taking place in most patients, being more frequently affected, with an extension to a neighboring lobe.

The epidemiological characteristics of pelvic ring fractures and injuries were the subject of study by Cação *et al*. (2017). A total of 66 patients were analyzed between August 2012 and January 2014, with an average age of 47 years, where the white race and the male gender were the most affected groups. The accident involving a car or truck was the most common cause of damage, which took place mainly in urban areas. Therefore, 16.6% of cases underwent emergency surgery, 42.4% had associated injuries and the right side of the body was the most affected side.

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Pelvic ring fractures and injuries are generally not considered frequent, representing only 2 to 8% of all fractures. Nevertheless, in polytrauma patients, the occurrence of this type of injury is considerably higher, being observed in 20 to 25% of cases. Pelvic ring fractures in young individuals most often take place as a result of high-energy trauma, such as car and motorcycle accidents, as well as falls from great heights. On the other hand, in the elderly individuals, they are usually caused by low-energy trauma (Pizanis *et al*. 2013).

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New Weighted Total Acceleration on Momentum Euler Equation for Formulating Water Wave Dispersion Equation

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Abstract— In this present study, weighted total acceleration for Kinematic Free Surface Boundary Condition (KFSBC) and in momentum Euler equation was formulated. Furthermore, by using both aforementioned equations, the nonlinear water wave dispersion equation was then formulated.

The wavelength obtained from dispersion equation is determined by weighting coefficient. The weighting coefficient value was determined by using the maximum wave height and critical wave steepness criteria which have been obtained from the previous studies.

I. INTRODUCTION

Wavelength L and wave number k in the $k = \frac{2\pi}{L}$ is a very important water wave parameter, where the accuracy of water wave analysis is largely determined by these parameters. The equation for calculating these parameters is called the dispersion equation and the most used is the dispersion equation from the linear wave theory (Dean (1991)).

Hutahaean (2019) formulated the dispersion equation for water waves using the weighted total acceleration in the KFSBC equation and the Euler momentum equation, which the weighted total acceleration in both equations has the same form. In this study, the weighted total acceleration was developed in different forms.

With the KFSBC equation and Euler's momentum equation using weighted total acceleration, the dispersion equation for water waves was formulated. To get the weighted coefficient value, the critical wave steepness of the equation is calibrated against that of the previous research results. There are two critical criteria for wave steepness, and the first criteria of Michell, J.H. (1893). The results of Michell's research were widely used by other researchers in developing breaking criteria in shallow waters, including Miche (1944), Battjes and Jansen (1978), Ostendorf and Madsen (1979), Battjes and Stive (1985) and Rattanapittikon and Shibayama (2000).).

The newest criteria of critical wave steepness is the criteria proposed by Toffoli, A., Babanin, A., Onorato and Waseda,T. (2010), with the same form as Michell's (1893) criteria, but having different coefficients. In this study, the criteria from Toffoli et all will be used.

Wiegel (1949,1964) proposed an equation for the maximum wave height for a wave period. By using this wave height maximum, wavelengths that meet the criteria of Toffoli, et al (2010) can be calculated. So that we get a wavelength value that meets the maximum wave height criteria and the critical wave steepness criteria.

II.   MAXIMUM WAVE HEIGHT AND CRITICAL WAVE STEEPNESS

a.   Wiegel's criteria (1949,1964)

According to Weigel (1949,1964) , the maximum wave height in a wave period is,

$$H_{max} = \frac{gT^2}{15.6^2} \quad ....(1)$$

T = wave period (sec)

g = gravitational force (m/sec^2)

b.   Michell's criteria (1893)

According to Michell (1893) critical wave steepness is

$$\frac{H}{L} = 0.142 \quad ....(2)$$

c.   Toffoli, A., Babanin, A., Onorato and Waseda,T. (2010)

According to Toffoli, A., Babanin, A., Onorato and Waseda,T. (2010), critical wave steepness is

$$\frac{H}{L} = 0.170 \quad ....(3)$$

L= wavelength

With the input wave height from (1), it can be calculated the wavelength with (2) or (3), it is then compared with the deep water wavelength of the dispersion equation from the linear wave theory (Dean (1991)),

$$L_0 = \frac{gT^2}{2\pi}....(4)$$

Table.1: The wavelength from (2), (3) and (4)

T	H_{max}	L_{Tof}	L_{Mich}	L_0
(sec)	(m)	(m)	(m)	(m)
6	1.45	8.54	10.22	56.21
7	1.98	11.62	13.91	76.5
8	2.58	15.18	18.17	99.92
9	3.27	19.21	22.99	126.47
10	4.03	23.71	28.39	156.13
11	4.88	28.69	34.35	188.92
12	5.8	34.15	40.88	224.83
13	6.81	40.07	47.98	263.86
14	7.9	46.48	55.64	306.02
15	9.07	53.35	63.87	351.29

On table (1), L_{Tof} is the wavelength that is calculated by (3), L_{Mich} wave length that is calculated by using (2), and L_0 is the wavelength that is calculated by using (4). The results of the wavelength calculation are presented in table (1). It can be seen that the wavelength produced by the linear wave theory is too long, so that the critical wave steepness criteria of both Michel and Toffoli will never be achieved.

Furthermore, if the wavelength of (4) is used to calculate the critical wave height with (2) and (3), a very large critical wave height is obtained as presented in table (2) below.

Table.2: Wave height maximum according to (2) and (3), wave length is calculated by (4)

T	H_{Mich}	H_{Tof}
(sec)	(m)	(m)
6	7.98	9.56
7	10.86	13.01
8	14.19	16.99
9	17.96	21.5
10	22.17	26.54
11	26.83	32.12
12	31.93	38.22
13	37.47	44.86
14	43.45	52.02
15	49.88	59.72

In table (2), it can be seen that the maximum wave height that is calculated using the wavelength of the linear wave theory produces a very large wave height. In table (2), H_{mich} the wave height is calculated using the Michell's criteria, while the wave height H_{Tof} is calculated using the Toffoli's criteria. Considering that Toffoli et al's criteria produce a greater maximum wave height than Michell's criteria, this research uses the Toffoli et al's critical wave steepness criteria to calibrate the wavelengths produced by the dispersion equations of this study.

III.   WEIGHTED TOTAL ACCELERATION.

Courant (1928) stated that the relation between δx and δt in the water wave equation is $\delta x = 3.0 \, C \, \delta t$ where C is wave celerity, x is the horizontal axis and t is the time.

Hutahaean (2021) who used the Taylor series on a sinusoidal function

$$f(t,x) = A \cos \sigma t \cos kx \quad ....(5)$$

A= amplitude

σ = angular frequency=$\frac{2\pi}{T}$, T = period

k = wave number

gained a relationship that is more or less the same as the Courrant relationship, that is $\delta x = 3.01519\, C\, \delta t$

Hutahaean (2021) used the Taylor series for functions that take the form of:
$f(t, x, z) = A\cos \sigma t \cos kx \cosh k(h + z)$ ......(6)
which is the solution to Laplace's equation (Dean 1991), where z is the vertical axis, get the relation or $\delta z = 3.0012\, C\, \delta x$ or $\delta z = 3.012^2\, C\, \delta t$.
Based on Courrant (1928) and Hutahaean (2021), the relationship obtained
$\delta x = \gamma\, C\, \delta t$ ......(7)
$\delta z = \gamma^2\, C\, \delta t$ ....(8)

where γ is called as weighting coefficient.

Relationship between δx and δt and between δz and δt were done on Taylor series order 1, in a function of time and space $f(t, x)$ by working on the weighting coefficient on time differential terms.
$$f(t + \delta t, x + \delta x) = f(t, x) + \gamma \delta t \frac{\partial f}{\partial t} + \delta x \frac{\partial f}{\partial x}$$
While on a function $f(t, x, z)$
$$f(t + \delta t, x + \delta x, z + \delta z) = f(t, x, z) +$$
$$\gamma^2 \delta t \frac{\partial f}{\partial t} + \gamma \delta x \frac{\partial f}{\partial x} + \delta z \frac{\partial f}{\partial z}$$

a.   Function $F = f(t, x)$
$$f(t + \delta t, x + \delta x) = f(t, x) + \gamma \delta t \frac{\partial f}{\partial t} + \delta x \frac{\partial f}{\partial x}$$
$$\frac{f(t + \delta t, x + \delta x) - f(t, x)}{\delta t} = \gamma \frac{\partial f}{\partial t} + \frac{\delta x}{\delta t} \frac{\partial f}{\partial x}$$
$$\frac{Df}{dt} = \gamma \frac{\partial f}{\partial t} + u \frac{\partial f}{\partial x} \quad ......(9)$$

For the water level equation $\eta = \eta(x, t)$
$$\frac{D\eta}{dt} = \gamma \frac{\partial \eta}{\partial t} + u \frac{\partial \eta}{\partial x}$$

KFSBC, Dean (1991) is :
$$w_\eta = \frac{\partial \eta}{\partial t} + u_\eta \frac{\partial \eta}{\partial x} \quad ......(10)$$
Where w_η is the the velocity of water is in the direction of the vertical axis-z - on the surface of the water, whereas u_η is the velocity of water particles in the direction of the horizontal axis-x on the surface of the water. It can be seen that KFSBC is the total derivative in the Taylor series for a function $F = f(t, x)$ as in (9). Therefore, by using the weighting coefficient as in (9), KFSBC becomes
$$w_\eta = \gamma \frac{\partial \eta}{\partial t} + u_\eta \frac{\partial \eta}{\partial x} \quad ......(11)$$

b.   Function $F = f(t, x, z)$
Taylor series firstorder for function $f(t, x, z)$

$$f(t + \delta t, x + \delta x, z + \delta z) = f(t, x, z)$$
$$+ \gamma^2 \delta t \frac{\partial f}{\partial t} + \gamma \delta x \frac{\partial f}{\partial x} + \delta z \frac{\partial f}{\partial z} \quad ....(12)$$

The total acceleration is,
$$\frac{Df}{dt} = \gamma^2 \frac{\partial f}{\partial t} + \gamma u \frac{\partial f}{\partial x} + w \frac{\partial f}{\partial z}$$
The total acceleration of the water particles in the horizontal direction-x is,
$$\frac{Du}{dt} = \gamma^2 \frac{\partial u}{\partial t} + \gamma u \frac{\partial u}{\partial x} + w \frac{\partial u}{\partial z} .....(13)$$
In the same way, the total weighted total acceleration can be obtained in the vertical direction.-z
$$\frac{Dw}{dt} = \gamma^2 \frac{\partial w}{\partial t} + \gamma u \frac{\partial w}{\partial x} + w \frac{\partial w}{\partial z} ....(14)$$
With (13) and (14), then the equation for Euler's momentum in the horizontal direction-x and the vertical direction-z becomes,
$$\gamma^2 \frac{\partial u}{\partial t} + \gamma u \frac{\partial u}{\partial x} + w \frac{\partial u}{\partial z} = -\frac{1}{\rho} \frac{\partial p}{\partial x} \qquad ....(15)$$
$$\gamma^2 \frac{\partial w}{\partial t} + \gamma u \frac{\partial w}{\partial x} + w \frac{\partial w}{\partial z} = -\frac{1}{\rho} \frac{\partial p}{\partial z} - g \qquad ....(16)$$

Equations (15) and (16) are a modification of Euler's momentum equation in the total acceleration term, by adding the weighted coefficient γ. The difference between this study and Hutahaean's (2019a) is that in this study the weighting coefficient is not only in time differential terms.

IV.   FORMULATION OF SURFACE MOMENTUM EQUATIONS
        The irrotational flow condition is substituted in (15) and (16) where, $\frac{\partial u}{\partial z} = \frac{\partial w}{\partial x}$,
$$\gamma^2 \frac{\partial u}{\partial t} + \frac{1}{2} \frac{\partial}{\partial x}(\gamma uu + ww) = -\frac{1}{\rho} \frac{\partial p}{\partial x} ......(17)$$
$$\gamma^2 \frac{\partial w}{\partial t} + \frac{1}{2} \frac{\partial}{\partial z}(\gamma uu + ww) = -\frac{1}{\rho} \frac{\partial p}{\partial z} - g ......(18)$$

Eq. (18) is written into an equation for p and integrated with respect to the vertical axis z from the elevation z to the water surface η, and the dynamic boundary condition of the surface where the surface pressure $p_\eta = 0$ is applied, thenthe equation of pressure p is obtained

$$\frac{p}{\rho} = \gamma^2 \int_z^\eta \frac{\partial w}{\partial t} dz + \frac{1}{2}(\gamma u_\eta u_\eta + w_\eta w_\eta)$$
$$- \frac{1}{2}(\gamma uu + ww) + g(\eta - z)$$

This equation is differentiated with respect to the horizontal axis-x,

$$\frac{1}{\rho}\frac{\mathrm{d}p}{\mathrm{d}x} = \gamma^2\frac{\mathrm{d}}{\mathrm{d}x}\int_z^\eta \frac{\mathrm{d}w}{\mathrm{d}t}dz$$

$$+\frac{1}{2}\frac{\mathrm{d}}{\mathrm{d}x}\left(\gamma u_\eta u_\eta + w_\eta w_\eta\right)$$

$$-\frac{1}{2}\frac{\mathrm{d}}{\mathrm{d}x}\left(\gamma uu + ww\right) + g\frac{\mathrm{d}\eta}{\mathrm{d}x}.....(19)$$

Substituting (19) by (17),

$$\gamma^2\frac{\mathrm{d}u}{\mathrm{d}t} = -\gamma^2\frac{\mathrm{d}}{\mathrm{d}x}\int_z^\eta \frac{\mathrm{d}w}{\mathrm{d}t}dz$$

$$-\frac{1}{2}\frac{\mathrm{d}}{\mathrm{d}x}\left(\gamma u_\eta u_\eta + w_\eta w_\eta\right) - g\frac{\mathrm{d}\eta}{\mathrm{d}x}...(20)$$

The solution to $\frac{\mathrm{d}}{\mathrm{d}x}\int_z^\eta\frac{\mathrm{d}w}{\mathrm{d}t}dz$ was done using the equation of the potential velocity of water waves (Dean (1991)), that is

$$\Phi(x,z,t) = Gcoshk(h+z)coskxsin\sigma t \quad ....(21)$$

The velocity and acceleration in the vertical direction-z are,

$$w = -\frac{\mathrm{d}\Phi}{\mathrm{d}z} = -Gksinhk(h+z)coskxsin\sigma t..(22)$$

$$\frac{\mathrm{d}w}{\mathrm{d}t} = -Gksinhk(h+z)\sigma coskxcos\sigma t \quad ....(23)$$

(23) is integrated with respect vertical axis$-z$,

$$\int_z^\eta \frac{\mathrm{d}w}{\mathrm{d}t}dz =$$

$$-G\big(coshk(h+\eta) - coshk(h+z)\big)coskxcos\sigma t$$

then was differentiated with respect to the horizontal axis-x,

$$\frac{\mathrm{d}}{\mathrm{d}x}\int_z^\eta \frac{\mathrm{d}w}{\mathrm{d}t}dz =$$

$$Gk\big(coshk(h+\eta) - coshk(h+z)\big)\sin kx \, cos\sigma t$$

$$......(24)$$

Horizontal direction velocity and acceleration-x is,

$$u = -\frac{\mathrm{d}\Phi}{\mathrm{d}x} = Gkcoshk(h+z)sinkxsin\sigma t.....(25)$$

$$\frac{\mathrm{d}u}{\mathrm{d}t} = Gk\sigma coshk(h+z)sinkxcos\sigma t.....(26)$$

From(24) and (26) the following relationship is obtained

$$\frac{\mathrm{d}}{\mathrm{d}x}\int_z^\eta \frac{\mathrm{d}w}{\mathrm{d}t}dz = \frac{\mathrm{d}u_\eta}{\mathrm{d}t} - \frac{\mathrm{d}u}{\mathrm{d}t} \qquad ......(27)$$

Substituting (27) to (20) the equation of surface momentum is obtained,

$$\gamma^2\frac{\mathrm{d}u_\eta}{\mathrm{d}t} + \frac{1}{2}\frac{\mathrm{d}}{\mathrm{d}x}\left(\gamma u_\eta u_\eta + w_\eta w_\eta\right) = -g\frac{\mathrm{d}\eta}{\mathrm{d}x}....(28)$$

V. FORMULATION OF THE DISPERSION EQUATION

The dispersion equation is formulated at the characteristic point, where $\cos kx = \sin kx = \cos \sigma t =$

$\sin \sigma t = \frac{\sqrt{2}}{2}$. At this characteristic point, water surface elevation $\eta = \frac{A}{2}$.

The dispersion equation will be formulated using two equations, namely the KFSBC and the surface momentum equation, (28).

a. KFSBC operation.

Hutahaean (2021), by integrating KFSBC (11) against time t, obtained

$$\eta(x,t) = Acoskxcos\sigma t...(29)$$

At the characteristic point,

$$\frac{\mathrm{d}\eta}{\mathrm{d}x} = -\frac{kA}{2}...(30)$$

Where,

$$A = \frac{Gk}{2\sigma\gamma}coshk\left(h+\frac{A}{2}\right)\left(1-\frac{kA}{2}\right).......(31)$$

Substituting (31) to (30)

$$\frac{\mathrm{d}\eta}{\mathrm{d}x} = -\frac{k}{2}\frac{Gk}{\sigma\gamma}coshk\left(h+\frac{A}{2}\right)\left(1-\frac{kA}{2}\right).....(32)$$

Equation (31) can be written as an equation for G,

$$G = \frac{2\sigma\gamma A}{kcoshk\left(h+\frac{A}{2}\right)\left(1-\frac{kA}{2}\right)}....(33)$$

b. Operation of Surface Momentum Equations

Substituting (25) for horizontal velocity u, (22) for vertical velocity$w$ and (32) for $\frac{\mathrm{d}\eta}{\mathrm{d}x}$to (28), where at the characteristic point $\eta = \frac{A}{2}$,

$$\gamma^2\sigma + \frac{1}{2}(\gamma-1)Gk^2coshk\left(h+\frac{A}{2}\right) + \frac{1}{2}\frac{Gk^2}{coshk\left(h+\frac{A}{2}\right)}$$

$$= \frac{gk}{2\sigma\gamma}\left(1-\frac{kA}{2}\right)$$

Substituting G by (33),

$$\gamma^2\sigma\left(1-\frac{kA}{2}\right) + \sigma\gamma Ak\left((\gamma-1) + \frac{1}{cosh^2k\left(h+\frac{A}{2}\right)}\right)$$

$$= \frac{gk}{2\sigma\gamma}\left(1-\frac{kA}{2}\right)^2$$

Hutahaean (2021) found that $\frac{\partial k\left(h+\frac{A}{2}\right)}{\partial x} = 0$, so the $\cosh k\left(h+\frac{A}{2}\right)$ values is constant. In deep water, element $\frac{1}{cosh^2k\left(h+\frac{A}{2}\right)} = 0$, is also constant. The final equation becomes,

$$\gamma^2\sigma\left(1-\frac{kA}{2}\right) + \sigma\gamma Ak(\gamma-1) = \frac{gk}{2\sigma\gamma}\left(1-\frac{kA}{2}\right)^2$$

$$.......(34)$$

This equation is the dispersion equation for deep water, which can be solved by the Newton-Rhapson method. The solution using the Newton-Rhapson method requires an initial estimate value of k. The initial estimation value can be obtained by working with the assumption that in deep water the convective acceleration term, the second term on the left side (34) can be ignored, so that a simpler equation is obtained,

$$2\gamma^3\sigma^2 = gk\left(1 - \frac{kA}{2}\right)$$

Or,

$$\frac{gA}{2}k^2 - gk + 2\gamma^3\sigma^2 = 0 \quad ......(35)$$

Calculating k using (35), when the formulas a, b, c is used are:

$$k = \frac{-b - \sqrt{d}}{2a}$$

The determinant d in (35) is:

$$d = g^2 - 4gA\gamma^3\sigma^2$$

At the determinant value $d = 0$, the maximum amplitude for a wave period will be obtained, that is

$$A_{max} = \frac{g}{4\gamma^3\sigma^2} \quad ......(36)$$

VI.   ADJUSTMENT TO CRITICAL WAVE STEEPNESS CRITERIA AND MAXIMUM WAVE HEIGHT IN DEEP WATER.

In (34) there is a weighting coefficient γ whose value will determine the resulting wavelength. In this section the weighting coefficient value γ will be determined using the maximum wave height criteria and critical wave steepness criteria.

The calculation was done by trial and error that is by determining γ, the wave amplitude A is calculated using (36), then the wave number k is calculated using (34), where the wavelength $L = \frac{2\pi}{k}$, then the wave height H is calculated using (37)-(40). Trial and error was carried out until wave height $H = H_{max}$ was obtained, where H_{max} was calculated by using (1).

Calculation of wave height H was done using the water level equation

$$\eta_0(x,t) = A_0 cos kx cos \sigma t ....(37)$$

A_0 is the wave amplitude calculated by (36). Then the wave amplitude A was calculated,

$$A = \frac{Gk}{2\sigma\gamma} cosh k(h + k\eta_0)(1 - k\eta_0) .....(38)$$

Water wave surface elevation is:

$$\eta(x,t) = A cos kx cos \sigma t ....(39)$$

The calculation was done for $t = 0$. By using the water wave surface equation the η-maximum and η-minimum were calculated. Wave height H is,

$$H = \eta_{max} - \eta_{min} ....(40)$$

The trial error on value γ was done until $H = H_{max}$ where the condition was achieved at $\gamma = 1.4614$, but the critical wave steepness $\frac{H}{L} = 0.210$ is greater than the Toffoli et all's (2010) criteria that is $\frac{H}{L} = 0.170$.

Table.3: Wave height and critical wave steepness on $\gamma = 1.4614$

T (sec)	L (m)	A (m)	H (m)	H_{max} (m)	$\frac{H}{L}$
6	6.894	0.717	1.451	1.451	0.21
7	9.383	0.975	1.975	1.975	0.21
8	12.256	1.274	2.58	2.58	0.21
9	15.511	1.612	3.265	3.265	0.21
10	19.149	1.99	4.031	4.031	0.21
11	23.171	2.408	4.877	4.878	0.21
12	27.575	2.866	5.804	5.805	0.21
13	32.362	3.364	6.812	6.812	0.21
14	37.533	3.901	7.9	7.901	0.21
15	43.086	4.478	9.069	9.07	0.21

The water wave surface profiles was calculated by (37), (38) and (39) are sinusoidal in shape where $\frac{H}{A} = 2$, but with truncated peaks. This condition is in accordance with the characteristics of the sinusoidal solution to Laplace's equation (Dean (1991)).
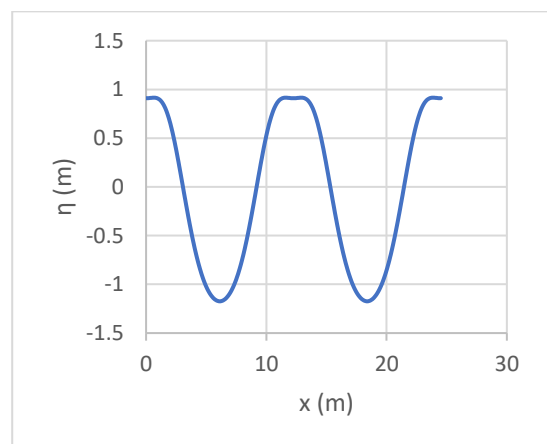
Fig.1: Wave profile for $T = 8$ sec., $\gamma = 1.4614$

In this following section, trial-error of the weighting coefficient value was done until wave steepness value $\frac{H_{max}}{L} = 0.170$, which is the Toffoli criteria. This condition was achieved atthe weighting coefficient value $\gamma = 1.45$, but wave height H is less than H_{max}, as can be seen in Table (4).

Table.4: Wave height and critical wave steepness on $\gamma = 1.45$

T (sec)	L (m)	A (m)	H (m)	H_{max} (m)	$\frac{H_{max}}{L}$
6	7.101	0.734	1.206	1.451	0.17
7	9.665	0.998	1.642	1.975	0.17
8	12.623	1.304	2.144	2.58	0.17
9	15.976	1.651	2.714	3.265	0.17
10	19.724	2.038	3.35	4.031	0.17
11	23.866	2.466	4.054	4.878	0.17
12	28.403	2.934	4.825	5.805	0.17
13	33.334	3.444	5.662	6.812	0.17
14	38.659	3.994	6.567	7.901	0.17
15	44.379	4.585	7.538	9.07	0.17

It can be concluded thatstudy on deep water results weighting coefficient valueγ in the range 1.45-1.464, with a critical wave steepness in the range 0.17-0.21. Where with this weighting coefficient value the wave height maximum is in accordance with the wave height maximum criteria of Wiegel (1949,1964) and the wave steepness is in accordance with the Toffoli's (2010) criteria .

VII.   THE EFFECT OF WAVE AMPLITUDE ON WAVELENGTH

In the previous section, it has been found that the wavelength and wave amplitude are determined by the weighting coefficient value γ. In (34), there is an interaction between wave ampltude$A$and wavelength$L$. In the following section, the effect of wave amplitude on wavelength is investigated. This is important, considering that (34) there is no water depth parameter h. So it is necessary to explain how the effect of water depth h on wavelength L.
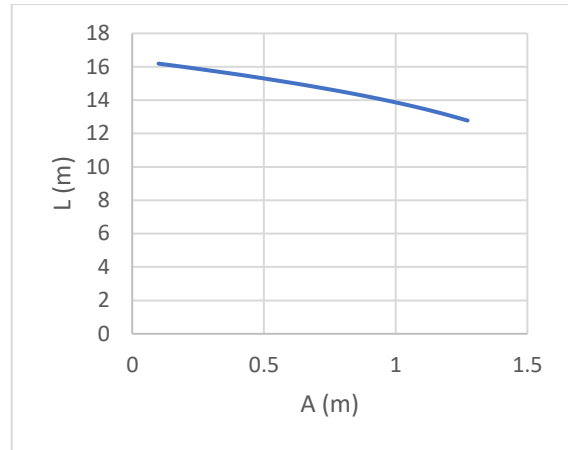
Fig. 2: Wavelength graphic L towards the wave amplitude A, wave perod 8 sec., $\gamma = 1.45$.

The effect of wave amplitude on wavelength is shown in Fig. (2) where the larger the wave amplitude, the shorter the wavelength. When waves move from deeper waters to shallower waters, an enlargement of the wave height and shortening of the wavelength occurs, known as the shoaling phenomenon. Thus the effect of water depth on wavelength is through the wave amplitude, where the wave amplitude is influenced by the water depth. In other words, to obtain wavelengths in shallow water, shoaling analysis must be carried out. However, the wavelength calculation can be done in a simple way by ignoring the wave amplitude enlargement, which will be discussed in section 8.

Table.5: Wave height and critical wavelength on $\gamma = 1.00$

T (sec)	L (m)	A (m)	H (m)	H_{max} (m)	$\frac{H_{max}}{L}$
6	28.104	2.236	4.027	1.451	0.143
7	38.252	3.044	5.481	1.975	0.143
8	49.962	3.976	7.159	2.58	0.143
9	63.233	5.032	9.061	3.265	0.143
10	78.066	6.212	11.187	4.031	0.143
11	94.459	7.517	13.536	4.878	0.143
12	112.414	8.946	16.109	5.805	0.143
13	131.931	10.499	18.905	6.812	0.143
14	153.008	12.176	21.926	7.901	0.143
15	175.647	13.977	25.17	9.07	0.143

To further clarify the effect of wave amplitude on wave length, the calculation is done with the weighting coefficient value $\gamma = 1.00$. With this weighting coefficient value, the effect of the convective acceleration

in (34) is neglected with the calculation results presented in Table (5). It can be seen that even though it is used $\gamma = 1.00$, the wavelength of (34) is still much shorter than the wavelength of the linear wave theory (4), where the wavelength of the equation can be seen in Table (1). This shows the magnitude of the wave amplitude influence on wavelength. With this weighting coefficient value, a very large wave height is produced, much bigger than H_{max} Wiegel's criteria (1949,1964), but with a critical wave steepness that is very close to Michell's (1893) criteria, namely $\frac{H}{L} = 0.142$.

VIII.   SIMPLE METHODS FOR CALCULATING WAVELENGTHS ON SHALLOW WATER

The dispersion equation obtained was the equation for deep water. In the previous section, it has been found that the effect of waterdepth on wavelength is through wave amplitude, where the calculation of wavelength in shallow waters must go through shoaling analysis. In this section analysisof wavelength was done by ignoring the phenomenon of wave amplitude enlargement, or by working on constant wave amplitudes. The calculation was done using the wave number conservation equation (Hutahaean (2021)), namely,

$$\frac{\partial k\left(h+\frac{A}{2}\right)}{\partial x} = 0 \quad .....(41)$$

For waves moving from water depth h_1 to shallower water depth h_2 this applies

$$k_2\left(h_2 + \frac{A_2}{2}\right) = k_1\left(h_1 + \frac{A_1}{2}\right)$$
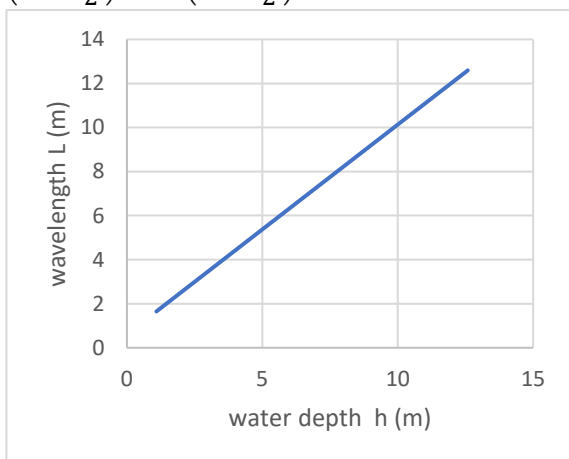
Fig.3: Wavelength graphic on water depth, $T = 8$ sec., $\gamma = 1.45$

By ignoring the change in wave amplitude

$$k_2 = \frac{k_1\left(h_1+\frac{A_1}{2}\right)}{\left(h_2+\frac{A_1}{2}\right)} \quad .....(42)$$

In (43) it can be seen that for h_2 less than h_1 there will be an enlargement of the wave number k or shortening on wavelength L.

On Fig. (3), it presents the calculation results with (42) for waves with wave period $T = 8$ sec., weighting coefficient $\gamma = 1.45$, with a linear change in water depth, it is found that the wavelength also changes linearly.

IX.   CONCLUSION

The main conclusion is that the total acceleration equation in both the KFSBC equation and the momentum equation, which uses the weighting coefficient produces a dispersion equation that can produce a wavelength that is close enough to the criterion of critical wave steepness.

The weighting coefficient value obtained was 1.45-1.464, where with this weighting coefficient value the critical wave steepness and maximum wave height were obtained according to the existing criteria of previous researchers.

In the dispersion equation obtained, there is no effect of water depth, but there is an influence of wave amplitude. The effect of wave amplitude on wavelength is quite significant, that even though a weighting coefficient of 1.0 is used, the wavelength is still much shorter than the wavelength of the linear wave theory.

The effect of wave amplitude on wavelength is that the bigger the wave amplitude is, the shorter the wave length. This is consistent with the shoaling-breaking phenomenon in waves moving from a deeper water depth to a shallower water depth, where an enlargement of the wave amplitude occurs which results in a shortening of wavelengths which eventually breaking occurs when the critical wave steepness is exceeded.

To get a more definite weighting coefficient value, it is necessary to examine the shoaling-breaking phenomenon in a model developed using the KFSBC equations and Euler's momentum using weighting total acceleration and comparing the model results with the breaker index equation.

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Efficiency and response of corn cultivars to nitrogen, associated or not with *Azospirillum brasilense*

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Abstract— *Green corn is an economic and social alternative for small and medium-sized farmers. However, the high cost of the insums, especially in relation to the use of nitrogen, has advanced studies with nitrogen-fixing bacteria. This study evaluated commercial maize cultivars for the production of green ears, responsive and efficient to nitrogen use, with and without application in Azospirillum brasilense seeds. Two trials were installed in the agricultural years 2019/20 and 2020/21 in soweds carried out on 12/04/2019 and 10/12/2020 in this order, at the Federal University of Tocantins, Palmas-TO. In each trial, the experimental design was randomized blocks, with three replications, being the treatments arranged in subdivided plots, where the treatments involving the processes with inoculation of seeds with the bacterium Azospirillum (C Az) and without inoculation of seeds (S Az) were allocated in the plots, two doses of nitrogen (30 and 120 kg ha^{-1} N, considered as low and high N, respectively) and in the subplots eight corn cultivars were allocated in the subplots. Joint variance analysis was performed for each of the seed inoculation processes (C Az and S Az) and then the efficiency and response of corn cultivars were studied for the use of N for each process. The inoculation of seeds with the bacterium promoted changes in the efficiency and response of cultivars regarding the use of nitrogen. The cultivar BRS-3046 was the most important for the cultivation of green ears, since it was efficient and responsive to the use of nitrogen with Azospirillum brasilense.*

I. INTRODUCTION

The production of green corn (*Zea mays*) is a source of income and food, both for human and animal feed, being used by the consumer market in grain or in natura "green ears" and in the canned industry [1]. In Brazilian cuisine, it is marketed in free fairs, grocery stores and supermarket chains and even on the borders of highways in the forms of roasting, cooked etc. [2].

In the Northern region of Brazil, specifically in the state of Tocantins, the low productivity of corn occurs, among other factors, due to the presence of high temperatures, low technological level, scarcity of

improved seeds, and the conditions of abiotic stresses, such as climatic and nutritional variations, in the latter case, mainly related to N [3].

The use of nitrogen fertilizers is one of the factors responsible for high corn productivity. According to Lemaire & Gastal [4], N is the element required in greater quantity by corn and the most limiting for grain yield. However, its continuous use outs of production costs related to its acquisition, transportation, application installment, etc. [5], [6].

Obtaining genotypes with greater efficiency in the use of nitrogen (EUN) would be a desirable alternative for capitalized agriculture and low use of insums, aiming to reduce waste and scarcity of this mineral element, which could generate economic, environmental, public health and food safety problems [7]. An alternative for the supply of N to plants would be to use plant growth-promoting bacteria (BPCP) for biological nitrogen fixation (FBN), via *Azospirillum brasilense*, which is considered a cheap, clean and sustainable alternative in the supply of N, with benefits for current agriculture [8], besides contributing to the reduction of greenhouse gas emissions [9].

However, there are still contradictions regarding the efficiency of the use of Inoculation of *Azospirillum brasilense* in corn seeds. While [10], it highlights that efficiency can increase by up to 30% in productivity and promote a reduction of up to 15% of nitrogen fertilization [9], reports not obtaining increases in plants when inoculated with bacteria and nitrogen doses. According to Quadros et al. [11], the success of inoculation may vary due to some factors, such as soil type, soil climate and plant genotype.

Several researchers have sought to obtain genotypes with higher EUN for corn ([12], [13], [14], [15], [16], [17]. However, there are few studies involving corn genotypes, responsive and efficient to nitrogen use, after inoculation of seeds with *Azospirillum brasilense*, as well as comparisons involving EUN in cultivars with seeds inoculated and not inoculated with *Azospirillum*.

Thus, the present work was carried out with the objective of studying commercial cultivars of corn for the production of green ears, efficient and responsive to the use of nitrogen, with and without application in the seeds of the bacterium *Azospirillum brasilense*.

II. MATERIAL AND METHODS

Two trials were installed in the experimental area of the Federal University of Tocantins in Palmas-TO (latitude 10º12'46"S, longitude 48º21'37"W and altitude of 260 m), one in the agricultural year2019/20, in sowing held on

12/04/2019, and another in the agricultural year 2020/21, in sowing held on 10/12/2020.

The climate is tropical humid (Köeppen, Aw) which contributes to the high temperatures in the region. During the periods of conduction of the tests, the average maximum, minimum and relative humidity were in the ranges of 35.9 ºC; 26.33 ºC and 65.96% RH respectively. The cumulative total rainfall in the period was 1,418 mm, with monthly averages of 354.5 mm [18], [19], [20].

The soil of the experimental area, according to the Brazilian Soil Classification System is considered as dystrophic Yellow Red Latosol [21]. Soil samples collected at a depth of 0 to 20 cm, and their chemical analyses revealed the following: pH(CaCl2) 6.0; clay 15.5%; Site 5.9%; sand 78.6%; M.O 11.63 g dm-3; P (Mehlich-1) 9.92 mg dm-3; K 0.2 cmol dm-3; Ca 1.90 cmol dm-3; Mg 1.12 cmol dm-3; S.B 3.22 cmol dm-3; CTC 5.02 cmol dm-3, e V 64.14%.

The experimental design used in each assay was randomized blocks, with three replications. The treatments were arranged in subdivided plots, where the treatments were allocated in the plots with inoculation of seeds with *Azospirillum* (C Az) and without inoculation of seeds (S Az),in the subplots two nitrogen doses (30 and 120 kg ha^{-1} N, considered as low and high N, respectively) and in the subsub plots eight corn cultivars, three simple hybrids (M-274, PR-27D28, AG 8088-PRO2), two double hybrids (BRS-2022, AG-1051), two triple hybrids (BRS-3046, BM-3061) and a variety of open pollination (Anhembi), all cultivars were acquired in the local trade.

The experimental plots consisted of four rows, with 3.0 m in length, spaced by 1.0 m totaling an area of 12,0 m2. At harvest, the two central rows were considered useful, discarding 0.50 m from the extremities.

The tillage was in conventional cultivation, without the need for cathes. At sowing, fertilization was performed in the groove with 70 kg ha^{-1} of P_2O_5, and 48 kg ha^{-1} of K_2O, of potassium chloride.

Sowing was performed no-head in the groove, and the seeds were inoculated 30 minutes before planting with the bacterium *Azospirillum brasilense* (AbV5 and AbV6), being 100ml for every 25 kg of seeds, as recommended by the manufacturer. Population density was 50,000 plants per hectare [22].

Weed control was performed using post-emergent herbicide. Subsequently, weeding was performed. It was not necessary to control pests and diseases.

The cover fertilization was performed with ammonia sulfate (21% N), at doses of 30 (low N) and 120 kg ha^{-1}

(high) in the between plots, being half applied in stage V4 and V8 (four and eight true leaves) [23].

In the useful area of each plot, the green ears were harvested as the grains presented 70% to 80% humidity, at stages R3 and R4 [24]. Then the ears were scattered, and the weight of each parcel converted into kg ha^{-1}.

The data of each experiment were submitted to individual variance analysis and, when the homogeneity of variances was verified, the joint analysis was carried out for each of the seed inoculation processes (with and without *Azospirillum brasilense*). Next, the efficiency and response of maize cultivars regarding the use of nitrogen (N) was studied for each process, according to the methodology proposed by [25].

By this methodology, the efficiency corresponded to the yield measurement of green ears in each cultivar in the environment with low nitrogen (BN) (30 kg ha^{-1} of N). On the other hand, the response to the application of N for each cultivar is represented by the formula below:

Response (%) = (RAN – RBN) / (DEN)

RAN = high yield N;

RBN = yield low N and;

DEN = difference between the doses applied (high N – low N, in kg ha^{-1}).

The graphic representation was used in the Cartesian plane to classify the cultivars, and in the axis of the abscissas, the efficiency of the use of N is represented and in the axis of the ordered the responses to its application. The point of origin of the axes corresponds to the average efficiency and average response of the cultivars. In the first quadrant are represented the efficient and responsive cultivars (I); in the second the Inefficient and Responsive (II); in the third the Non-Efficient and Non-Responsive (III) and in the fourth quadrant the Efficient and Non-Responsive (IV).

The medium of cultivars and nitrogen doses, in the processes with seed inoculation (C Az) and without seed inoculation (S Az) with the bacterium *Azospirillum brasilense*, were compared by Scott-Knott [26] test, at 5% significance using the statistical program SISVAR [27]. For the preparation of the graphics, the Origin Pro 8 program was used.

III. RESULTS AND DISCUSSION

The medium average yield of green ears spread (kg ha^{-1}) of the eight maize cultivars, in two nitrogen levels (30 and 120 kg ha^{-1} N) and in two inoculation processes with *Azospirillum* (C Az) and without *Azospirillum* (S Az), as well as the efficiency and response indices are presented in Table 1.

Table 1: Average yield of green ears spread (kg ha^{-1}) of eight green corn cultivars, in two levels of nitrogen (30 and 120 kg ha^{-1} N) and two inoculation processes C Az (with Azospirillum) and S Az (without Azospirillum), in Palmas - TO, in the 2019/2020 and 2020/2021 harvests.

Cultivars	Low N (30 kg ha^{-1})		High N (120 kg ha^{-1})		Response	
	C *Az*	S *Az*	C *Az*	S *Az*	C *Az*	S *Az*
BRS-3046	9.037bA	8.920bA	10.784aA	9.974aA	19.41	11.71
Anhembi	7.719bB	8.200bB	9.343aB	9.085aB	14.04	9.83
M-274	7.811bB	8.678bA	9.606aB	9.261aB	19.94	6.47
PR-27D28	8.350bB	7.568bB	9.112aB	9.283aB	8.47	19.05
BRS-2022	8.670bA	8.184bB	9.540aB	9.323aB	9.67	12.65
BM-3061	9.474bA	8.300bB	10.214aA	9.974aA	8.22	18.60
AG-1051	9.136bA	9.380bA	9.614aB	10.071aA	5.31	7.68
AG 8088-PRO2	8.481bB	8.397bB	9.714aB	10.081aA	13.70	18.71
Medium	8.585b	8.578b	9.741^a	9.632a	12.35	13.09
General Medium	C *Az* 9.163 e S *Az* 8.977					
CV (%)	C *Az* 2.20 e S *Az* 2.29					

1- Medium between n doses, for the same inoculation process and for the same cultivar, followed by the same lowercase letter, in the line belong to the same statistical group by test [26], at 5% significance.

2- Medium between cultivars, for the same n dose and for the same inoculation process, followed by the same capital letter in the column belong to the same statistical group by test [26], at 5% significance.

Os coeficientes de variação CV (%) foram de C Az = 2.20 e S Az = 2.29 (tabela 1), o que indica uma ótima precisão na condução do ensaio experimental [28].

The comparative study between n doses in each inoculation process revealed that both in the C Az process and in the S Az process, all cultivars presented a higher yield of ears under high N (120 kg ha^{-1}).

The N is the nutrient with the highest demand in corn crop [29], being present in relevant functions in plant metabolism, such as protein synthesis, ionic absorption, photosynthesis, respiration, cell multiplication and differentiation, ultimately reflecting on plant characteristics related to growth and development, which directly or indirectly affect crop yield [30], [31]. [32] approximately 70 to 77% of what is absorbed is exported to the grains.

The results are in agreement with [17], who studied the efficiency and response of corn cultivars to nitrogen use in the south of the state of Pará, for silage production, and also verified a better performance of all cultivars when under cultivation in high N.

When comparing the cultivars, within each inoculation process and within each n dose, it can be observed that two groups of means were always formed, which differed in their composition. In this sense, when the seeds (C Az), both in high N and low N, the cultivars BRS-3046 and BM-3061 were the ones that stood out the most. On the other hand, in the process without inoculation (S Az), in high and low N, BRS-3046 and AG-1051 were the most productive.

It is emphasized the higher productivity of BRS-3046 and the lowest yields of the variety Anhembi and PR-27D28 in all doses of N and in all inoculation processes. The lowest yield of the cultivar Anhembi occurred because the varieties are known as open pollination cultivars and are obtained by the free pollination of a group of selected individuals. Thus, they are highly heterozygous and heterogeneous, presenting greater genetic variability and lower uniformity and productivity [33].

According to Fancelli [34], the agronomic and productive performance of corn cultivars are directly characterized by the different phenological phases of the crop, combined with its association with nutrients.

The efficiency and response to nitrogen fertilization of cultivars in the process without inoculation of seeds with *Azospirillum* (S Az), related to the production of green ears, are shown in Fig. 1a.
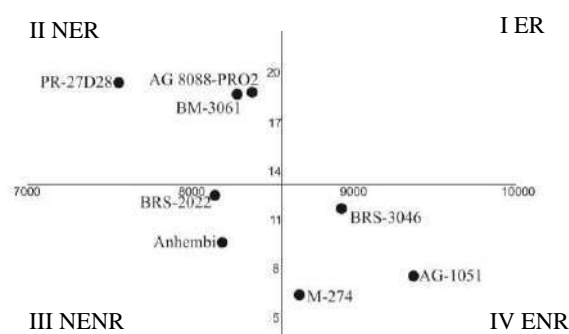
Fig. 1a S Azosp
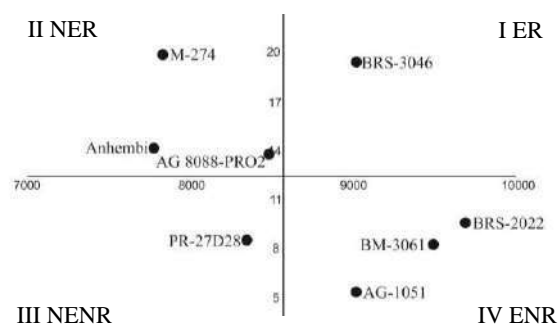
Fig. 1b C Azosp

Fig 1: Efficiency and response of nitrogen application associated with processes with and without Azospirillum brasilense (C Az and S Az) in eight green corn cultivars in Palmas - TO, in the 2019/2020 and 2020/2021 harvests.

The cultivars M-274, AG-1051 and BRS-3046 (Quadrant IV) were considered as efficient to the application of N, because they presented production of green ears under low N (BN) higher than the general average of cultivars in BN, and not responsive, that is, they are recommended for properties that adopt low technological level [35].

The cultivars AG 8088-PRO2, PR-27D28 and BM-3061 (Quadrant II) and Anhembi and BRS-2022 (Quadrant III) were classified as inefficient. Of these, the first three are responsive and the last two are non-responsive. Inefficient and responsive cultivars are indicated for use by producers with a high technological level [17]. On the

other hand, inefficient and non-responsive cultivars are not indicated for use in any agricultural properties [36].

In studies carried out in the South of the State of Pará that evaluated the efficiency and response of eleven commercial maize cultivars to nitrogen fertilization for silage production, they also obtained similar classifications for cultivars BRS-3046 and Anhembi, regarding nitrogen efficiency [17].

It is emphasized that without inoculation of seeds with *Azospirillum* (S Az), efficient and responsive cultivars (Quadrant I) were not obtained. This fact did not occur when the seeds were inoculated, revealing the importance of *Azospirillum brasilense* in the performance of the cultivars.

Corn germplasm consists of Creole breeds, adapted populations and introduced materials and is characterized by a wide genetic variability, which can interfere with the efficiency of the use of N [37].

Fernandes et al. [38], working with six maize cultivars, also showed significant differences in the efficiency of N utilization by plants, due to genetic variations among genotypes [39].

The efficiency and response to nitrogen fertilization of cultivars in the process with inoculation of seeds with *Azospirillum* (C Az), for the production of green ears, are shown in Fig. 1b.

The cultivars BRS-3046 (Quadrant I) and BRS-2022, BM-3061 and AG-1051 (Quadrant IV) were considered as efficient to the application of N. Of These, BRS-3046, highlighted for being efficient and responsive to the application of N and the others not responsive. According to Fidelis et al. [36] genotypes considered efficient and responsive are recommended for low to high technological agricultural crops, thus being economically viable for small farms and family farming.

The cultivars M-274, Anhembi and AG 8088-PRO2 (Quadrant II) and PR-27D28 (Quadrant III) were classified as inefficient. Of these, the first three are responsive and PR-27D28 non-responsive.

The comparative study between the processes of efficiency and n response with the inoculation of seeds (C Az) (Fig. 1b) and without inoculation of seeds (S Az) (Fig. 1a) revealed changes in the classifications of all cultivars, except for cultivars AG 8088-PRO2 and AG-1051.

The cultivars BM-3061 and BRS-2022, which were classified as inefficient to the application of N in the process without inoculation of seeds (S Az), in the process with inoculation of seeds with *Azospirillum* (C Az) were classified as efficient. This fact may have come from a greater availability of N via symbiotic fixation and, also,

from a greater absorption of nitrate available in the soil by the greater development of the root system of plants.

Bacteria of the genus *Azospirilun* spp., are able to stimulate plant growth by biological fixation of N and the increase in nitrate reductase activity [8], [40], as well as can alter the morphology and growth of the roots, enabling the exploration of a larger volume of soil [41], [42]. This higher root growth, which occurs due to the greater presence of in dolatic acid [43], may increase the absorption of minerals from the soil [44], including nitrate, P and K [41], [45] resulting in a higher production of dry matter, which combined with a greater accumulation of N in the plant, will promote increases in production [46], [47], [48].

For Chotte et al. [49], in soils with a deficiency of N, the biological fixation of N (FBN) can supply the deficiency of this nutrient in the soil, so that the occurrence of diazotrophic microorganisms in high numbers may be essential for the FBN is effective.

The efficiency of the use of *Azospirilun* spp., in the development of corn crop, has been the subject of research for several years. In this sense, [50], analyzing data from 22 years of field studies, they concluded that bacteria of the genus *Azospirillun* spp., tend to promote yield gains for corn crop in the most varied climate and soil conditions. These same authors also point out that the influence of *Azospirillun* spp., is not only related to the fact that these microorganisms act in biological nitrogen fixation, but also act as growth promoters, helping to increase the contact surface of the root system of plants, which culminates in greater absorption of water and nutrients by the roots.

Segundo Hungria [8], *Azospirillum* probably results in larger seedlings, with rapid initial growth, and in plants with a larger number of roots and longer roots, which provides a greater amount of dry matter in the shoot (28%) and a higher grain yield 7.1% (average of 221 Local). Also according to this same author, the bacteria of the genus *Azospirillum* are considered associative and excrete only a part of the nitrogen fixed directly to the associated plant, which will partially supply the needs of plants with N, which is still dependent on the hybrid used, edaphoclimatic conditions and adequate crop management. Thus, in addition to the fixation of nitrogen from associative bacteria, nitrogen fertilization is needed for the plant to obtain all the nitrogen necessary for its development.

Regarding the N response, the cultivars Anhembi, M-274 and BRS-3046 that were classified as non-responsive to the application of N in the process without inoculation of seeds (S Az), when seeds were inoculated with *Azospirillum* (C Az), were classified as responsive. On the

other hand, PR-27D28 and BM-3061, which were responsive to the application of N in the process without inoculation of seeds (S Az), became non-responsive when the seeds were inoculated with *Azospirillum* (C Az).

The genotype of the plant can influence the efficiency of N fixation Sala et al. [51], indicating a differential response of genotypes according to the form of inoculation used [52]. Thus, measures such as identification, selection and use of less demanding maize genotypes for element N are relevant tools from the economic and environmental point of view [53].

Salomone & Dobereiner [54] evaluating different maize genotypes inoculated with *Azospirillum* obtained different responses regarding inoculation under yield in production, highlighting that there are variations in the interactions between corn genotypes and diazotrophic bacteria.

Chotte et al. [49] when evaluating 32 maize cultivars for efficiency in nitrogen absorption and association with diazotrophic bacteria, they found that the occurrence of a high population of diazotrophic bacteria and the low response to nitrogen fertilization together with a large accumulation of N under conditions of low fertility, may indicate a promising cultivar for future studies of selection of efficient cultivars for cultivation in soils with low nitrogen availability.

Reis et al. [55] reported that, in many cases, the absence of response to inoculation of diazotrophic bacteria in grasses has been attributed to the use of inadequate strains. However, there is consensus that the genotype of the plant is the key factor to obtain the benefits derived from the BNF, combined with the selection of efficient strains.

IV. CONCLUSION

The inoculation of seeds with the bacterium *Azospirillum brasilense* promoted changes in the efficiency and response of cultivars regarding the use of nitrogen.

The cultivars efficient to the use of N, in the presence of *Azospirillum brasilense*, were BM-3061, BRS-2022 and AG-1051.

The cultivar BRS-3046 stood out and obtained its best increment for the cultivation of green ears, since it was efficient and responsive to the use of nitrogen in the presence of *Azospirillum brasilense*.

Breeding charts will be useful for the development of more efficient and nitrogen-responsive cultivars with the use of *Azospirillum*.

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Contribution of Artificial Intelligence in B2B Sales: A Danfoss Case Study

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Abstract — The objective of the work is to evaluate the influence of Artificial Intelligence in the sales activities of B2B companies. The case researched was the Danfoss company, a multinational of Danish origin with B2B sales in more than 100 countries for the markets of refrigeration, heating, inverters and hydraulic in the main industries. A unique case study was employed through participatory observation, with an evaluation of annual reports and semi-structured interviews with 22 employees from various global sales areas, human resources, segment directors, regional presidents and members of the global executive committee who actively participate in defining the sales activities of each region, and globally through digital tools with Artificial Intelligence. In the organization studied, 4 dimensions were identified: Contributions, Possible Disadvantages, Current Moment and the Future with 8 categories of analysis: Internal Processes, Sales Efficiency, Sales Adaptation, Data Security, Behavioral Change, Traditional Salesman, Future Salesmen and the Future of the Company. The data analysis showed different results for each hierarchical level of the company on the contributions and convergences in relation to the Possible Disadvantages. In addition, it was identified that there is a low level of knowledge of Artificial Intelligence and its applications in sales activities and that all respondents do not see a Future without the use of Artificial Intelligence at Danfoss.

I. INTRODUCTION

The first studies of Artificial Intelligence were developed by Alan Turing (1950) with the objective of demonstrating an acceptable explanation of intelligence. Moreover, with the emergence of computer systems with powerful processors, the field of use was expanded, entering the world of B2C and B2B sales. This technology was compared to Thomas Edison's use of electricity which, according to Andrew Ng (Lynch, 2017), if well used, can be applied alone to revolutionize dozens of different industries.

According to Syam and Sharma (2017), experts suggest that the next decades will herald the fourth industrial revolution, which will be driven by technology of digitalization, information and communication, machine learning, robotics and Artificial Intelligence; and will further shift decision making from humans to machines. This decision making is more complex due to the amount of information available in the digital media, impacting the decisions of the sellers within B2B sales activities. Rich and Knight (1991) defined Artificial Intelligence as a science that studies human tasks that can be performed by computers, considering the current data processing capacity.

Dubinsky (1981) was the initial milestone in the discussion of a B2B sales process that is based on seven stages with tasks well defined by the salespeople:

prospecting, preparation, approach, presentation, objections, closure and follow-up. Homburg, Müller and Klarmann (2011); Kock and Rantala (2017) and Ferreira, Paschen and Wilson (2020) used Dubinsky's (1981) model as a reference in their research on the influence of Artificial Intelligence on sales. The influence of Artificial Intelligence in each step was evaluated with its possible benefits, risks and complements in current sales functions.

Zhang, Mookerjee and Zhao (2018) suggest that Artificial Intelligence and machine learning are the greatest forces for the fourth industrial revolution, impacting the sales area in various parts of the business. Among such benefits, it is relevant to mention that sales representatives no longer need to enter data manually; marketing professionals no longer need to use manual A/B tests to select the best social media images for their next campaign; and customer service managers no longer need to dig through long lists of incoming service calls to prioritize their time.

Singh et al. (2019) analyzed in a framework the contribution of Artificial Intelligence in three domains: (a) the sales profession, (b) sales professionals: as an organization, and (c) sales professionals: as an individual. In this context, the analysis was based on individual, sales profession and company focusing on general contributions in B2B sales activities in the three domains, while Ferreira et al. (2020) dedicated themselves to the influence of Artificial Intelligence based on a classic B2B sales process by Dubinsky (1981). The complements between the studies and their general contributions in B2B sales activities were analyzed.

Moreover, especially when considering the traditional industrial market, with its complex technical requirements and fields of application, questions arise about the possible interactions between the customer and the new technologies. For example, how can a team studying the future of new technologies in these markets benefit from information related to customers and products for the development of a new technology? According to Brecht Gentner, Stelzer and Ramosaj (2018), researchers and professionals try to fill this gap of information transference of the market related to products, as the ideation and initial stages of the development process, that is, to increase the interaction between the market and the development inside the companies. In the future, these interactions can occur in an automated way, that is, through digital technologies, such as Artificial Intelligence and machine learning (Ameri & Dutta, 2005), with the support of the sales team that has the daily relationship with the customer.

Given this context, the main purpose of this research is to analyze and evaluate the influence of Artificial Intelligence on Danfoss' B2B sales activities in the global context.

II. LITERATURE REVIEW

After the mid-1940s with the end of World War II and the invention of the first computer, the first studies on Artificial Intelligence began. The divulgation of Alan Turing's Work (1950) was considered the initial study in this chronology of evolution, in Computing Machinery and Intelligence, known as Turing's Test, presenting a way to verify if a machine has some sustainable human intelligence capacity. However, the first in-depth discussions on the subject began in 1955, with "A Proposal for the Dartmouth Summer Research Project on Artificial Intelligence," at the University of Dartmouth, with 10 researchers under the leadership of McCarthy J., a follower of the logistic line and with the participation of Minsky M.L. (1955), one of the researchers aligned with the connectionalist line of Artificial Intelligence. In this sense, there are several lines of studies and definitions with several applications in industries. According to Norvig and Russel (2010), Artificial Intelligence can be used in any human intellectual application, serving any field and task. Therefore, Artificial Intelligence is not only about opening new markets, but it can also consist in offering new forms to existing and mature ones.

Contribution of Artificial Intelligence in B2B Sales: The first studies of Artificial Intelligence in a more commercial way, that is, that brought contributions to the sales process, started in the 80s, through the study of McDermott (1982), who developed a program to configure customer orders, already demonstrated in the previous section. This application brought a huge contribution of Artificial Intelligence in sales within the B2B sales process, using rational thinking in their studies. With Dubinsky's (1981) studies on the sales process, it was possible to present the tasks of B2B salespeople at each stage. In addition, Ferreira et al. (2020) and Homburg et al. (2011) used the sales process of Dubinsky (1981) to demonstrate the contribution and influence of Artificial Intelligence in each stage of B2B sales, which will be detailed in this section. Singh et al. (2019) presented the contribution of Artificial Intelligence in three domains; (1) Sales Profession, (2) Sales Professional: company and (3) Sales Professional: individual. Many of the aspects already demonstrated in the other studies were highlighted by Antonio (2018) with the five contributions of Artificial Intelligence in sales.

Business managers for B2B sales are always concerned with serving customers at all stages of the sales process. In the 1940s, sales professionals used mainly manual

analog technologies to enable their B2B sales (examples: maps, conventional phones, etc.). The launch of the first cell phones - many years ago - has already greatly improved the contact between clients and sales professionals, according to Paschen, Pitt and Kietzmann (2020), and with Artificial Intelligence the contributions in sales activities are even greater with the use of data in a more effective way.

Narayanan, Asur, Nair, Rao and Kaushik (2012) and Rizkallah (2017) define the types of data that can be used within an Artificial Intelligence system. The data can come in two forms: structured, which encompass standardized sets in numerical form (examples: demographic data, web clicks or transaction data), and unstructured, non-numerical and multifaceted in the form of text, audio or images (examples: comments, likes, reviews, requests, photos, videos). An estimate today is that 80% of the data is unstructured according to Rizkallah (2017) and they are increasing 15 times faster than structured data (Narayanan et al., 2012). In addition, data are values that describe an item or person with respect to qualitative or quantitative variables, but only when a data is processed and analyzed can it be used for decision making (Bellinger, Castro, & Mills, 2004). Therefore, correct data are fundamental for the use of Artificial Intelligence and for B2B sales. The contribution of sales teams is essential in this process with the decrease of interaction between people.

Kietzmann, Paschen and Treen (2018) and Syam and Sharma (2017) emphasize the increased interaction between humans and machines with Artificial Intelligence, enabling computers to solve problems with minimal or no human intervention. In this sense, sales teams can focus on processes in which human interaction is fundamental within the sales process. In addition, Ferreira et al. (2020) point out that innovative technologies have modified the B2B sales format, especially technologies with deep advances in information and communications, such as digitalization and Artificial Intelligence. Other technologies developed in the past have greatly influenced the B2B sales process, helping with collection, processing or communication. However, Artificial Intelligence has influenced the final decision making in sales.

For a more precise understanding of the contribution of Artificial Intelligence in B2B sales, it is necessary to detail the traditional sales process and how salespeople interfere in each step of the process. Moreover, as the different types of data: structured or unstructured, are worked within this process. The description of each step is based on Dubinsky's classic sales model (1981).

Dubinsky (1981) divided a sales process into seven steps, detailing the seller's tasks in each step (Figure 1). In the sales process there are 7 sequential steps with very specific tasks that are described below.

(1) Prospecting

(2) Preparation

(3) Approach

(4) Presentation

(5) Dealing with objections

(6) Closing

(7) Follow-up

The first step in the sales process is (1) Prospecting - also known as lead generation. It is the process of searching for potential clients, which is aligned with the task of marketing segmentation (Jarvinen & Taiminen, (2016; Syam & Sharma, 2017). In the classic version, sales managers filter out potential leads, which are opportunities raised by sales teams with potential to become an effective business for the company.

After the identification of the prospection, and subsequent evaluation, it is moved to the next steps: (2) Preparation and (3) Approach, which can be examined together in our analysis (Syam & Sharma, 2017). These two steps serve to acquire more details about the leads: needs, habits, preferences and others relevant to initiate the first contacts with the client. While step (2) Preparation is related to internal work to collect information, step (3) Approach is related to building the relationship with the client.

In step (4) Presentation, the sales firm presents the characteristics and the solution according to the customer's needs, and may include a prototype of a product or solution (Syam & Sharma, 2017). In step (5) Dealing with objections, during the sales presentation, the purchasing firm may generate questions, statements, indications of dissatisfaction or a non-verbal expression that may signal that a customer intends to buy. Step (6) Closing can be examined in conjunction with step (5), as the closing is connected with the management of possible objections.

The last step (7) Follow-up can be divided into two components: support for a current order or follow-up after closing an order. In the first component, the follow-up can present the current order status, such as delivery, stock, etc., and the following component can present other services or complementary products (upselling or cross-selling), which will be examined in the next chapters. In the classic sales model, all tasks described are done by internal or external sales teams.

Step 1: Prospecting
- External Sources
- Internal Sources
- Personal Contacts
- Miscellaneous

Step 2: Preparation
- Approach Interviews
- Information sources

Step 3: Approach
- Non-product related approaches
- Approach through Internet contacts
- Approach through direct contact with the customer
- Product related approach

Step 4: Presentation
- Visual presentation techniques
- Types of Sales Presentations
- Non-visual clarification techniques

Step 5: Dealing with objections
- Create techniques for management
- Techniques of Objections by displacement
- Clarification Techniques of Objections
- Other Techniques

Passo 6: Closing
- Clarifications for closing
- Psychological orientation of closure
- Simple closing
- Closing with concessions

Passo 7: Follow-up
- Customer Service Activities
- Customer-oriented activities
- Customer Reference Activities

Fig.1: 7 classic sales steps summarized

Source: Adapted from Dubinshy (1981).

Homburg et al. (2011); Kock and Rantala (2017) and Ferreira et al. (2020) used Dubinsky's (1981) model as a reference in their research on the influence of Artificial Intelligence on sales, but with only 5 steps, incorporating (2) Preparation and (3) Approach, (5) Dealing with objections and (6) Closing, because they can use the same tools of Artificial Intelligence to obtain the results. The authors also point out that Artificial Intelligence will not replace current vendors, it will only help in decision making at each step.

Felder (2016) has identified other sales areas that can use chatbots or bots, increasing efficiency and changing vendors' daily tasks: (1) customer retention service and (2) business operation. These two points can be widely used in the step (7) follow-up of the classic sales process. Another

important point highlighted by Felder (2016) is cyber security, as companies are working with internal and confidential data. Therefore, the IT area will be impacted by these structural changes in the sales process.

Antonio (2018) highlights five contributions of Artificial Intelligence in B2B sales in alignment with Ferreira et al. (2020): pricing optimization, which can be used in step (5) of the sales process, upselling and crosselling, which are used in step (7) follow-up to cover new needs. Two additional contributions are not connected in the sales process, but in the general sales management: forecasting, based on sales history and sales performance, improving the general strategies of a B2B company.

Singh et al. (2019) analyzed through a framework the contribution of Artificial Intelligence in three domains: (a) the sales profession, (b) sales professionals: as an organization and (c) sales professionals: as an individual. This framework mapped through research the priorities and issues motivated by digital sales and Artificial Intelligence (Figure 2).

In the domain (1) Sales Profession: automation and value creation sales digitalization, including the use of Artificial Intelligence, is a key trigger for changes to create value in the sales profession according to Singht et al. (2018). Specifically, companies are increasing (1) the digitalization of sales channels to streamline buying and selling processes, (2) the digitalization of the sales hopper through decisions supported by Artificial Intelligence, and (3) the digitalization of the offering through a digital transformation where customers can see in detail the products and services they are acquiring.

In the sequence in the domain (2) Sales professionals: organizational issues, the solutions, mainly for B2B sales, are more customized, requiring a wider domain of the vendors in the products offered. For Tuli, Kohli and Bharadwaj (2007), most vendors, especially B2B, expect to provide solutions more in line with customer needs, rather than standard products and services. In this way, digitalization with Artificial Intelligence can generate a co-creation of solutions with clients and identify needs that previously did not exist.

In domain (3) Sales Professionals: individual issues, Artificial Intelligence can change the tasks of salespeople, generating some issues for individuals in relation to their functions, affecting and challenging the functioning of organizations. In addition, it can generate new skills for salespeople in using these new tools with Artificial Intelligence.

The framework of Singh et al. (2019) complements the Artificial Intelligence contribution studies focused on the sales process, as it covers other aspects, such as the

function of the salesperson, the sales professional and the organization. In this sense, it presents the influence of Artificial Intelligence in all B2B sales activities, not only limited to the sales process and its tasks. This framework becomes important because the sales activities of B2B companies are not only limited to the sales process, the entire organization needs to be transformed for Artificial Intelligence to adequately influence (Singh et al., 2019).

Sales Professionals
(Organizacional issues)
• Technology-human interaction
• Sales Interfaces
• Manager Salesperson relationship

Sales Profession:
Automation – Sales stills & Jobs
Value Creation – Technology Deployment & Integration

Sales Technologies:
Digitalization – Enables sales knowledges
Artificial Intelligence – Enables Sales Learning

Sales Professionals
(Individual issues)
• Salesperson Contacts
• Salesperson KSAs
• Salesperson Roles

Fig.2: Framework
Source: Adapted from Singh et al. (2018).

Possible barriers and limitations to the use of Artificial Intelligence for B2B sales: Due to the vast amount of data available and the great change in customer preferences, a long sales process with multiple influencers making purchasing decisions, in addition to market changes, decisions can change rapidly (Cotter, Guan, Mahdavian, Razzaq, & Schneider, 2018; Ingram, Louis and Schroeder, 2004), and can cause difficulties in the use of Artificial Intelligence in B2B sales, according to Ferreira et al.

In addition, systems with Artificial Intelligence need data from the environment (inputs) and manipulation of this data (process), to generate information (output) back into the environment (Paschen et al., 2019). The environment data are generated by the sales team, which needs to change the current behavior of individualization of information. This point can generate some barriers, making it difficult to obtain effective results.

These barriers or resistance generated by employees who are involved in this sales process or some concerns in their current positions that may become obsolete are possible, according to Paschen et al. (2019). Leadership positions should actively participate in this change process (Seijts & Gandz, 2018) to smooth the transition from using Artificial Intelligence in B2B sales. In particular, management teams should improve team involvement in this era of rapid change with digitization (Crittenden & Crittenden, 2015). A key point in this regard, according to Paschen et al. (2019), is that leadership should make clear to the team that human contact remains a critical factor within the sales process.

Another fundamental point is data security: when more information is collected, stored, security tools are extremely important (Santanen, 2019). The leadership needs to revisit all internal policies and practices to ensure the privacy and security of customer and company data.

Training is extremely important in this phase of adaptation. Employees need to develop new skills to extract positive results from Artificial Intelligence systems (Kaplan & Haenlein, 2019), and training is essential to help employees be adaptable according to Pachen et al. The sales team needs to understand well the benefits and limitations of using Artificial Intelligence.

Artificial Intelligence can contribute to current sales processes, but a period of transition and customer support is important in this phase. Artificial Intelligence can change the customer experience, and each company is in a different phase of using the technology. The sales team needs to identify customers who are hesitant to use Artificial Intelligence and are more accustomed to traditional sales service. Managing the customer

experience is conceptualized as a higher order construct that encompasses certain cultural mindsets, strategic directions and firm capabilities that are focused on managing each point of contact throughout the scope of the customer's journey (Homburg, Jozic, & Kuehnl, 2017).

A system with Artificial Intelligence can analyze data, particularly unstructured data, usually in real time, and turn it into useful information. However, human intelligence is fundamental in decision making. Artificial Intelligence is limited in presenting emotional and social competencies (Left & Clear, 2020; Kaplan & Haenlen, 2019), which are particularly important in B2B sales and will continue to be critical in human tasks within the Artificial Intelligence sales process.

III. THE CASE SETTING

The specific analysis unit for this study is the company Danfoss in its global context, founded in 1933 in Denmark by Mads Clausen (1905-1966). The company has its headquarters in Nordborg, Denmark, with subsidiaries in more than 100 countries and about 28,000 employees.

For the purpose of this study, were considered members of senior management, chairman, regional presidents, presidents of each segment, global human resources VP, managers and sales directors of Latin America and Brazil. This includes managers responsible for geographically dispersed divisions or units of an organization, as well as functional managers, considered as middle management (responsible for marketing, human resources and financial sectors) and executives responsible for teams or projects in a total of 22 respondents.

Based on the analysis of the documents provided by the company, such as the global sales reports, presentations and their strategies aimed at digitization in all areas, it was possible to identify that the influence of Artificial Intelligence on sales began in 2014, when the segments began to use digitized sales tools through the Sales Force platform, initiating a digitization process in the sales process of Danfoss. The team responsible for the global development of the tool is in the division called Business Excellence, focused on developing the platform for all segments. This team, together with the Sales Force team, develops the dashboards and algorithms that are adapted to the Danfoss sales process, so the sales experts support the developer of the tool.

Despite the start in 2014, Danfoss spent two years using the Sales Force without the development of sales steps, i.e. the tool was standard without algorithms and dashboards aligned with Danfoss' processes. Only in 2016, the tool started to be used with some features more aligned

with the Danfoss sales area with the development of MyPipeline (Figure 3). These actions were instrumental in promoting the use of digital tools, encouraging Danfoss to verify the influence of Artificial Intelligence on sales. The main actions were:

- Creation of a global Business Excellence area, playing the role of sales specialists, corroborating with the literature.

- Development of the tool for the needs of Danfoss.

- Global directors encouraging each region and segment.

- Setting regional goals by using the Sales Force.

- Periodic training for sales in this new process.

- Regular meetings with regional leaders.
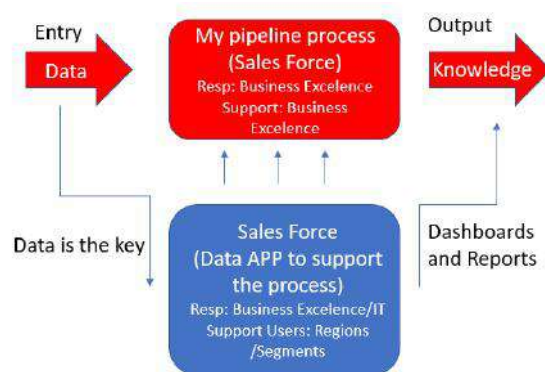
Fig.3: Sales Force MyPipeline development
Source: Elaborated by the author.

The process of digitalization of the entire company today is led by the executive committee and the presidents of the segments, with the creation of the ONE ERP program, started in 2018, with completion scheduled for 2022. This program aims to use only one platform for all the company's websites, digitizing all its processes, reaching the sales activities. Figure 4 shows the steps of scanning the ONE ERP program. This research analyzes the contribution of Artificial Intelligence in the sales stage and its possible interactions with other areas.
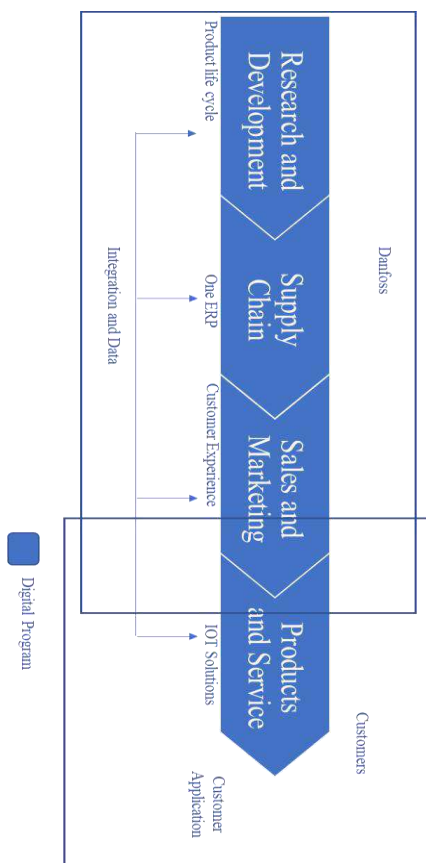
Fig.4: Program One ERP

Source: Elaborated by the author.

In the Danfoss case, the influence of Artificial Intelligence on sales through new digital tools is notorious, as is a process of digitizing all areas that will support sales by 2022. In this phase, different projects were presented and can be used in several sales processes already described and others still in the process of implementation. One point to highlight in the study, and especially within the sales team, is the constant change of professionals to other regions (even countries), different sales areas within the company, competitors and even activities related to sales, taking into account the know-how acquired by these professionals. Artificial Intelligence supports the company by keeping the information in its systems, reducing the need for a traditional salesperson, mitigating these changes. Moreover, the variety of different products and applications changes the way of acting in each type of customer.

Interview Analysis: Faced with this empirical research context, Table 1 depicts the dimensions, categories and subcategories used in the research investigation. To better understand the theoretical model relating to Artificial Intelligence within the sales activities of the Danfoss

company, the data collected was treated based on the categories of analysis created (Bardin, 2011).

Table 1 - Research Analysis Categories

Dimensions	Categories	Subcategories
Contributions	Modification of internal processes	New digital channels
		Sales process with AI
	Sales Efficiency	CRM Tools with AI
Possible Disadvantages	Sales Adaptation	Decreasing Human Decision and Interaction
		Time Management
	Data security	
Current Moment	Behavioural change	HR in selection and training for AI
	Traditional sale	Low IA knowledge
Futuro	Future salesmen	
	Future of the company	

Source: Elaborated by the author.

The exploratory analysis through Nvivo provides the cluster nodes that indicate the similarity grouping by encoding in a total of 4 terms. In this way, the nodes function as variables that gather descriptive information of the text, allowing the identification of trends and ramifications in the similarity of the narratives, taking into account the coded words in each node and the sources of these text units. In this analysis, the relationships between the categories were considered by means of diagrams of similarity by coding, according to the Figure 5:

Fig.5: Distribution of quotations by dimensions

Source: Survey data consolidated in Nvivo 11.0.

When analyzing the total group of interviews, one notices the formation of two branches in the similarity of the narratives. There is a group formed in the first branch with the contributions and possible disadvantages and a second branch between the future categories and the

current moment. The first branch, with a larger quantity of quotations, presents narratives that observe the contributions of Artificial Intelligence in sales, but with possible disadvantages in their application.

Authors such as Ferreira et al. (2020); Cotter, Guan, Mahdavian, Razzaq, Schneider (2018) present the same conclusions in their studies, pointing out several contributions at various stages of sales processes, but highlighting some points of observation related to internal barriers, data security, data quality. Despite the possible disadvantages, the authors understand that the risks can be mitigated within companies.

In this sense, the interviewees corroborate with the authors, presenting several benefits, mainly in the areas of support, leads and follow-ups, but with many observations regarding the adaptation of traditional practices and applicability of tools within the rational and human dimensions of Artificial Intelligence. Many respondents believe that Artificial Intelligence can replace sales in rational tasks, but human touch points will not be replaced by Artificial Intelligence in the short term.

In the second branch, the interviewees make a relationship between the current moment with a low knowledge of Artificial Intelligence and the future of the company and the salesmen. At this point, the literature of the interviewees presented studies on the applicability of Artificial Intelligence and the use of specialists in the development of tools. The Business Excellence area plays the role of the experts in sales in the development of the tools, in this connection between the current moment and the future of Danfoss with Artificial Intelligence.

Authors such as Singh et al. (2019), Antonio (2018), Homburg et al. (2017), consider the contribution of Artificial Intelligence as a journey of experimentation and adaptation and there is no future in sales without tools with Artificial Intelligence corroborating with the 22 respondents. Therefore, a good diagnosis of the current moment will help in this journey of experimentation of tools with training to increase the knowledge of the team and applicability of the tools in the company.

IV.   CONCLUSION

The literature suggests that the use of Artificial Intelligence will change the way of doing business in various industries (Linch, 2017; Syam & Sharma, 2017), and the traditional sales process, according to Dubinsky (1981), can be more effective using Artificial Intelligence in each stage: prospecting, preparation, approach, presentation, dealing with objections, closure and follow-up, according to Antonio (2018).

In this context, the importance of using data in a more effective way and an alignment of the sales profile is highlighted (Kock & Rantala, 2017). In addition, Artificial Intelligence can improve the performance of sales teams through better pricing, forecast optimization, crosselling and upselling (Antonio, 2018). In general there is a positive perception regarding the influence of Artificial Intelligence on sales. The main advantages pointed out are better pricing, time optimization, process efficiency, forecast and pipeline. This finding is consistent with studies that understand that Artificial Intelligence can increase the company's ability to generate more results (Feldner, 2016; Antonio, 2018).

The 22 respondents confirmed that the level of knowledge of Artificial Intelligence at Danfoss is very low at all levels and especially with salespeople, and is one of the main barriers to using Artificial Intelligence. The analysis of the responses seems to indicate that despite the use of Artificial Intelligence and the implementation of new CRMs in the company, the initiatives do not focus on explaining the technology, only on implementing the tools. Another point very highlighted was the use of data in a correct way. Algorithms need external information, and vendors have a key role in this point, corroborating with Paschen et al. (2019). However, the company has created an area dedicated to the development of Artificial Intelligence tools, and there is active participation from all levels of the company through regular global and local meetings, working as facilitators within Danfoss. In addition, respondents understand the benefits and influences in the sales process, despite the little knowledge, facilitating the process of use and influence.

The respondents listed several gains, from customer service tools using chatbots, as a productivity gain within the sales process from the first stage of leads, to the follow up, already in an after-sales process. In addition, the history of sales information was highlighted, as there are frequent changes in the Danfoss sales teams. However, some limitations were highlighted. One of the examples cited was that of salespeople who might not have autonomy in decisions, acting as an intermediary between the responses of an Artificial Intelligence algorithm and the needs of the end customer. In this context, salespeople begin to play a role of passing on information, with the loss of experience and history of the salesperson with customers. Depending on the degree of utilization and complexity of the algorithm, it can generate internal competition between salespeople and Artificial Intelligence, causing slowness, loss of qualified professionals or rework.

In addition, respondents understand that this decrease may impact personal relationships, causing a major change

in the behavior of current sellers and buyers more accustomed to face-to-face visits. On the other hand, it would increase the efficiency in sales, since the sellers would focus on more important topics to close a deal, and the face-to-face contact would be more effective. The 22 interviewees understand that there will be no B2B sales without the use of Artificial Intelligence, aligned with Antonio (2018), in his research.

This research corroborated the findings of Ferreira et al. (2020), which emphasize that Artificial intelligence has modified the B2B sales process as well as the way of relating to customers. Besides, they suggest that the process of use in sales is a journey of experimentation, in other words, the authors understand the need for training and participation of all levels of the company aligned with the respondents of the interviews.

Contributions, limitations and suggestions for future research: This research presents arguments in the discussion about the contribution of Artificial Intelligence in B2B sales in traditional industrial companies that use a traditional sales process.

It seems a consolidated knowledge that Artificial Intelligence can contribute to a more optimized sales management for industrial companies, developing new competencies in pricing, forecasting and a contribution at each stage of the sales process. According to Norvig and Russel (2010), there are many fields of studies in various industries, most are aligned with studies related to thinking as a human, i.e. activities such as decision making, problem solving and learning, within the human dimension (Bellman, 1978).

This research, however, has some limitations. One of them is related to the single case study methodology. According to Yin (2015), although the case study allows a greater understanding of the subject studied, as a focus on "why" and "how", such a study limits the generalization of research findings. Another limitation refers to the process of collecting data for the case study and the participative observation of the researcher who is also an employee of the company researched, which are based on the perceptions of respondents about the contribution of Artificial Intelligence in sales. Such perceptions can have biases, for instance, certain functions exercised in their day by day, or certain subject or topic that has been the target of a more deep discussion between the parties.

Considering this scenario of contributions and limitations, this dissertation suggests as a theme of new research the deepening of contributions in a regional way, considering more specific segments, and a participation of salesmen who are directly in contact with customers.

This work has brought the contribution that Artificial Intelligence by itself does not guarantee an effective result in sales, because it depends on good management in its implementation with the mitigation of possible barriers and limitations and does not answer which are the effective gains for this result. Hypotheses can be raised, such as lack of knowledge of technology in High Management, lack of knowledge of the benefits about the contribution in the sales team or issues purely related to a good communication between the levels and regions of the company, but there are not enough elements in this dissertation to support any conclusion in this respect.

Another contribution would be to map in a quantitative way the influence of the sellers on the adoption of Artificial Intelligence on sales in each segment. Although the advantages identified in this work corroborate the literature on the subject and throw a little light on the use in some phases of the sales process, there is not yet a detailed study prioritizing the use of Artificial Intelligence to the detriment of the current sales process.

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Application of Cost, Risk and Return Management Indicators: A Contribution to Determining Temporary Soy, Maize and Wheat Crops

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I. INTRODUCTION

The evolution in several market branches has been expanding daily, where globalization and competitiveness are increasingly gaining strength with high technologies, thus requiring innovations and transformations in several areas. In view of this reality, Brazilian agribusiness stands out with an important relevance, being one of the main sources of income in the country, making the agricultural sector a broad labor and development market, moving millions of financial units worldwide and with great productive potential, aiming meet various global needs. With this, the producer has reached high levels of production and positive profitability.

In this way, even with positive results, many farmers do not have a control, even simple so that they are able to ascertain, execute, predict and control the activities performed, since the use of control and the management of the property, be it small, medium or large, it is considered a factor of great satisfaction for an efficient decision making, with tools for the administration of its products, enabling knowledge about seasonality and future markets, seeking ways to reduce its costs and waste, thus obtaining information about its products. , production and results. In most cases the farmer grows different temporary crops, with different harvests and consequently with different costs,

In this article, the topic "Cost analysis in agribusiness, a comparison of temporary soybean, corn and wheat crops" was addressed with the objective of assisting financial and production control in relation to their annual harvests, proposing a comparison of products , so that it is easy to see in which culture the best result is obtained in relation to costs, resulting in an essential

method for the administration of the rural property that provides information that supports decision making, improving the economic and financial performance of the activity agricultural.

II. THEORETICAL FRAMEWORK

Agricultural properties can be defined as true rural companies, which, like any other company, need materials, need financial resources, labor, improvement for their survival and their ultimate goal is to obtain profit, these factors influence directly in its products and services, which are combined with knowledge of the production and operations of the property.

According to CREPALDI, (1998, p. 22):

Knowledge of market conditions and natural resources gives rural producers the basic elements for the development of their economic activity. It is now up to him to decide what, how much and how to produce, control the action after starting the activity and, finally, evaluate the results achieved and compare them with those initially planned.

The agricultural producer must choose ways to reduce his costs and waste without jeopardizing his productivity, in order to improve the planning and control of his activities, obtaining information about his production, products and results. Thus, it is necessary to analyze the cost of your product where it allows the planning, control, evaluation and verification of which culture will have the best result in relation to its costs. Following is a theoretical framework on costs in agricultural activity, agricultural accounting and agricultural costs.

2.1 BRAZILIAN AGRIBUSINESS

Agricultural activity represents the activity of land exploration, which has been expanding year by year, mainly with the implementation of new production technologies and controls, which is characterized by the high demand for food necessary for survival in a world context, which is fundamental importance for the country's development.

According to MARION, (2006, p. 2):Rural activities are those that exploit the productive capacity of the soil through cultivating the land, raising animals and transforming certain agricultural products. Rural companies can be divided into three types, being companies that carry out agricultural activity, those that carry out zootechnical activity, and even those that carry out agro-industrial activity.

Agricultural activity encompasses two types of crops, the temporary ones which are those that are subject to replanting after harvest, having a short life span in their production process, and also the permanent ones, which are those that are not subject to replanting after harvesting. the harvest, this crop provides more than one harvest or production.

For the administrator of the rural property, it is of utmost importance to know the crop cycle in order to have an efficient and effective control and planning for its production, as well as the correct period for planting, fertilization, spraying and management, in order to achieve a good profitability and profitability.

2.1.1 Agricultural Product

In the region where the study is carried out, most cultures are temporary and the geographical and climatic conditions provide advantages to these cultures. The rural producer must have an in-depth knowledge of agricultural cultivation, for an efficient programming of his objectives for the next periods, aiming to respect the best forms of soil management in relation to different situations that occurred year by year. Among the three crops selected for analysis, the producer must make an advance schedule to select which ones will be grown in the next periods, based on a history and information obtained about the time, cost and future market:

a) Soy

According to the website of the Ministry of Agriculture (2019), soy is considered in Brazilian agribusiness, the product that had the greatest growth in the last three decades, is standing out in national agriculture and in the trade balance. Its cultivation is intended both for human consumption and for the manufacture of animal feed.

Fig.1: Soy cultivation
Source: Analyzed property, 2019/2020.

B) Corn

According to the website of the Ministry of Agriculture (2019), Brazil is the third largest world producer of corn, totaling 53.2 million tons in the 2009/2010 harvest. The first idea is the cultivation of grain to meet consumption on the table of Brazilians, but this is the smallest part of production. The main destination of the harvest is the animal feed industry.

Fig.2: Corn cultivation
Source: Analyzed property, 2019/2020.

C) Wheat

Wheat is considered globally as the second most produced cereal in the world, after corn, according to the Ministry of Agriculture (2019). In Brazil it is grown in the South, Southeast and Midwest regions, due to the climatic conditions not being so favorable for production, producers receive reinforcement from government agencies for planting. Wheat grain is used mainly as food and derived products, but it is also used for animal feed.

Fig.3: Wheat cultivation
Source: Analyzed property, 2019/2020.

2.2 AGRICULTURAL ACCOUNTING

Agricultural accounting applies to rural companies, it is the branch that aims to analyze the administration of crops and livestock, which are considered as those that are intended for the production of goods with their cultivation / management and commercialization, that is, it is defined with the objective of removing livelihood through land exploitation.

2.2.1 Agricultural Costs

Agricultural costs are part of the daily life of rural companies, as they record, collect and classify important data, whether monetary or not, both external and internal, bringing information to different levels of management in order to assist in decision-making.

According to MARTINS (2003, p. 21):

Cost Accounting has two relevant functions: assisting Control and assisting decision making. With regard to Control, its most important mission is to provide data for the establishment of standards, budgets and other forms of forecasting and, at an immediately following stage, to monitor what actually happened for comparison with previously defined values.

Among the various cost divisions, the cost of labor can be highlighted as highly relevant, and many producers want to account for this cost, for the reason that the production processes are performed by family members or themselves. Also highlighting the costs of materials and inputs that are accounted for as direct costs. In addition, the producer 's knowledge of the other costs listed below are of great importance for the financial success of the property.

The following are related to the division of agricultural costs:

a) Labor costs: Labor costs are related to all the people who work with the company. rural activity, regardless of the positions they occupy within the property.

The cost of labor can be divided into direct, which is defined as the work applied directly in the manufacture of the product, parts or components, or in the provision of services, where the cost of labor consists of wages, social charges and provisions for vacation and 13th salary, and indirect, which is represented by the work carried out in the auxiliary departments.

b) Costs with materials and inputs: It is defined as the materials and agricultural inputs produced or acquired by the company to be used during cultivation of the product, from the preparation of the soil to the sale of the product, are classified as all expenses and investments that contribute to the formation of a certain product or merchandise until final consumption.

Therefore, in the rural company, inputs are: seeds, fertilizers, pesticides, limestone, machines and implements, parts and fuels, which are essential for the

formation of crops, in which all are used in the production processes of selected crops.

c) Depreciation: Depreciation is defined as the reduction in the value of the goods due to wear or loss of utility due to use, action of nature or obsolescence, applied to tangible and intangible goods such as machinery, equipment, vehicles and improvements. Depreciation can occur for a variety of physical and economic reasons.

According to MARION, (2007, p. 43):

Agricultural implements such as tractors, harvesters, agricultural equipment, etc. they are not used uninterruptedly during the year (as industrial equipment normally is) due to off-season, rain, frost, idleness, etc. Accordingly, it is recommended that depreciation be appropriated as a result of the use of the respective cultures or projects. Hence the need to calculate depreciation per hour, estimating a number of hours of work per equipment, instead of the number of years of useful life.

One of the difficulties encountered is the exact calculation of the depreciation cost and useful life of the assets used in the agricultural activity, which can vary from equipment to equipment, and the depreciation of the machines is calculated by the hours worked, while the equipment and improvements by their working time. use.

d) Revenue and taxes: Gross revenue from rural activity consists of the amount of sales, with the deduction of taxes and costs listed above and from these results, the net result is obtained.

Funrural is calculated on the value of its sale, being 1.5% on the invoice value, which is a social contribution that must be paid by the rural producer as a percentage of the total value of his revenues, in addition to Funrural is also accounted for the ITR (Rural Territorial Tax), where a percentage is calculated on the exploitation of cultivated land.

Also highlighting the ICMS (Tax on the Sale of Goods and Services), as per annex 03 of RICMS / SC DEC 2.870 / 01, art. 4th the tax is deferred in the agricultural establishment when they are destined for commercialization or industrialization, for that the product must be in a natural state.

e) Cost of goods sold: The cost of goods sold includes all resources used in the production process of each crop, some of them may be affected by seasonal factors with changes in values. This cost is part of the income statement and it is directly related to profit or loss of property.

f) Result: For the rural producer, in addition to personal goals (productivity and product quality), there are financial objectives that are related to the final result of the harvest, which is the moment when the producer wants to know and check if the work it is giving satisfactory result, making a retrospective of the investment made, being able to optimize future processes.

They can be calculated from the profitability indexes that are related to the profit, that is, the result (profit or loss) obtained by the company. Profitability is the percentage of gain obtained on sales made, indicating what the company manages to generate on the work it develops.

The profitability that indicates the percentage of expected return on an investment must also be considered. To calculate profitability, in a new company or in an investmentto be carry outof, it is necessary to use the value of the capital applied. When it comes to an operating company, the value of the company's total equity can be used.

According to the Rrecipe Federal (2019),the result of rural activity, when positive, will be included in the income tax calculation base for the annual declaration, in its calculation, revenues, expenses and investments are computed monthly on a cash basis. The result of the rural activity performed by the individual is determined through the bookkeeping, covering the revenues, expenses, investments and other values that integrate the activity.

III.   METHODOLOGY

This study, as to its degree of presentation, reveals itself as applied research, since it is directed to the solution of specific problems, presenting a descriptive character, with the purpose of describing, interpreting and analyzing data on production costs, expectations of costs in the agribusiness of the temporary crops in the cultivation of soy, corn and wheat.

As for the approach to the problem, it was configured as quantitative. According to BEUREN (2006, p. 92):

[...] the quantitative approach is characterized by the use of statistical instruments, both in the collection and treatment of data. This procedure is not so profound in the search for knowledge of the reality of the phenomena, since it is concerned with the general behavior of events.

The study is defined as quantitative, characterized by the use of statistical instruments, using mathematical resources for the solution and analysis of the data.

As for its temporality, it can be characterized as a cross-sectional nature, since the information considers a period of time, limited the scope of the research. The methodology used in this study has as a typology a case

study, for BEUREN (2006, p. 84) "it is noticed that this type of research is carried out in a more intensive way, due to the efforts of the researchers to concentrate on a certain study object". The research aims to inform the researcher about production costs, controls, values and behaviors related to the analyzed cases.

As for the methodological procedures, the research of this academic work was carried out through a survey, which comprises the research with the producer to obtain data on the production of temporary crops.

After collecting the documentary information, the total production costs were applied to a spreadsheet to assess profitability and profitability, after deducting costs and expenses. "In accounting, documentary research is used with some frequency, especially when it is desired to analyze the behavior of a certain sector of the economy, such as aspects related to the patrimonial, economic and financial situation" (BEUREN 2006, p. 90).

In this study, spreadsheets were used, using the EXCEL software to determine costs, the variable direct costing method was applied, according to MARION (2007). Aiming to compare the cost per hectare in relation to soy, corn and wheat products.

IV. DEVELOPMENT

This research is constituted in the analysis of the costs in the agricultural activity, starting with the development of a cost system applied to the rural property, looking for the formation of the total and unitary cost of the agricultural production of some selected products, making a comparison of which product has a better profitability and profitability for rural producers.

The object of study consists of a rural property, in which the activity exercised is the cultivation of temporary crops of soy, corn and wheat, based on the 2019/2020 crop year for data analysis.

4.1 PRODUCTION AREA

Based on information collected within the analyzed agricultural property, it was possible to survey the total cultivated area, with the selected items in the summer crops being soybeans and corn and in the winter culture wheat, totaling the areas of crops of summer on 520 hectares and winter crops on 140 cultivated hectares, as shown in the graphs below:

Graph 1 - Summer crop cultivated area

Source: From the authors, 2020.

According to Graph 1, of the total area of 520 hectares belonging to the property, it was found that in the crop year analyzed, 290 hectares of soybeans and 230 hectares of corn were cultivated.

Graph 2 - Winter crop area

Source: From the authors, 2020.

As shown in the graph above, in the winter harvest, 140 hectares of wheat are cultivated, so that, of the total area of the property, 380 hectares are free, in this area the oats are sown with the objective of rotating the soil and preventing pests from being created or remain for future harvests.

The property has an investment of R $ 19,760,000.00, referring to land, machinery, equipment, vehicles and improvements used directly in the production processes of the crops and will be applied in the calculation of profitability.

4.2 DESCRIPTION OF CULTURE CYCLE

For better analysis, the flowcharts of the production stages of each culture were raised.

4.2.1 Soy Culture Production Process

The cultivation of soybeans on the property under study is carried out through mechanized no-tillage, using fertilizers and pesticides. One hectare (10,000 m²) was used for data analysis. The varieties of manipulated seeds are transgenic RR, the data refer to the crop year

2019/2020, and the growing period started in September 2019 and ended in April 2020. The soybean production process on the property consists of the steps presented below:

Fig.4: Flowchart of the soybean production process.

Source: From the authors, 2020.

Figure 4 shows the flowchart of the soybean production process, the process begins with the definition of the area to be planted until the moment of sale of your product.

4.2.2 Maize Crop Production Process

The cultivation of corn on the property under study is through mechanized no-tillage, using fertilizers, pesticides and seeds of transgenic Herculex hybrids for production, in which 1 hectare (10,000 m²) was also used for the analysis. The data used refer to the 2019/2020 harvest, which took place between August 2019 and April 2020. The corn production process consists of the following steps:
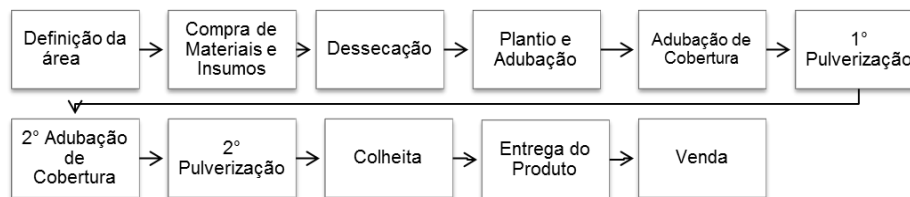
Fig.5: Flow chart of the corn crop production process.

Source: From the authors, 2020.

Figure 5 shows the flowchart of the corn crop production process, the process begins with the definition of the area to be planted until the moment of the sale of the product.

4.2.3 Wheat Culture Production Process

In wheat culture, the planting is mechanized, using chemical fertilizers and pesticides for production, 1 hectare (10,000 m²) was used for data analysis. Planting starts in June 2019 and ends in November 2019 with the harvest. The wheat production process consists of the following steps:
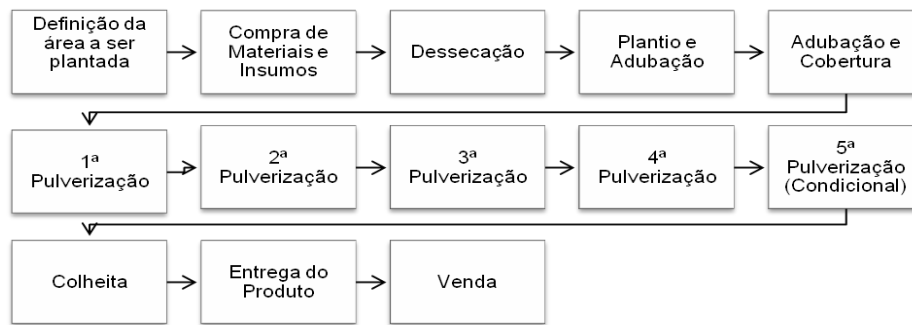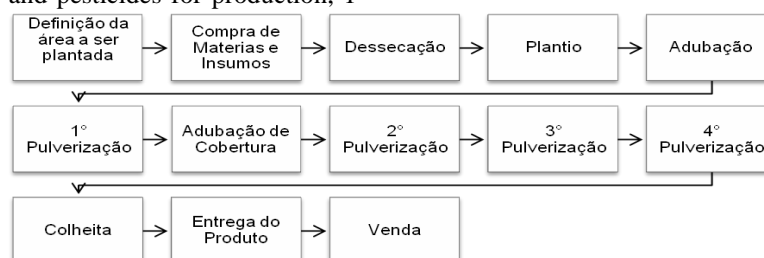

Fig.6: Flowchart of the wheat crop production process.

Source: From the authors, 2020.

Figure 6 shows the flowchart of the wheat crop production process, the process starts with the definition of the area to be planted until the moment of the sale of the product.

4.3 LIFTING OF COSTS

The costs in the analyzed property are made up of inputs, labor, fuels, depreciation, Funrural, while indirect costs are considered as expenses with energy, water, telephone, maintenance, insurance, ITR, interest with agricultural costs and other unforeseen costs during the year. The following is a detailed calculation of costs:

4.3.1 Calculation of Hand Costs in Obra

The cost of labor in the analyzed rural property is composed by the family, being three people, in which all work during the activity of the productive process of the cultures.

For rural employers, the salary and contributions are calculated according to resolution 8212/1991, and the employee is entitled to vacation and 13th salary, the calculation with labor is shown in the following table:

Table 1 - Labor charges in the month

Description	Aliquot	Employee A	Employee B	Employee C	Total
Gross Annual Salary		1.158,00	1.158,00	1.158,00	3.474,00
INSS	0%	-	-	-	-
FGTS	8%	92,64	92,64	92,64	277,92
INSS Company	1,50%	17,37	17,37	17,37	52,11
Vacation		386,00	386,00	386,00	1.158,00
INSS Vacations	0%	-	-	-	-
FGTS Vacations	8%	30,88	30,88	30,88	92,64
INSS Company	1,50%	5,79	5,79	5,79	17,37
13th salary		1.158,00	1.158,00	1.158,00	3.474,00
INSS 13th Salary	0%	-	-	-	-
FGTS 13th Salary	8%	92,64	92,64	92,64	277,92
INSS Company	1,50%	31,27	31,27	31,27	93,80
Total		**2.972,59**	**2.972,59**	**2.972,59**	**8.917,76**

Source: From the authors, 2020.

For the elaboration of Table 1, the calculation of the monthly salary, obligations with INSS and FGTS, vacation, INSS and FGTS on vacation, 13th salary, INSS and FGTS on 13th salary and INSS of the company was used as a basis, cost of R $ 2,979.59 per employee and the total labor cost of employee A, B and C of R $ 8,917.76.

The calculation also included 10% of estimated technical loss, due to the fact that rural areas depend on climatic sources for their production. An average of twenty working days worked per month will be considered, with 8.8 (eight point eight) hours per day.

The following table shows the calculation of available hours and the cost of direct labor applied per product.

Table 2 - Available hours

Days	Hours Days	Total	Loss	Hours available
20	8,8	176,00	17,60	158,40

Source: From the authors, 2020.

Table 2 shows 176 hours available, deducting a 10% loss on monthly hours, reaching a total of 158 hours and 40 minutes worked in the month.

Table 3 - Cost of direct labor applied to the product

Product	Hours	Hourly Cost	Time	MOD
Soy	158,40	18,77	02:01:00	37,85
Corn	158,40	18,77	02:30:00	46,92
Wheat	158,40	18,77	01:42:00	31,90
Total				**116,66**

Source: From the authors, 2020.

In order to raise the labor cost for each product, it was necessary to calculate the monthly hours, after which the hourly cost was calculated and also the estimated time in the production process, from desiccation to harvest, at the end, the labor cost of each product in one hectare (10,000 m²) planted, as shown in Table 3.

4.3.2 Calculation of Depreciation Costs

Depreciation is defined as the loss of the value of the goods, due to their wear and tear or due to the action of time and loss of utility, in the analyzed property there are goods used directly in production and other goods to help in the better performance of functions, depreciation is divided into equipment, machinery and buildings, according to Tables 4 and 5:

Table 4 - Depreciation cost of equipment

Type	Price		Waste	Lifespan	Depreciation / hour
Tractor 90 CV 4R	85.100,00	-	25.530,00	59.570,00	9.000,00	6,62
Platform tractor	138.848,00	-	41.654,40	97.193,60	10.000,00	9,72
Combine harvester	389.019,00	-	116.705,70	272.313,30	4.000,00	68,08
Total						**84,42**

Source: From the authors, 2020.

Table 5 - Depreciation cost of improvements

% maintenance	Maintenance	Fuel	Machine Time	MOD	Total Hourly Cost
75%	7,09	20,44	34,15	18,77	52,92
100%	13,88	37,96	61,56	18,77	80,33
75%	72,94	52,56	193,58	18,77	212,35
					345,59

Source: From the authors, 2020.

Tractors and combines were used to estimate the useful life of the hours worked in each crop, because they are directly related to the production process, as shown below Tables 6, 7 and 8, where the machines are

depreciated by the hours according to their production process, the cost of depreciation by hours and the amount of time used in its entire production process to depreciate 1 hectare (10,000²).

Table 6 - Machine hourly cost in the soybean production process for 1 hectare

Process	Machinery or Equipment	Hourly Cost (R $)	Time spent	Cost (R $)
Desiccation	Trator 90 CV 4R	52,92	00:08:40	7,41
Fertilization and Coverage	Trator 90 CV 4R	52,92	00:06:52	5,75
Planting	Trator plataforma	80,33	00:50:00	66,94
Harvest	Colheitadeira	212,35	00:20:00	70,78
Pulverization	Trator plataforma	80,33	00:35:43	47,44
Total				**198,32**

Source: From the authors, 2020.

Table 7 - Machine hour cost in the production process of Maize for 1 hectare

Process	Machinery or Equipment	Hourly Cost (R $)	Time spent	Cost (R $)
Desiccation	tractor 90 CV 4R	52,92	00:08:40	7,41
1st Fertilization and Coverage	trator 90 CV 4R	52,92	00:06:45	5,69
Planting	Trator plataforma	80,33	01:00:00	80,33
two[The] Fertilization Coverage	Trator 90 CV 4R	52,92	00:27:27	24,05
Harvest	Colheitadeira	212,35	00:30:00	106,17
Pulverization	Trator plataforma	80,33	00:18:02	24,13
Total				**247,78**

Source: From the authors, 2020.

Table 8 - Machine hourly cost in the soybean production process for 1 hectare

Process	Machinery or Equipment	Hourly Cost (R $)	Time spent	Cost (R $)
Desiccation	trator 90 CV 4R	52,92	00:08:40	7,41
Fertilization and Coverage	trator 90 CV 4R	52,92	00:13:39	11,81
Planting	Trator plataforma	80,33	00:24:00	32,13
Harvest	Colheitadeira	212,35	00:20:00	70,78
Pulverization	Trator plataforma	80,33	00:35:43	47,44
Total				**169,57**

Source: From the authors, 2020.

Table 9 - Cost of depreciation by hours worked in each crop for 1 hectare

Product	Worked hours	Total Depreciation (R $)
Soy	02:01:15	198,32
Corn	02:30:54	247,78
Wheat	01:42:02	169,57
Total	**06:14:11**	**615,66**

Source: From the authors, 2020.

Table 9 shows the cost of depreciation per hour worked on 1 hectare.

4.3.3 Calculation of Costs with Inputs

The inputs are of great importance for a good productivity of winter and summer crops. In which herbicides, fungicides, insecticides and fertilizers are generally used, each has a function to protect the plant in its production cycle. It is of great importance to analyze the cost of inputs so that the producer can know the variations that may occur in production. The purchase of inputs is made by the owner. The table below shows the statement of the inputs used in the analyzed crops.

Table 10 - Inputs used in the cultivation for 1 hectare of soybeans

Description	Product	The amount	Unit	Unit Cost (R $)	Total Cost (R $)
Desiccation	Original Roundup	2	L	14,00	28,00
Planting	Seed 5909rr	50	KG	6,00	300,00
Treatment	Standak Top	80	ML	0,75	60,00
Fertilizing	Rhizobium inoculant	100	ML	4,80	480,00
	Fert. Mineral MS09 07.34.11	250	KG	2,44	610,00
Cover fertilization	Potassium Chloride 00.00.60	150	KG	1,78	267,00
1st Spraying	Certero SC480	50	ML	0,18	9,00
	Original Roundup	2	L	14,00	28,00
2nd Spraying	Certero SC480	50	ML	0,18	9,00
	Sphere Max	200	ML	0,27	53,80
	Aller Biw	100	ML	0,01	1,00
3rd Spraying	Certero SC480	50	ML	0,18	9,00
	Sphere Max	200	ML	0,27	53,80
	Aller Biw	100	ML	0,01	1,00
	Connect SC 112.5	750	ML	0,04	32,25
4th Spray	Priori Xtra	300	ML	0,15	43,92
	Aller Biw	100	ML	0,01	1,00
Total					**1.986,77**

Source: From the authors, 2020.

In Table 10, the amount and value of each input used in the soy production process was calculated, according to the amount needed to cultivate 1 hectare (10,000 m²). In this case, the total cost of inputs was R $ 1,986.77.

For the production of corn, the same processes used for soy production are also used, using inputs for their production cycle as shown in the table below:

Table 11 - Inputs used in the cultivation for 1 hectare of corn

Description	Product	The amount	Unit	Unit Cost (R $)	Total Cost (R $)
Desiccation	Original Roundup	2	L	14,00	16,00
Planting and Fertilization	Seed 30f53 Poncho / Standak	1,2	UND	820,00	821,20
	Mineral Fertilizer NPK 10.20.20	400	KG	2,30	402,30
1st Fertilization	Potassium Chloride 00.00.60	150	KG	1,78	151,78
	Soberan SC 630	250	ML	0,53	250,53
1st Spraying	Golden	300	ML	0,02	300,02
	Siptran SC 500	3	L	15,40	18,40
2nd Fertilization	Agricultural Urea 45.00.00	400	KG	2,00	402,00
	Native SC 300	750	ML	0,08	750,08
2nd Spraying	Golden	300	ML	0,02	300,02
	Portero	1	L	52,60	53,60
Total					**3.465,93**

Source: From the authors, 2020.

In Table 11, all the inputs used in the corn crop were surveyed during their production process, where the amount used and the cost of all inputs are shown. The total cost of R $ 3,465.93 was reached for 1 hectare.

The cultivation of wheat is carried out at different times than soybeans and corn, which is cultivated in winter, as follows the table with the presentation of the inputs used in this culture:

Table 12 - Inputs used in the cultivation for 1 hectare of wheat

Description	Product	The amount	Unit	Unit Cost (R $)	Total Cost (R $)
Desiccation	Original Roundup	2	L	14,00	28,00
	Seed Tbio Itaipu	120	KG	2,40	288,00
Planting	Baytan FS 150	80	ML	0,09	7,40
	Derosal Plus FS 500	100	ML	0,07	6,80
	Formax Formaiz	50	ML	0,11	5,50
Fertilizing	Fert. Mineral NPK 08.20.20	300	KG	0,84	252,00
1st Spraying	Hussar VVG 20	100	GR	0,87	87,00
	Hoefix EC 279	200	ML	0,02	3,76
Cover fertilization	Fert. Mineral NPK 36.00.12	200	KG	2,02	404,00
	Fox	400	ML	0,27	108,00
2nd Spraying	Aller Biw	100	ML	0,01	1,00
	Engeo Pleno	100	ML	0,21	20,70
	Sphere Max	200	ML	0,27	53,60
3rd Spraying	Golden	300	ML	0,02	6,09
	Connect SC 112.5	750	ML	0,04	32,25
	Native SC 300	750	ML	0,08	62,25
4th Spray	Golden	300	ML	0,02	6,09
	Engeo Pleno	100	ML	0,21	20,70
Total					1.393,14

Source: From the authors, 2020.

Table 12 shows the inputs used in the wheat crop during the production process, showing the amount used and the cost of all inputs. In this case, the total cost of inputs was R $ 1,393.14 for 1 hectare.

It was found that, of the three crops analyzed, the one with the lowest cost is soybeans and the highest cost is corn, but this will depend on the quantity of bags that are produced in 1 hectare, in order to conclude which of the crops the producer obtains the highest profitability. and profitability.

4.3.4 Determination of Indirect Costs

In order to determine indirect costs, it is not possible to allocate them to each product in its production process. In the analysis of this work, they were identified and included in the income statement, where it will deduct from the total gross profit of the three crops and after that arrive at the net result of the crop year.

Table 13 - Annual indirect costs of ownership

Description	Price R$)
Electricity	600,00
Telephone	480,00
Water	120,00
Depreciation	3.284,42
Insurance	7.000,00
ITR	1.800,00
Maintenance	15.912,00
Others	9.000,00
Total	**38.196,42**

Source: From the authors, 2020.

Table 13 shows the total indirect costs of the property, totaling R $ 38,196.42.

4.4 CALCULATION OF THE CROP RESULT IN EACH CULTURE

The objective of every company or agricultural property is to obtain a profit, to know if their work is paying off or not, so it is necessary to analyze the costs and expenses that directly and indirectly influence the result.

Firstly, all costs and expenses that are part of the production process of all crops were verified, after this it was necessary to know the quantity of bags that are produced in 1 hectare and in the total produced of each crop, it was also possible to reach the sale price of the bag (60 kg) after consulting the EPAGRI website for the 2019/2020 harvest at the time the products were sold.

Then, the total produced in each crop is presented, being shown in one hectare and also in the total of the property, the sale price per sack and finally the gross sales revenue that make up the income statement.

Table 14 - Total produced per hectare and gross revenue from sales

Product	Description	Cultivated Area - Hectare	Price of bag 60kg (R $)	Total Harvest (sc)	Gross Revenue (R $)
SOY	Study Area	1	128,00	65,00	8.320,00
	Cultivated Area	290	128,00	18.850,00	2.412.800,00
CORN	Study Area	1	54,00	200,00	10.800,00
	Cultivated Area	230	54,00	46.000,00	2.484.000,00
WHEAT	Study Area	1	72,00	55,00	3.960,00
	Cultivated Area	140	72,00	7.700,00	554.400,00

Source: From the authors, 2020.

According to table 14, corn was then reached as the product with the highest productivity per hectare, with the production of 200 bags (60kg.) Per hectare and 46,000 in the total cultivated by the property, at a sale price of R $

54.00 per bag, generating total revenue of R $ 2,484,000.00 in the crop year. Next is soybeans with the production of 65 bags (60kg.) Per hectare and 18,850 in the total cultivated by the property, at the sale price of R $ 128.00 per bag, generating total revenue of R $ 2,412,800.00 in the crop year. And finally, wheat, with the lowest productivity in bags and per hectare, with 55 bags (60kg.) Per hectare and 7,700 in the total cultivated by the property, at the sale price of R $ 72.00 per bag, generating total revenue of R $ 554,400.00 in the crop year.

4.4.1 Income Statement

The income statement started from the determination of gross sales revenue for one hectare, it was also developed for the total cultivated on the property, after that, the deduction of Funrural was made with the rate of 1.5% on the total of sales, Net Sales Revenue was then arrived at.

Then, the Costs of Products Sold were deducted, which includes inputs, direct labor and the cost of machine hours that are part of the production process of each crop, so the Operational Gross Profit was reached in the crop year 2019 / 2020. Table 16 shows the demonstration for 1 hectare:

Table 15 - Statement of income for the year for 01 hectare

Income Statement - for a Hectare	SOY		CORN		WHEAT	
	R$	%	R$	%	R$	%
Gross Sales Revenue	R$ 8.320,00	100%	R$ 10.800,00	100%	R$ 3.960,00	100%
(-) Taxes - Funrural (1.5%)	R$ 124,80	2%	R$ 162,00	2%	R$ 59,40	2%
(=) Net Revenue	R$ 8.195,20	100%	R$ 10.638,00	100%	R$ 3.900,60	100%
Inputs	R$ 1.986,77	24%	R$ 3.465,93	33%	R$ 1.393,14	36%
Direct labor	R$ 37,85	0%	R$ 46,92	0%	R$ 31,90	1%
Cost Hourly Tractors	R$ 198,32	2%	R$ 247,78	2%	R$ 169,57	4%
(=) Gross Operating Profit	R$ 5.972,27	73%	R$ 6.877,37	65%	R$ 2.305,99	59%

Source: From the authors, 2020.

Table 15 presents the net operating profit for 1 hectare, it is concluded that the property has a positive result, it is observed in the individual analysis of each crop that soybean presented the highest profitability, with 73% on net revenue, corn presented 65% and wheat presented a 59% profit on its net revenue. In the general analysis, soybeans generated the best net operating profit for the producer.

In the analysis below, the value of the total revenue from summer crops was demonstrated, the calculation was made on all areas produced by the producer, deducting all costs and expenses that are part of the production process.

Table 16 - Statement of the total result of the summer harvest

Total Income Statement for Summer Crop	SOY		CORN		TOTAL	
	R$	%	R$	%	R$	%
Gross Sales Revenue	R$ 2.412.800,00	100%	R$ 2.484.000,00	100%	R$ 4.896.800,00	100%
(-) Taxes - Funrural (1.5%)	R$ 36.192,00	2%	R$ 37.260,00	2%	R$ 73.452,00	2%
(=) Net Revenue	R$ 2.376.608,00	100%	R$ 2.446.740,00	100%	R$ 4.823.348,00	100%
Inputs	R$ 576.163,30	24%	R$ 797.164,73	33%	R$ 1.373.328,03	28%
Direct labor	R$ 10.975,17	0%	R$ 10.790,64	0%	R$ 21.765,81	0%
Cost Hourly Tractors	R$ 57.512,16	2%	R$ 56.988,69	2%	R$ 114.500,85	2%
(=) Gross Profit	R$ 1.731.957,37	73%	R$ 1.581.795,94	65%	R$ 3.313.753,31	69%
(-) Financial costs	–		–		R$ 296.400,00	
(-) Indirect costs	–		–		R$ 38.196,42	
(=) Net Operating Profit	–		–		R$ 2.979.156,89	62%

Source: From the authors, 2020.

According to Table 16, the final result of the summer harvest was reached, presenting a net profit of R $ 2,979,156.89, with 62% of its net sales revenue, corn presented the highest sales revenue , but as the costs of corn production are high, soybeans showed the highest profit in relation to corn, obtaining a satisfactory result on both crops and their harvest.

The following is a statement of the total result of the winter harvest, reaching the total gross sales revenue and deducting all indirect costs and expenses that are part of the production process.

Table 17 - Statement of the total result of the winter harvest

Total Income Statement for Winter Harvest	WHEAT		TOTAL	
	R$	%	R$	%
Gross Sales Revenue	554.400,00	100%	554.400,00	100%
(-) Taxes - Funrural (1.5%)	8.316,00	2%	8.316,00	2%
(=) Net Revenue	546.084,00	100%	546.084,00	100%
Inputs	195.039,60	36%	195.039,60	36%
Direct labor	4.466,39	1%	4.466,39	1%
Cost Hourly Tractors	23.739,37	4%	23.739,37	4%
(=) Gross Profit	322.838,65	59%	322.838,65	59%
(-) Financial costs	–		79.800,00	
(-) Indirect costs	–		38.196,42	
(=) Net Operating Income	–		204.842,23	38%

Source: From the authors, 2020.

In Table 17, the income statement for the winter crop was not so satisfactory, with a 38% net profit on net revenue, it is possible to observe the high cost of inputs, which was 36%, not being a product with the result is so relevant, but it must be cultivated for soil rotation.

So that the analysis and comparison of each product with the total revenue and its costs can be made, the graph below was elaborated:
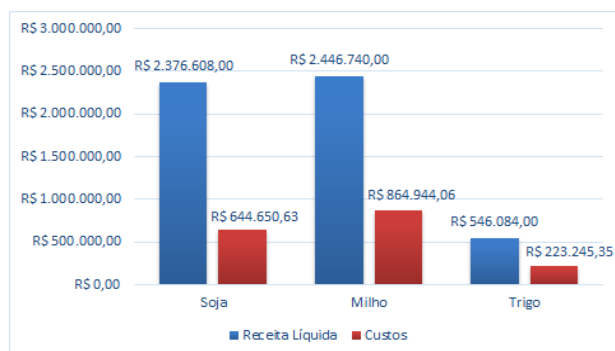
Graph 3 - Total revenues and direct costs for the total cultivated

Source: From the authors, 2020.

Product	Gross Operating Profit (R $)	Sales (R $)	Profitability (%)
Soy	1.731.957,37	2.412.800,00	71,78%
Corn	1.581.795,94	2.484.000,00	63,68%
Wheat	322.838,65	554.400,00	58,23%
Total	**3.636.591,96**	**5.451.200,00**	**6,71%**

Source: From the authors, 2020.

In view of Graph 3, it was analyzed that soy in relation to corn, presents lower costs and revenue, with the cost / revenue ratio being around 27%, corn found that its sales revenue is higher when compared to the other products, but its cost is also higher, with a cost / revenue ratio of around 35%, whereas wheat has a lower revenue, not being such a profitable crop for the producer, but it constitutes a good alternative for land use (crop rotation) and revenue increase.

The result of rural activity, when positive, will integrate the income tax calculation base for the annual declaration, in its calculation, revenues, expenses and investments. In the case of the exploitation of a rural unit by more than one individual, each rural producer must record the portions of revenue, operating expenses, investments and other values that are part of the rural activity that fits him.

In the analyzed property, it was not possible to calculate the income tax, since the property is composed of three people, thus, the costs, expenses and proven revenues are in the name of the three CPF, it is not possible to verify which cost and expense belong to each of them to perform the calculation.

4.4.2 Profitability Analysis

For the calculation of profitability, the financial data of the property is required, which was presented in the income statement, using the value of sales, costs and expenses to arrive at the percentage of profit of the property. As shown in the income statement, the company's profit is obtained by deducting costs and expenses from total sales. In order to calculate the profitability index, it is necessary to divide the net profit by sales and multiply by 100, as shown below:

Table 18 - Profitability index for summer and winter crops

Table 18 shows the calculation of the profitability of the analyzed crops. In soybeans, the percentage of profit it is generating on sales is 71.78% and corn, its profitability index is 63.68%, so in the total summer crop, soybean and corn crops have 67.67 % of profitability, it can be considered that these indices are positive for the producer.

In the winter harvest, wheat cultivation reached a rate of 58.23%, compared to the other crops under study, the percentage of return on sales is low. The annual profitability of the crop year presented a 66.71% profitability over the sales of the three crops.
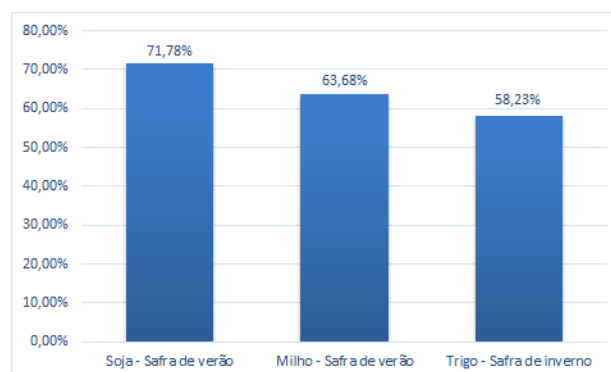
Graph 4 - Profitability by product grown.

Source: From the authors, 2020.

Analyzing Graph 4, the summer and winter crops, it can be seen that the gain in the summer crops is quite relevant for soybeans, corn has slightly lower profitability than soybeans, but it is still favorable, since winter crop wheat crop shows the lowest profitability index on the graph.

4.4.3 Profitability Analysis

The profitability index shows the return on investment, as shown in the statement As a result, the company's profit is obtained by deducting costs and expenses from the total sales, but in order to calculate profitability, it is necessary to divide the net profit by the investment value and multiply by 100:

Table 19 - Summer and winter crop profitability index

Product	Gross Operating Profit (R $)	Investment (R $)	Profitability (%)
Soy	1.731.957,37	19.760.000,00	8,76%
Corn	1.581.795,94	19.760.000,00	8,01%
Wheat	322.838,65	19.760.000,00	1,63%
Total	**3.636.591,96**	**33.455.900,00**	**6,13%**

Source: From the authors, 2020.

According to Table 19, the profitability index of summer crops was first identified, soybeans showed an 8.76% return on investment and corn an index of 8.01%, therefore, in the total summer harvest, the soybean and corn crops have 16.77% profitability. Soy has the best index.

For the winter crop, wheat showed a return of 1.63% on the total invested, a low index when compared to the summer crops. The annual profitability of the crop year presented a 6.13% return on investment.
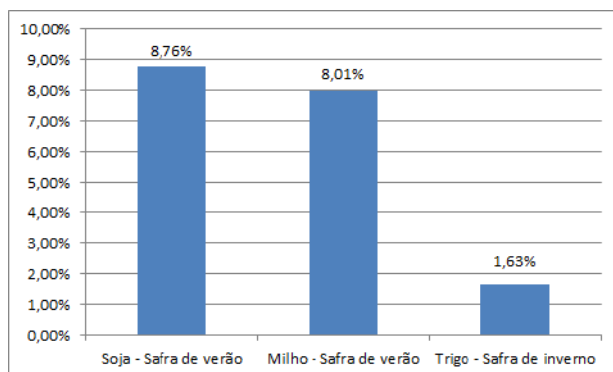
Graph 5 - Profitability by product grown

Source: From the authors, 2020.

It was analyzed in Graph 5 that the summer crops generate more return on investment, mainly the soybean crop which was 8.76%, the corn crop 8.01% and the lowest, the wheat crop with 1.63 %. Profitability is related to the net operating profit and the total investment and the indices are showing the return that each product generated to the producer in the crop year analyzed, comprising summer crops (soybeans and corn) and winter crops (wheat).

4.4.4 Risk and return analysis for 01 hectare

For the analysis of risk and return for 01 hectare, cash flow was used over a period of 10 years, per crop in order to verify the best use, as shown below:

Table 20 - Analysis of net cash flow

Period (YEARS)	SOJA	MILHO	TRIGO
0	- 38.000,00 -	38.000,00 -	38.000,00
1	5.972,27	6.877,37	2.305,99
2	5.972,27	6.877,37	2.305,99
3	5.972,27	6.877,37	2.305,99
4	5.972,27	6.877,37	2.305,99
5	5.972,27	6.877,37	2.305,99
6	5.972,27	6.877,37	2.305,99
7	5.972,27	6.877,37	2.305,99
8	5.972,27	6.877,37	2.305,99
9	5.972,27	6.877,37	2.305,99
10	5.972,27	6.877,37	2.305,99

Source: From the authors, 2020.

From the cash flows, the risk and return indicators were calculated according to the multi-index methodology, proposed by Souza and Clemente (2008), it is characterized by the simultaneous use of two sets of indicators to evaluate the return and risks associated with an investment project, with the objective of obtaining a more comprehensive view of the investment context, facilitating the decision-making process choice of the investment project. Atmulti-index methodology, the return is evaluated by the indicators Net Present Value (NPV), Annualized Net Present Value (NPV), Cost Benefit Index (IBC) and Additional Return on Investment (ROIA). In this case, the multi-index methodology is analyzed by type of culture, as shown in Table 01.

It can be seen that the best product is corn, considering that it has a Present Value of R $ 50,618.00, Net Present Value of R $ 12,618.00, its Annualized Net Present Value is R $ 13,249.00, its Index Benefit per Cost is 1.332 and its Additional Return on Investment per year is 2.91%, with respect to risk, has an Internal Rate of Return of 12.55%, its Minimum Rate of Attractiveness by Internal Rate of Return of 0.40, Risk of Management of 0 , 40 and Business Risk of 0.46.

Followed by soybeans, as it has a Present Value of R $ 43,956.00, a Net Present Value of R $ 5,956.00, its Annualized Net Present Value is R $ 6,254.00, its Benefit Ratio by Cost is 1.157 and itsAdditional Return on Investment per year is 1.47%, with respect to risk, has an Internal Rate of Return of 9.20%, its Minimum Rate of Attractiveness by Internal Rate of Return of 0.54, Risk of Management of 0 , 40 and Business Risk of 0.46.

And later on wheat resulting in a Present Value of R $ 16,972.00, a Net Present Value of negative R $ 21,028.00, its Annualized Net Present Value is a negative R $ 22,079.00, its Benefit Ratio by Cost is 0.447 it's yours Additional Return on Investment per year is -7.74%, with respect to risk, it has an Internal Rate of Return of -8.18%, its Minimum Attractiveness Rate by Internal Rate of

Return of 0.61 negative, Risk of Management of 0.40 and Business Risk of 0.46.

Table 21 - Risk and return analysis

		SOJA	MILHO	TRIGO
RETURN	Present value	43.956	50.618	16.972
	Net present value	5.956	12.618	-21.028
	Annualized Net Present Value	6.254	13.249	-22.079
	Benefit / Cost Index (IBC)	1,157	1,332	0,447
	ROIA / Year	1,47%	2,91%	-7,74%
	Internal Rate of Return (IRR)	9,20%	12,55%	-8,18%
RISK	TMA / TIR index	0,54	0,40	(0,61)
	Pay Back / N			
	Pay Back / N Index			
	Management Risk	0,40	0,40	0,40
	Business Risk	0,46	0,46	0,46

Source: From the authors, 2020.

As shown in Table 21, the winter wheat crop, if analyzed separately, presents a negative Net Present Value - NPV (non-viable), however, because it involves the use of an area that would be idle (during the winter period) in addition to income, allows the use and rotation of the soil.

The Additional Return on Investment - ROIA, is the best estimate of profitability for an investment project, representing, in percentage terms, the wealth generated by the project. In the case of the study in question in relation to the winter crop of wheat, for the reasons explained in the previous paragraph, regarding the analysis of NPV (Net Present Value), ROIA is also negative (-7.74%).

With regard to the risk of the study, the soybean crop has an Internal Rate of Return - IRR of 9.20%, the corn crop 12.55% and the wheat crop -8.18%.

V.   CONCLUSION

At the conclusion of the study, it was possible to verify the production processes of the soybean, corn and wheat crops and from there the cost analysis, looking for all the costs allied to these productions and after that to make the segregation by culture (soybean, corn and wheat) with the use of cost accounting, as a tool assisting in efficient management and decision making within the property.

Thus, the objectives sought by the present work were to analyze the profitability and profitability of these crops, verifying in which product the producer obtains better results, at first the cost was made for one hectare, and after that for the entire property cultivated in relation to to the three selected cultures.

In relation to the three crops, soybean was first found, the product in which the producer has the largest cultivated area within the analyzed property and also has higher profitability and profitability indexes. Its cultivation is very favorable for its development, it obtains a good price at the time of its sale and its cost is not so high in relation to the other cultures, in addition, soy is one of the products that has been growing considerably in the last three decades and the producer has enough technologies for its cultivation.

After soybeans, corn was cultivated, a product that in Brazil and especially in the region is widely cultivated by most producers. In the analyzed property, it is the second crop that has the largest area produced in relation to the three crops, its selling price is the lowest, but it is the one that produces the largest amount per hectare, thus achieving a good profitability, its cost is also high in in relation to soybean culture, but still obtain positive results.

Then, the wheat crop, the only winter crop produced by the producer, was verified, its area produced is low, because the climate is not so favorable to this type of crop in the region, it presented the highest cost index in relation to its revenues and profitability rates much lower compared to other crops, but still manages to honor its commitments, it can be said that the producer continues with this crop to promote the use and rotation of soil and increase income.

In the general analysis of production it was observed that in developed crops the producer has very favorable rates for development, it would be to say that he is on the right path for growth, it can be concluded that the crops that provide him with the greatest results are the summer crops, soybeans and corn, where the profitability and profitability of soybean stands out for its market price is good and the cost of inputs is low, whereas corn is favorable because it can produce large quantities in one hectare, where they can be observed in the income statement and in the graphs above.

It is noteworthy that in many cases, like this object of study, the producer does not have control over its costs, that is, their separation for each crop, being extremely important to control, thus improving their planning of future crops and all related items. However, caution is emphasized since these crops are subject to market price fluctuations and climatic problems.

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Probability Distribution in the Variability of the Nγ Factor of Shallow Foundations

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Abstract— Due to the existing variability in the calculation of the bearing capacity factors, specifically when obtaining the N_γ value of the bearing capacity, which is estimated by a large number of equations that have been obtained by approaches of limit equilibrium, method of characteristics, empirical, semi-empirical, among others; thus existing a great uncertainty, therefore, this article took a total of 55 equations that compute this value to carry out a probabilistic study where N_γ values were obtained for friction angles of 5º, 10º, 15º, 20º, 25º, 30º and 35º, being the variability obtained being directly proportional to friction angle. Also, it was found that the data have a good correlation with the Lognormal distribution, according to the Kolgomorov-Smirnov and Anderson-Darling tests, in this context, Lognormal cumulative probability distribution curves of the data under study were elaborated, thus allowing not to opt for a single or deterministic value but a probable or acceptable value according to the size of a project with a conservative range.

I. INTRODUCTION

The soil plays an important role as a support base for any construction, the gravitational load transmissions of any structure go to this outcrop, where its load capacity indicates to the specialist a foundation geometry to choose from, and it is precisely that, in shallow foundations, bearing capacity generally governs the design process (Shahin & Cheung, 2011), representing a primary step for shallow foundation stability evaluations (Dewaikar et al., 2008).

For decades it has been known that bearing capacity has been studied and it has always been noted that it depends on certain factors; for example, without reaching various differentiated cases Terzaghi (1943) proposed an equation well known to date for the calculation of the bearing capacity considering the case of a strip footing, which is detailed below.

$$q_u = cN_c + qN_q + \frac{1}{2}\gamma B N_\gamma \qquad (1)$$

Where q_u is the ultimate bearing capacity of the soil, c is the cohesion, q is the overburden pressure, γ is the unit weight of soil, B is the width of footing, N_c, N_q and N_γ are the bearing capacity factors which depend on the friction angle ϕ of the soil.

From equation 1, is particularly see that the values of N_c and N_q were made known by Prandtl in 1921 and Reissner in 1924; however, there is a great dissertation on the value N_γ since this is theoretically less precise than the other two terms (Griffiths, 1982), so there is a wide controversy considered over the theoretical values of N_γ (Mahmood, 2018) thus leading to great variability in the objective of achieving the value of the bearing capacity by various methods (Padmini, 2018; Shill & Hoque, 2015; Sieffert & Bay-Gress, 2000), is so the bearing capacity must be better understood using new parametric and numerical analyzes (Sieffert & Bay-Gress, 2000), in this

sense, today there are different investigations based on analytical model approaches, semi-empirical models, empirical models, finite difference models, upper limit and lower limit models, finite element models, etc. that try to determine this geotechnical parameter (Motra et al., 2016). As described, there are several proposed formulas, but no is totally accurate (Nguyen et al., 2016), generating as consequences discrepancies in the results (Ty et al., 2019).

The great geotechnical variability of the soil is well known, existing a certain proportion of uncertainty in the same parametric measurement, in this case, the N_γ value. Now, in this context, it is known that there are many forms of uncertainty as framed in JCGM (2008), where geotechnical uncertainty is recognized to be primarily epistemic, bayesian, and belief-based (Christian, 2004), of which this article will try to address the epistemic in a probabilistic way related to 55 formulas taken from Motra et al. (2016) that obtain the N_γ value, thus trying to improve the knowledge of this parameter, generating a reduction in epistemic uncertainties and therefore the total variability of the estimated soil design properties are reduced, as mentioned in Cao et al. (2017).

Characterization of geological uncertainty remains challenging (Juang et al., 2019), and it is particularly knowing that the model to choose is still the main source of uncertainty (Motra et al., 2016), due to geotechnical

properties vary spatially (Han et al., 2020; Juang et al., 2019; Popescu et al., 2005). However it is known that probabilistic methods provide a powerful tool for dealing with uncertainty in engineering projects (Christian, 2004), it is thus that what this article raises is to deal in a probabilistic way the value N_γ of bearing capacity under different friction angles ϕ, considering the results through a Cumulative Distribution Function (CDF), in this context, it will be allowed not only to opt for a single deterministic value but by a range of probabilistic values.

II. METHODS

2.1. Model for prediction bearing capacity factors.

Although equation 1 is used in practice to calculate the bearing capacity of shallow foundations; however, to obtain the value N_γ, influencing the bearing capacity there are a large number of methods. Table 1 shows 55 models to compute the N_γ value, which have been taken from the compilation of Motra et al. (2016).

Table 1: Models for prediction N_γ value adapted from Motra et al. (2016)

Nº	Author	Method	Model
1	Terzaghi (1943)	Limit equilibrium	$N_\gamma = \left[\tan^2\left(\frac{\pi}{4} + \frac{\phi}{2}\right) \exp\left(\pi \tan\phi\right) + 3.0 \right] \tan\left(1.34\phi\right)$
2	Taylor (1948)	Limit equilibrium	$N_\gamma = \left[\tan^2\left(\frac{\pi}{4} + \frac{\phi}{2}\right) \exp\left(\pi \tan\phi\right) - 1.0 \right] \tan\left(\frac{\pi}{4} + \frac{\phi}{2}\right)$
3	Caquot and Kérisel (1953)	Method of characteristics	$N_\gamma = \left[1.413 \tan^2\left(\frac{\pi}{4} + \frac{\phi}{2}\right) \exp\left(\pi \tan\phi\right) + 1.794 \right] \tan\left(1.27\phi\right)$
4	Biarez et al. (1961)	Equilibrium limit	$N_\gamma = 1.8 \left[\tan^2\left(\frac{\pi}{4} + \frac{\phi}{2}\right) \exp\left(\pi \tan\phi\right) - 1.0 \right] \tan\phi$
5	Feda (1961)	Empirical	$N_\gamma = 0.01 \exp\left(\frac{\phi}{4}\right)$ (for $\phi < 35º$, ϕ in degree)
6	Meyerhof (1963)	Semi-empirical based on limit equilibrium	$N_\gamma = \left[\tan^2\left(\frac{\pi}{4} + \frac{\phi}{2}\right) \exp\left(\pi \tan\phi\right) - 1.0 \right] \tan\left(1.4\phi\right)$
7	Hu (1964)	Fitted model, equilibrium limit	$N_\gamma = \left[1.901 \tan^2\left(\frac{\pi}{4} + \frac{\phi}{2}\right) \exp\left(\pi \tan\phi\right) + 0.27 \right] \tan\left(1.285\phi\right)$
8	Krizek (1965)	Empirical	$N_\gamma = \frac{6\phi}{40 - \phi}$ (for $\phi < 35º$, ϕ in degree)

Table 1: Models for prediction N_γ value adapted from Motra et al. (2016) *(continued)*

Nº	Author	Method	Model
9	Booker (1969)	Method of characteristics	$N_\gamma = 0.1045 \exp(9.6\phi)$
10	Hansen and Christensen (1969)	Fitted model, Method of characteristics	$N_\gamma = \left[\tan^2\left(\frac{\pi}{4} + \frac{\phi}{2}\right) \exp(\pi \tan \phi) - 1.0 \right] \tan(1.33\phi)$
11	Muhs and Weiss (1969)	Semi-empirical model	$N_\gamma = 2.0\left[\tan^2\left(\frac{\pi}{4} + \frac{\phi}{2}\right) \exp(\pi \tan \phi) - 1.0 \right] \tan \phi$
12	Abdul-Baki and Beik (1970)	Fitted model, limit equilibrium	$N_\gamma = \left[1.752 \tan^2\left(\frac{\pi}{4} + \frac{\phi}{2}\right) \exp(\pi \tan \phi) + 0.186 \right] \tan(1.32\phi)$
13	Brinch-Hansen (1970)	Semi-empirical	$N_\gamma = 1.5\left[\tan^2\left(\frac{\pi}{4} + \frac{\phi}{2}\right) \exp(\pi \tan \phi) - 1.0 \right] \tan \phi$
14	Davis and Booker (1971)	Fitted model, equilibrium limit	$N_\gamma = \left[\tan^2\left(\frac{\pi}{4} + \frac{\phi}{2}\right) \exp(\pi \tan \phi) + 2.33 \right] \tan(1.316\phi)$
15	Chummar (1972)	Fitted model, semi-empirical	$N_\gamma = \left[7.12 \tan^2\left(\frac{\pi}{4} + \frac{\phi}{2}\right) \exp(\pi \tan \phi) + 65.5 \right] \tan(0.27\phi)$
16	Vesic (1973)	Method of characteristics	$N_\gamma = 2.0\left[\tan^2\left(\frac{\pi}{4} + \frac{\phi}{2}\right) \exp(\pi \tan \phi) + 1.0 \right] \tan \phi$
17	Chen (1975a)	Upper bound limit analysis	$N_\gamma = 2.0\left[\tan^2\left(\frac{\pi}{4} + \frac{\phi}{2}\right) \exp(\pi \tan \phi) + 1.0 \right] \tan \phi \tan\left(\frac{\pi}{4} + \frac{\phi}{5}\right)$
18	Chen (1975b)	Fitted model, upper bound limit analysis	$N_\gamma = \left[1.45 \tan^2\left(\frac{\pi}{4} + \frac{\phi}{2}\right) \exp(\pi \tan \phi) + 0.754 \right] \tan(1.41\phi)$
19	Salenon et al. (1976)	Fitted model, limit equilibrium	$N_\gamma = \left[\tan^2\left(\frac{\pi}{4} + \frac{\phi}{2}\right) \exp(\pi \tan \phi) - 1.0 \right] \tan(1.405\phi)$
20	Craig and Pariti (1978)	Fitted model, limit equilibrium	$N_\gamma = \left[2.22 \tan^2\left(\frac{\pi}{4} + \frac{\phi}{2}\right) \exp(\pi \tan \phi) + 0.222 \right] \tan \phi$
21	Spangler and Handy (1982)	Approximation from Terzaghi's mechanism	$N_\gamma = 1.1\left[\tan^2\left(\frac{\pi}{4} + \frac{\phi}{2}\right) \exp(\pi \tan \phi) - 1.0 \right] \tan(1.3\phi)$
22	Ingra and Baecher (1983)	Statistical analysis	$N_\gamma = \exp(0.173\phi - 1.646)$ (ϕ in degree)
23	Simone and Restaino (1984)	Method of characteristics	$N_\gamma = \left[\tan^2\left(\frac{\pi}{4} + \frac{\phi}{2}\right) \exp(\pi \tan \phi) - 1.0 \right] \tan(1.341\phi)$
24	Hettler and Gudehus (1988)	Empirical	$N_\gamma = \exp\left[5.7 (\tan \phi)^{1.15} \right] - 1.0$
25	Saran and Agarwal (1991)	Limit equilibrium	$N_\gamma = \exp\left(\frac{0.757}{\ln \phi} + 15.286\phi - 3.452 \right)$
26	Bolton and Lau (1993a)	Method of characteristics	$N_\gamma = \left[\tan^2\left(\frac{\pi}{4} + \frac{\phi}{2}\right) \exp(\pi \tan \phi) - 1.0 \right] \tan(1.5\phi)$

Table 1: Models for prediction N_γ value adapted from Motra et al. (2016) *(continued)*

Nº	Author	Method	Model
27	Bolton and Lau (1993b)	Fitted model, method of characteristics	$N_\gamma = \left[1.274 \tan^2\left(\dfrac{\pi}{4} + \dfrac{\phi}{2}\right) \exp\left(\pi \tan\phi\right) + 3.736 \right] \tan\left(1.367\phi\right)$
28	Kumbhojkar (1993)	Fitted model, numerical solution	$N_\gamma = \left[1.2 \tan^2\left(\dfrac{\pi}{4} + \dfrac{\phi}{2}\right) \exp\left(\pi \tan\phi\right) + 1.324 \right] \tan\left(1.417\phi\right)$
29	Zadroga (1994)	Empirical model	$N_\gamma = 0.657 \exp\left(0.141\phi\right)$ (ϕ in degree)
30	Manoharan and Dasgupta (1995)	Fitted model finite element	$N_\gamma = \left[\tan^2\left(\dfrac{\pi}{4} + \dfrac{\phi}{2}\right) \exp\left(\pi \tan\phi\right) + 3.464 \right] \tan\left(1.279\phi\right)$
31	Bowles (1996)	Fitted model from K_{py} values	$N_\gamma = \dfrac{\tan\phi}{2}\left(\dfrac{K_{py}}{\cos\phi} - 1.0\right), \ K_{py} = \exp\left(1.708 + 3.287\phi - \dfrac{0.34}{\ln\phi}\right)$
32	Frydman and Burd (1997)	Fitted model, finite difference analysis	$N_\gamma = \left[\tan^2\left(\dfrac{\pi}{4} + \dfrac{\phi}{2}\right) \exp\left(\pi \tan\phi\right) + 1.0 \right] \tan\left(1.4\phi\right)$
33	Michalowski (1997)	Upper bound limit analysis	$N_\gamma = \exp\left(0.66 + 5.11 \tan\phi\right) \tan\phi$
34	Paolucci and Pecker (1997)	Fitted model, upper bound limit analysis	$N_\gamma = \left[\tan^2\left(\dfrac{\pi}{4} + \dfrac{\phi}{2}\right) \exp\left(\pi \tan\phi\right) + 1.0 \right] \tan\left(1.71\phi\right)$
35	Danish Standards Association (1998)	Empirical fitting	$N_\gamma = \dfrac{1}{4}\left\{\left[\tan^2\left(\dfrac{\pi}{4} + \dfrac{\phi}{2}\right) \exp\left(\pi \tan\phi\right) - 1.0 \right] \cos\phi\right\}^{1.5}$
36	Soubra (1999)	Fitted model, upper bound analysis	$N_\gamma = \left[1.374 \tan^2\left(\dfrac{\pi}{4} + \dfrac{\phi}{2}\right) \exp\left(\pi \tan\phi\right) - 0.162 \right] \tan\left(1.343\phi\right)$
37	Coduto (2001)	Approximation from Terzaghi's model	$N_\gamma = \dfrac{\left[1.374 \tan^2\left(\dfrac{\pi}{4} + \dfrac{\phi}{2}\right) \exp\left(\pi \tan\phi\right) + 1.0 \right] \tan\phi}{1.0 + 0.4 \sin\left(4.0\phi\right)}$
38	Poulos et al. (2001)	Solution based on Davis and Booker (1971)	$N_\gamma = 0.1054 \exp\left(9.6\phi\right)$
39	Ueno et al. (2001)	Fitted model, method of characteristics	$N_\gamma = \left[\tan^2\left(\dfrac{\pi}{4} + \dfrac{\phi}{2}\right) \exp\left(\pi \tan\phi\right) - 1.0 \right] \tan\left(1.436\phi\right)$
40	Wang et al. (2001a)	Fitted model one, upper bound limit analysis	$N_\gamma = 1.2\left[\tan^2\left(\dfrac{\pi}{4} + \dfrac{\phi}{2}\right) \exp\left(\pi \tan\phi\right) + 4.6 \right] \tan\left(1.436\phi\right)$
41	Wang et al. (2001b)	Fitted model two, upper bound limit analysis	$N_\gamma = \left[1.234 \tan^2\left(\dfrac{\pi}{4} + \dfrac{\phi}{2}\right) \exp\left(\pi \tan\phi\right) + 4.151 \right] \tan\left(1.394\phi\right)$
42	Zhu et al. (2001a)	Case 1, limit equilibrium	$N_\gamma = \left[2.0 \tan^2\left(\dfrac{\pi}{4} + \dfrac{\phi}{2}\right) \exp\left(\pi \tan\phi\right) + 1.0 \right] \left(\tan\phi\right)^{1.35}$
43	Zhu et al. (2001b)	Case 2, limit equilibrium	$N_\gamma = \left[2.0 \tan^2\left(\dfrac{\pi}{4} + \dfrac{\phi}{2}\right) \exp\left(\pi \tan\phi\right) + 1.0 \right] \tan\left(1.07\phi\right)$

Table 1: Models for prediction N_γ adapted from Motra et al. (2016) *(continued)*

Nº	Author	Method	Model
44	Dewaikar and Mohapatra (2003)	Fitted model, limit equilibrium based on Terzaghi's model	$N_\gamma = \left[1.626 \tan^2\left(\frac{\pi}{4}+\frac{\phi}{2}\right) \exp\left(\pi \tan\phi\right) + 2.019 \right] \tan\left(1.373\phi\right)$
45	Kumar (2003a)	Fitted model, method of characteristics	$N_\gamma = \left[0.96 \tan^2\left(\frac{\pi}{4}+\frac{\phi}{2}\right) \exp\left(\pi \tan\phi\right) + 0.508 \right] \tan\left(1.352\phi\right)$
46	Kumar (2003b)	Fitted model, upper bound analysis	$N_\gamma = \left[1.379 \tan^2\left(\frac{\pi}{4}+\frac{\phi}{2}\right) \exp\left(\pi \tan\phi\right) - 0.461 \right] \tan\left(1.337\phi\right)$
47	Hjiaj et al. (2005)	Lower and upper bound analysis	$N_\gamma = \exp\left[\frac{\pi}{6}\left(1+3\pi \tan\phi\right) \right] \left(\tan\phi\right)^{\frac{2\pi}{5}}$
48	Martin (2005)	Fitted model, method of characteristics	$N_\gamma = \left[\tan^2\left(\frac{\pi}{4}+\frac{\phi}{2}\right) \exp\left(\pi \tan\phi\right) - 1.0 \right] \tan\left(1.338\phi\right)$
49	Smith (2005)	Method of characteristics	$N_\gamma = 1.75 \left[\tan^2\left(\frac{\pi}{4}+\frac{\phi}{2}\right) \exp\left[\left(0.75\pi+\phi\right)\tan\phi\right] - 1.0 \right] \tan\phi$
50	Kumar and Kouzer (2007)	Lower and upper bound limit analysis	$N_\gamma = \left[1.012 \tan^2\left(\frac{\pi}{4}+\frac{\phi}{2}\right) \exp\left(\pi \tan\phi\right) - 0.226 \right] \tan\left(1.426\phi\right)$
51	Lyamin et al. (2007)	Lower and upper bound	$N_\gamma = \left[\tan^2\left(\frac{\pi}{4}+\frac{\phi}{2}\right) \exp\left(\pi \tan\phi\right) - 0.6 \right] \tan\left(1.33\phi\right)$
52	Kumar and Khatri (2008)	Fitted model, lower bound finite element linear programming	$N_\gamma = \left[\tan^2\left(\frac{\pi}{4}+\frac{\phi}{2}\right) \exp\left(\pi \tan\phi\right) - 1.0 \right] \tan\left(1.26\phi\right)$
53	Salgado (2008)	Approximation model from N_γ values of Martin (2005)	$N_\gamma = \left[\tan^2\left(\frac{\pi}{4}+\frac{\phi}{2}\right) \exp\left(\pi \tan\phi\right) - 1.0 \right] \tan\left(1.32\phi\right)$
54	Yang and Yang (2008)	Fitted model, upper bound limit analysis	$N_\gamma = \left[\tan^2\left(\frac{\pi}{4}+\frac{\phi}{2}\right) \exp\left(\pi \tan\phi\right) + 1.0 \right] \tan\left(1.396\phi\right)$
55	Jahanandish et al. (2010)	Fitted model, zero extension lines method	$N_\gamma = \left[\tan^2\left(\frac{\pi}{4}+\frac{\phi}{2}\right) \exp\left(\pi \tan\phi\right) + 1.0 \right] \tan\left(1.5\phi\right)$

As can be seen from the previous table, there is a great variety of models to obtain the N_γ value. This is due to the methodology used by the authors, the considerations and assumptions made such as the one usually used in which it is considered that the soil is a rigid material and that it generally fails due to shear (Meyerhof, 1951), and also due to the premise that soils may be homogeneous in terms of composition, they may not be homogeneous in terms of mechanical behavior (Uzielli et al., 2007).

2.2. Variability of prediction models.

It is known that geotechnics is not an exact science (Lacasse & Nadim, 1998) and that the specific

geotechnical parameters remain an open question in its analysis (Cao et al., 2016), this is clearly reflected in the large number of formulas presented in Table 1, that is why these formulas have been grouped for friction angles of 5º, 10º, 15º, 20º, 25º, 30º y 35º; the value of up to 35º has been chosen because some formulas establish an approach of $\phi < 35º$ e.g. Krizek (1965). The result of the variability of the N_γ values can be seen in the following figures.
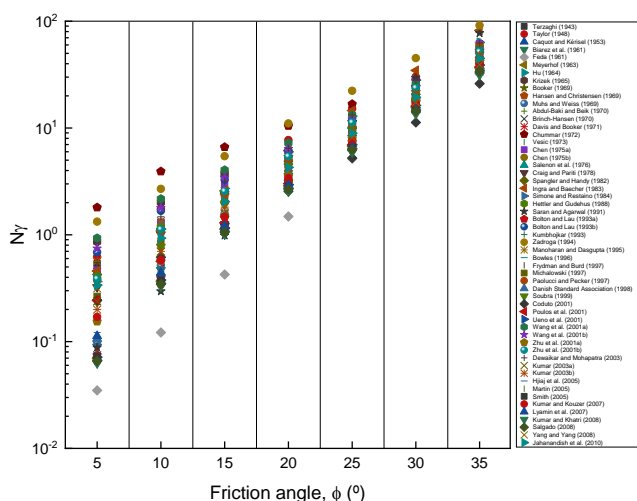
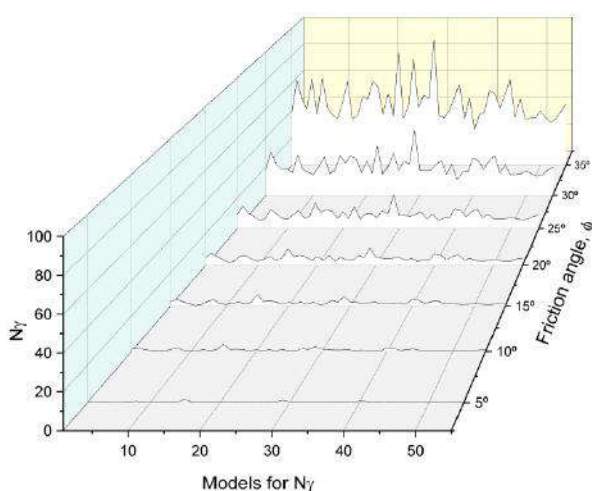*Fig. 1: Availability of the N_γ values for each author*

Fig. 2: Variability of the N_γ values for the 55 models in the study

From Fig. 2 shown, it is easy to check what is established in Padmini (2018) where the bearing capacity factor N_γ varies sharply with friction angle, especially when it is on the rise, thus Table 2 denotes both the maximum and minimum N_γ values for the studied database, where there is clearly a differentiation of values of up to 65.33 (specifically in ϕ =35°). Also, it is shown in Fig. 3 that the average values and the average values $\pm 1\sigma$

(standard deviation) for different friction angles, where most of the estimated models (ordered according to Table 1) are within this range, reflecting the existence of similarity of values between model and model, but when wanting to consider a unique estimated value of N_γ, this becomes somewhat complicated. Although different countries already have predefined different methods used to estimate the N_γ factor as shown in Sieffert & Bay-Gress (2000), it may be that these values used in a deterministic way do not exactly define or characterize the soil profile for different geotechnical zones, as it is widely known that the variability of soil properties encountered in any project is related to the particular site and specific regional geology (Baecher & Christian, 2003), so it is convenient to see this problem through a statistical approach. Therefore, if we expand the methodology in a method of probabilities based on uncertainties, we will have the advantage of providing more complete and realistic information regarding the level of safety of design (Uzielli et al., 2007), finding not a true value, but an acceptable or conforming value, to the reality of the safety of any project.

Table 2: Maximum and minimum values of N_γ

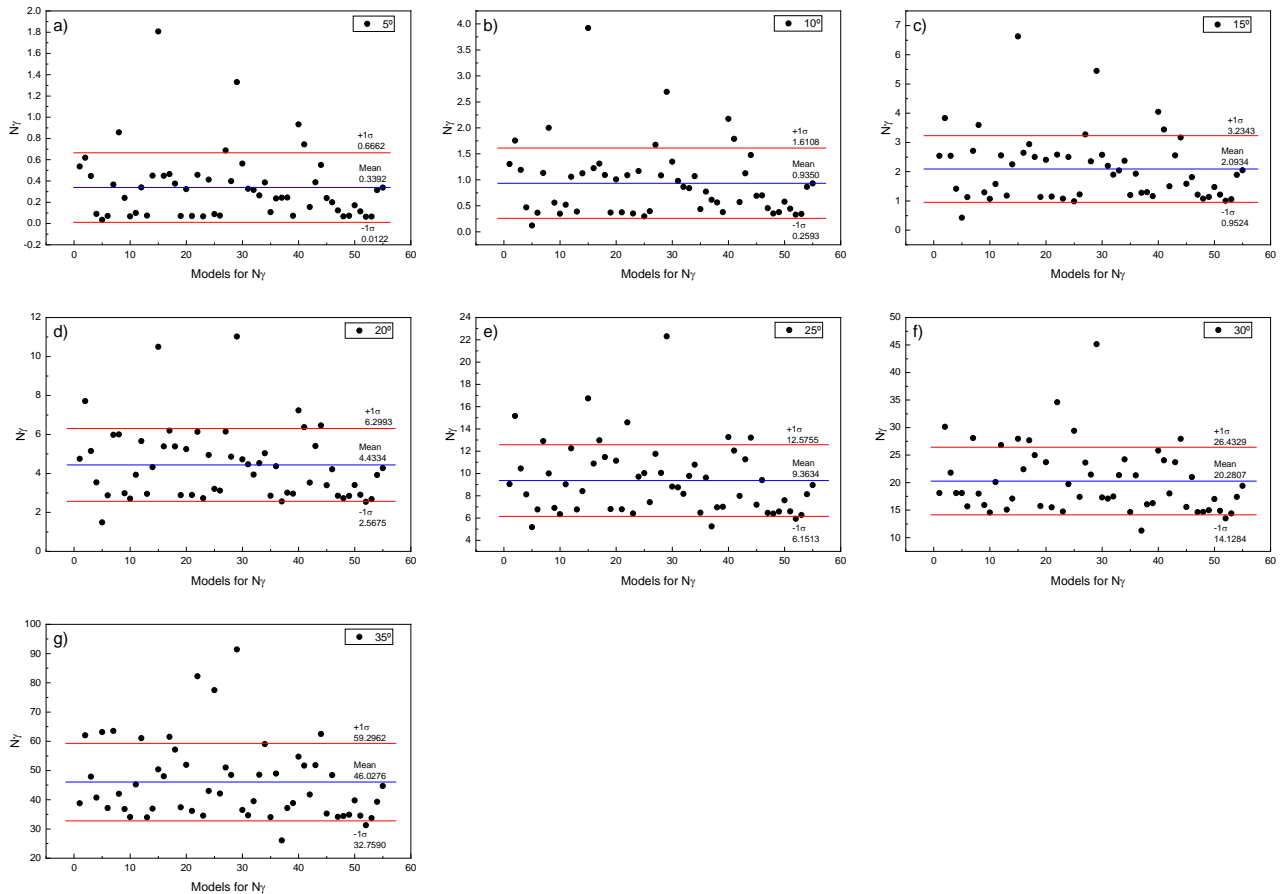| ϕ (º)	Maximum and minimum values of N_γ			
	Maximum	**Author**	**Minimum**	**Author**
5	1.81	Chummar (1972)	0.03	Feda (1961)
10	3.92	Chummar (1972)	0.12	Feda (1961)
15	6.62	Chummar (1972)	0.43	Feda (1961)
20	11.02	Zadrogra (1994)	1.48	Feda (1961)
25	22.31	Zadrogra (1994)	5.18	Feda (1961)
30	45.15	Zadrogra (1994)	11.27	Coduto (2001)
35	91.37	Zadrogra (1994)	26.04	Coduto (2001)

Fig. 3: Range of values $\pm 1\sigma$ for friction angles: a) 5º, b) 10º, c) 15º, d) 20º, e) 25º, f) 30º and g) 35º

2.3. Probabilistic approach.

The use of probability models and statistical methods to analyze data has become common practice in virtually all scientific disciplines (Devore, 2008), many studies that are based on probabilistic terms about geotechnics and soils have been developed in recent years (Al-Bittar & Soubra, 2013; Chen et al., 2012; Griffiths et al., 2002; Jung et al., 2008; Shahin & Cheung, 2011). If we see, for example, in a general approach, for engineering, the most common continuous probability distribution functions are the Exponential, Gamma, Beta, Uniform, Weibull, Rayleigh, Normal and Lognormal. On the other hand, in a slightly more particular approach, in geotechnics, the distributions used in the literature to model soil properties are the Lognormal, Gamma and Beta (Chen et al., 2012; Popescu et al., 2005). In this context, some examples are cited such as Vessia et al. (2009), who assumed in his study a Lognormal distribution, and Han et al. (2020) used the Beta, Gamma and Lognormal distributions.

2.4. Probabilistic function.

The probability function used in this article is the Lognormal. This distribution showed a good correlation

with the estimated N_γ values for the seven friction angles under study, which could be verified using both the Kolgomorov-Smirnov test (Massey, 1951) and Anderson-Darling test (Rahman et al., 2006) to ensure the goodness of fit of the distribution. The results are shown in Table 3.

The Probability Density Function (PDF) of the Lognormal distribution is given as:

$$f(x;\mu,\sigma) = \frac{1}{\sqrt{2\pi}\sigma_{\ln}x}\exp\left[-\frac{1}{2}\left(\frac{\ln(x)-\mu_{\ln}}{\sigma_{\ln}}\right)^2\right] \qquad (2)$$

Also, the probability value associated with the Cumulative Distribution Function (CDF) is as follows:

$$P[X \leq x] = \Phi\left(\frac{\ln(x)-\mu_{\ln}}{\sigma_{\ln}}\right) \qquad (3)$$

Where $\mu_{\ln}$ and $\sigma_{\ln}$ are the mean and standard deviation of $\ln(x)$ respectively.

Equation 2 was used to match the probability distribution presented by the N_γ value at different friction angles. It was found that the variability of the data has a

good correlation with the Lognormal distribution as shown in Fig. 4, where the data of the N_γ values for the different friction angles was plotted on the X-axis and the value on the Y-axis Lognormal probability.

Table 3: Tests for the estimation of N_γ probability Lognormal distribution

| ϕ (º)	Critical significance level	Testing				Decision
		Kolmogorov-Smirnov test		Anderson-Darling test		
		Critical value	Statistics	Critical value	Statistics	
5	0.05	0.17981	0.12815	2.5018	1.24130	The hypothesis should not be rejected
10	0.05	0.17981	0.09717	2.5018	0.72867	The hypothesis should not be rejected
15	0.05	0.17981	0.12073	2.5018	0.89589	The hypothesis should not be rejected
20	0.05	0.17981	0.11905	2.5018	0.80133	The hypothesis should not be rejected
25	0.05	0.17981	0.11198	2.5018	0.57770	The hypothesis should not be rejected
30	0.05	0.17981	0.15610	2.5018	0.93521	The hypothesis should not be rejected
35	0.05	0.17981	0.11978	2.5018	1.06750	The hypothesis should not be rejected
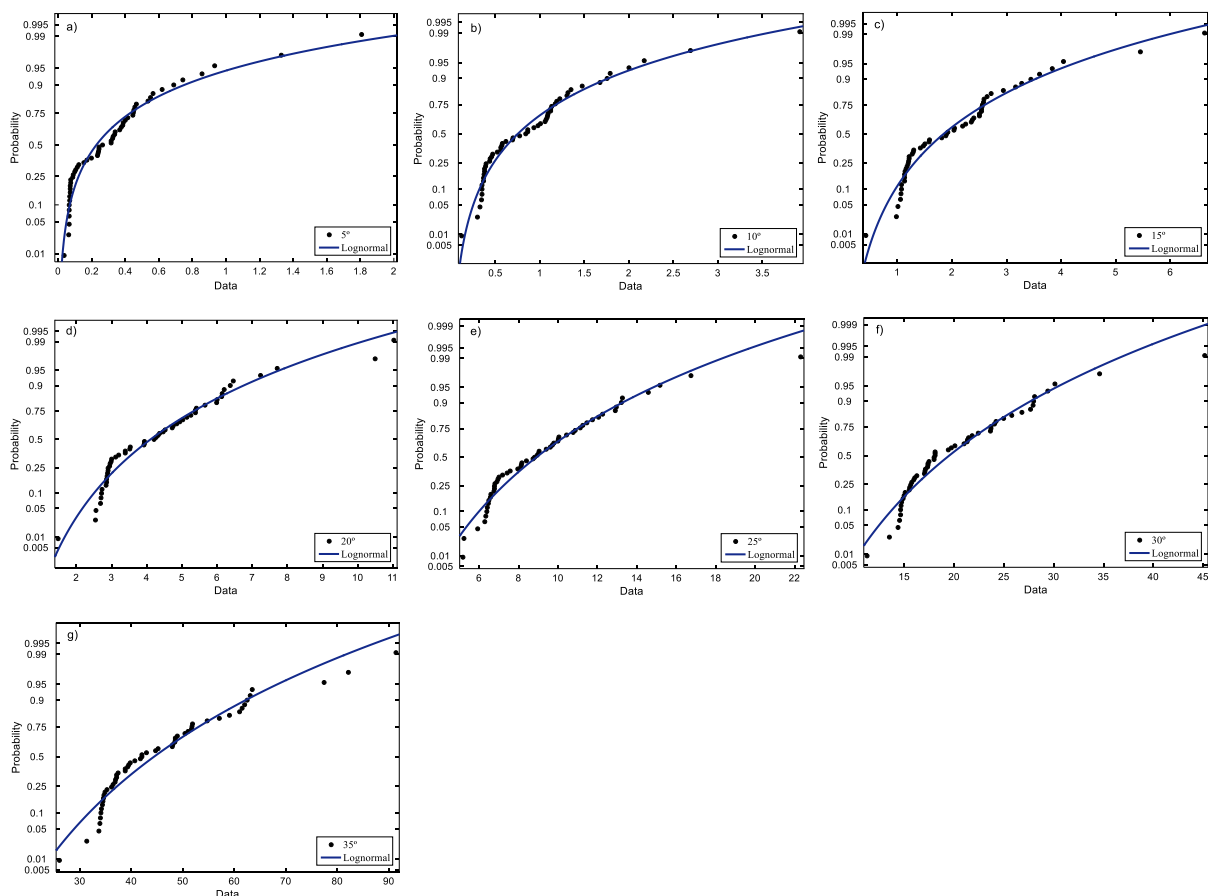
Fig. 4: Lognormal probability distribution curves for N_γ values for friction angles: a) 5º, b) 10º, c) 15º, d) 20º, e) 25º, f) 30º and g) 35º

III.   RESULTS

Based on the good correlation that exists between the Lognormal probability distribution, the data under study shown in the previous section and using equation 3 for the CDF, seven probability distribution curves were obtained for the friction angles 5º, 10º, 15º, 20º 25º, 30º y 35º, which are shown in Fig. 5.
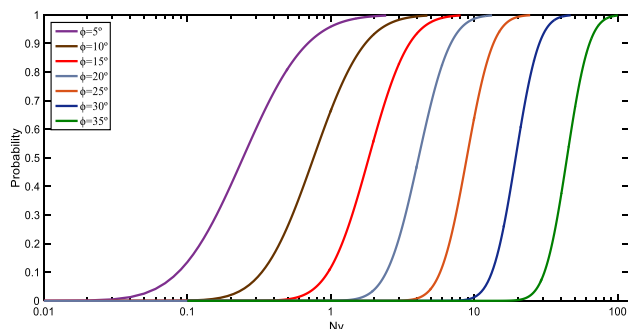

Fig. 5: Lognormal CDF of N_γ values for different friction angles

IV.   DISCUSSION

The curves shown in Fig.5 are commonly used to express probabilities of damage under a certain level of demand (Ahmed & Soubra, 2012; Popescu et al., 2005) but they are also used to express probability levels of different parameters as in Vessia et al. (2009) who used it in the dataset of bearing capacity of strip foundation or Chen et al. (2012) who used it in undrained shear strength. In this context, these curves allow access not only to select a single value, that is, to a characteristic value of the parameter N_γ; instead, select a value based on probabilities, under certain reliability that the user considers relevant, thus allowing to reduce the uncertainty when choosing which appropriate equation best estimates this parameter.

V.   CONCLUSION

In this article, the probability distribution of 55 approaches by various authors was investigated to obtain the N_γ value of the bearing capacity under the friction angles: 5º, 10º, 15º, 20º, 25º, 30º y 35º. The results are shown as follows.

There is great variability in obtaining the N_γ values through the 55 equations proposed by various authors, finding that this variation is proportional to the friction angle; that is, the greater the friction angle, the greater the variability of the estimated value of N_γ and vice versa.

Also, the N_γ values calculated for the friction angles mentioned above follow a suitable Lognormal probability distribution.

Finally, faced with the problems encountered in engineering, specifically concerning soils, it is very common to use a deterministic practical approach; however, in parameters with great dissertation such as the N_γ value, key in the bearing capacity, it is not advisable to choose a unique value knowing that there are currently different methodologies to calculate, in that sense, by incorporating previously verified CDF, in obtaining this parameter, it was found that the results are shown using a probabilistic approach reduce bias and uncertainty to characterize the value of bearing capacity, generating in decision making opt not only for a deterministic value based on a single formula but to choose one or more probable or appropriate values to the conservative quality required in a project.

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Quality of Life Assessment of Women with Urinary Incontinence, in two Health Clinics Schools in Porto Velho/RO

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Abstract—Objective: To evaluate the quality of life of incontinent women, as well as their epidemiological profile and complaints of higher prevalence, in two health clinics in Porto Velho - RO. Methods: Quantitative research, with cross-sectional design, carried out in women with complaints of urinary incontinence (UI) after 35 years of age. The questionnaire, King's Health Questionnaire (KHQ), was used, which measures the quality of life of this group through questions with ready answers, between the dates 23/09/2019 and 03/04/2020. Results: The evaluated samples were analyzed by Pearson's correlation coefficient, where the correspondence between the domains listed by the KHQ as predictors of quality of life and various urinary symptoms was observed, so that the main symptoms referred were UI, UI of effort, UI in sexual intercourse, nocturia and urgency. Which influenced, in particular, in the domains physical limitations, social limitations, emotions and sleep / mood. Discussion: UI affects the quality of life of women in several aspects, directly related to the voiding symptoms presented by patients, among which stress UI, UI during sexual intercourse, nocturia, urgency and voiding frequency stood out.

I. INTRODUCTION

Urinary Incontinence (UI) is a pathology known for its negative impact on different domains of a woman's life, not only at a physical level, but also at a psychological, emotional and social level, with substantial costs at an economic level [1]. According to the International Continence Society (ICS), urinary incontinence (UI) is defined as a condition in which there is a complaint of any involuntary loss of urine, being a social or hygienic problem that is often misinterpreted as a natural part of aging [2].

It is estimated that approximately 200 million people worldwide have some type of urinary incontinence (UI), the prevalence of which is twice as high in women than in

men, increases with age and varies widely, reaching up to 60% [3].

According to Magajewski FRL, et al. (2013), the main risk factors for UI in women described are age, obesity, parity, type of delivery, use of anesthesia during delivery, newborn weight, menopause, gynecological surgeries, intestinal constipation, chronic diseases, factors hereditary, drug use, caffeine consumption, smoking and physical exercise [4].

The involuntary loss of urine, often unpredictable or uncontrollable, can cause difficulties for women in carrying out their daily activities, whether at home or not, working, domestic or healthy living programs, in the case of physical activity, leading to frequent interruption of activities. same [5]. UI in women implies negative repercussions in their most varied contexts of life, at the physical, social, economic and psychological level, namely the decrease in self-esteem, being associated with modesty, embarrassment, social isolation [6].

It can lead to a clinical picture of depression, isolation and shame, thus changing social life [2]. This fact can also accentuate stress during work and reflect on the woman's emotional state [5].

For Carneiro JA, et al. (2017), the correct diagnosis is important in the evaluation and treatment of women with UI, as well as in determining the effect on the woman's Quality of Life (QOL) [7]. It should be noted that the impacts of UI are not restricted to the individual sphere, but are also related to the greater burden on caregivers.

The application of questionnaires to assess QOL has become frequent in recent decades, with generic and specific instruments emerging for certain pathologies [8]. In view of this, the International Continence Society recommends that QOL assessment measures be incorporated into clinical practice, thus valuing the patient's perception in relation to her health status [7].

Despite the involuntary loss of urine interfering devastatingly in the quality of life of women, female urinary incontinence continues to be under-diagnosed and under-treated [1]. It should be noted that UI is mistakenly seen as a natural aging process. However, it can be avoided, postponed and even treated [7].

The management of UI involves the assessment of the function of the Pelvic Floor Muscle (PFM), which can be performed manually or instrumentally. Assessing the function of PFM is of fundamental importance to enable a more efficient approach to UI, especially in elderly women, given the losses and changes that accompany even physiological aging [3]. Thus, a multiprofessional approach to prevention, evaluation and treatment is recommended, with a view to reducing the prevalence and benefits for individuals and their families [3].

Based on the above, this study aims to assess the quality of life of women diagnosed with urinary incontinence treated at two health clinics in Porto Velho - RO.

II. METHOD

This is a research with a quantitative approach, with a cross-sectional design, carried out in women over 35 years of age with a diagnosis of urinary incontinence.

The users were approached during the routine consultation, in two health clinics in Porto Velho - RO, and during the same question was asked about the desire to participate in the research, so that its purpose was explained. The patient who agreed to participate in the research was referred to a reserved place. At that moment, the patient received clarification about his participation in the research and about the IC, agreeing with the terms, signed it and then answered the questionnaire proposed with or without the researcher's help. After the patient signed the Free and Informed Consent Form (ICF), the form "Questionnaire on Quality of Life in Urinary Incontinence (King's Health Questionnaire)" was applied [9], in order to assess the quality of life of these women.

Pearson's coefficient was applied to establish the relationship between clinical UI parameters and the different domains validated by the KHQ, the results of this coefficient vary between -1 and +1, and the closer the result is to 1, negatively or positively, demonstrates a stronger relationship between the variables.

The research was approved by the ethics and research committee of Centro Universitário São Lucas under number CAAE 19906319.3.0000.0013 and opinion number 3.573.537 approved on September 13, 2019. The requested information was tabulated in the Microsoft Excel 2007 program, and after Quantitative and descriptive analysis of the results was carried out.

III. RESULTS

During data collection, 48 patients were interviewed, with an average age of 49.7 years, the youngest being 35 years old and the oldest being 77 years old. Of these, 60% (29 users - 60%) of the interviewed patients reported that the bladder problem did not interfere in their lives at all or little (Graph 1), demonstrating that the lack of knowledge about the subject and the understanding that UI is something physiological, is frequent among the population. Such data corroborate those of Câmara, et al

(2010), where 50% of the interviewees gave the same   importance   to   UI   [10].
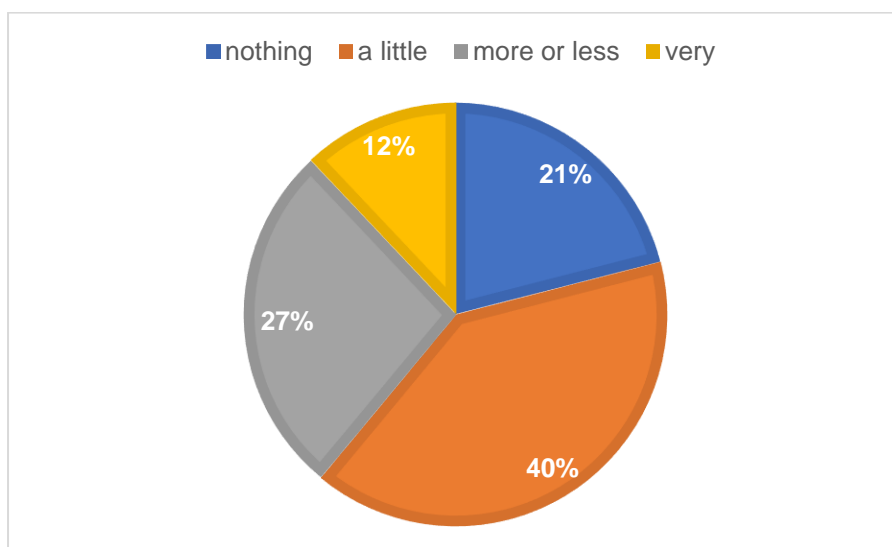
Graph 1. How much do you think your bladder problem affects your life.

Lopes, N. C. G., et al., 2021.

However, the questionnaire proved to be effective in elucidating the items that were relevant to the compromise of the patient's health status, related to UI. Thus proving to be a simple tool, however, with the possibility of great results when applied to the general population.

Of the patients interviewed during this study, most reported symptoms more related to mixed UI, followed by stress urinary incontinence (SUI) and lastly urgent urinary incontinence (UI) (Graph 2). Such data differ from large population studies in terms of the prevalence of UI types, but corroborate the results obtained by Faria, et al (2015), in which, most of the interviewees had mixed UI [5]. Furthermore, in the aforementioned study, there was a relationship between mixed UI and a worsening of the other domains analyzed in the research, such as limitation of daily activities, emotions and personal relationships, demonstrating greater degradation of quality of life in patients   with   mixed   UI.
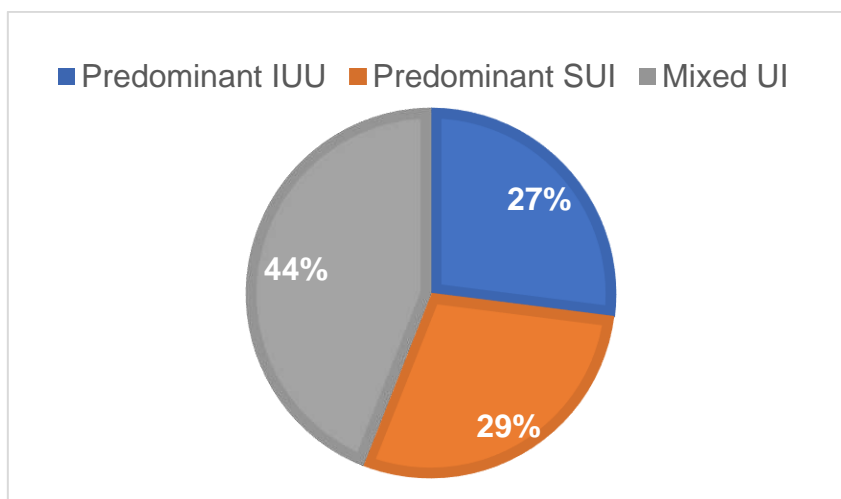
Graph 2. Most prevalent type of UI according to the reported symptoms.

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From data obtained through Pearson's correlation between clinical parameters and domains related to quality of life (Table 1), it was observed that physical limitations were related to the variables UI of effort and UI in sexual intercourse (0 , 43; 0.42), social limitations were related to nocturia (0.40), personal relationships were affected by nocturia, stress UI and UI during sexual intercourse (0.40; 0.42; 0.61) , emotions were related to urgency, UI of effort

and UI in sexual intercourse (0.42; 0.45; 0.47), sleep and disposition were related to nocturia (0.44) and the severity measures were correlated with voiding frequency, nocturia, voiding urgency and effort UI (0.41; 0.55; 0.52; 0.46). Such variables corroborate the work of Fonseca, et al (2005), who evaluated 54 patients aged between 34 and 82 years and obtained results similar to the present [9].

Table 1. Pearson's correlation between clinical parameters and the questionnaire domains.

Domain	Frequency	Nocturia	Urgency	Urinary Incontinence	Stress Urinary Incontinence	Nocturnal Enuresis	Incotinence in Sexual Intercourse	Frequent Infections	Bladder Pain	Number of Symptoms
General Health	-0,07	0,12	0,14	0,06	-0,04	-0,09	0,32	0,1	0,24	0,25
Impact of Incontinence	0,32	0,34	0,29	0,28	0,35	0,11	0,13	-0,09	0,17	-0,15
Limitations of Daily Activities	0,21	0,33	0,24	0,38	0,25	0,23	0,32	0,02	0,17	0,22
Physical Limitations	0,23	0,37	0,21	0,3	0,43	0,21	0,42	0,02	0,39	0,34
Social Limitations	0,05	0,4	0,15	0,27	0,39	0,3	0,38	0,04	0,18	0,26
Social Relationships	0,17	0,4	0,29	0,42	0,32	0,1	0,61	0,2	0,34	0,27
Emotions	0,17	0,34	0,42	0,45	0,37	0,31	0,47	0,09	0,31	0,26
Sleep/Mood	0,3	0,44	0,38	0,34	0,13	0,08	0,27	0,04	0,14	-0,16
Severity Measures	0,41	0,55	0,52	0,46	0,3	0,16	0,19	-0,08	0,23	0,19

Lopes, N. C. G., et al., 2021.

The items mental health, impact of incontinence and limitation of daily activity did not have any statistically significant variable (Table 1).

IV.   DISCUSSION

Analyzing such data, it is noted that the lives of patients are affected in several areas by UI, in this sense, each of these aspects has a relevant participation in the decline in their quality of life, and the more aspects are added, the more the quality of life is deteriorated.

In this way, the variables UI of effort, UI in sexual intercourse, nocturia, urgency and voiding frequency were highlighted in general. Demonstrating that, the patients who presented UI during sexual intercourse were also the most affected in terms of personal relationships, emotions and physical limitations, which expresses possible loss in conjugal and family relationships, which impacts on the patient's psychological.

Nocturia was related to social limitations and sleep / mood, where it shows the relevant impact on the quality of life of the affected people, due to frequent trips to the bathroom. Since this habit has a strong relationship with the lack of leisure outside its residential scope, corroborating the study by Rett, et al (2007) [11], in addition to the feeling of weariness or tiredness due to disturbed sleep. As mentioned in the study by Bueno 2006, sleep deprivation has an impact both on the psychological level and on the general physical state, causing indisposition to the patient's daily activities, with a consequent reduction in quality of life [12].

In addition, the domains of emotions and physical limitations were also related to SUI and urinary urgency, demonstrating not only physical impairment, but also how the event has affected the emotional state of the patient in question, corroborating the study by Rett, et al (2007) [11]. Still, according to this analysis, after undergoing physiotherapeutic treatment and an improvement in SUI and urinary urgency, there was a significant advance in

emotions, in addition to having minimal side effects and not precluding future surgical treatment.

In this context, it is observed that UI is due to a combination of physiological and emotional factors, negatively impacting the social, economic, domestic, occupational and sexual spheres, in order to disadvantage the quality of life of the individual with UI. Another related factor is feelings of vulnerability and incapacity, which lead to isolation, anxiety and depression in some patients, especially in elderly women, according to Oliveira, et al (2018) [13].

Despite the impact that UI has on the quality of life of incontinent patients, many do not have access to treatment, as there are psychological, physical and cultural barriers, in addition to feelings of hopelessness and embarrassment, as they have to report their condition to other individuals and professionals. Such circumstances only accentuate the difficulty of health professionals in detecting the pathology and consequently generate losses in terms of treatment and improvement in the quality of life of this target audience, which reinforces the study by Oliveira, et al (2018) and Perreira, et al (2019) [13, 14].

V.   CONCLUSION

In short, UI affects the quality of life of women in several aspects, directly related to the voiding symptoms presented by patients, among which the variables UI of effort, UI in sexual intercourse, nocturia, urgency and frequency of voiding stood out. . In this sense, an approach focused on these symptoms would be effective in improving the overall quality of life of this target audience. It is also emphasized the importance of carrying out educational and treatment actions, such as making the population aware of the existence, severity and ways of preventing UI, as well as instructing women to perform perineal strengthening exercises, which they act both in the prevention and in the treatment of incontinence. In this context, it is essential that new studies are carried out on the topic, covering women's health in an integral way in terms of quality of life and risks related to UI, thus facilitating early diagnosis and new strategies for approach and treatment.

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Criteria for requesting upper digestive Endoscopy in the diagnosis of dyspeptic Syndrome: A literature review

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Abstract— Dyspepsia is defined by any disorder of digestion in the gastrointestinal tract or gastric sensitivity, and is divided into two groups: secondary dyspepsia, which are specific lesions such as peptic ulcer, esophagitis, gastric cancer, and cholelithiasis that result from different diseases, and functional dyspepsia. For the diagnosis of functional dyspepsia, the Rome IV criteria should be adopted. For the diagnosis of functional dyspepsia, the patient must have one or more of the following symptoms: a nagging sensation of postprandial fullness, early satiety, epigastric burning, and no evidence of structural disease that would explain the symptoms. There are signs and symptoms that the physician must be alert to in order to investigate more serious diseases that require earlier therapeutic measures, such as neoplasms. These signs are characterized as "alarm signals" and among them are, for example: unintentional weight loss, dysphagia, odynophagia, persistent vomiting, hematemesis, family history of cancer of the gastrointestinal tract. The use of upper endoscopy is one of the most common methods for investigating dyspepsia, but it should not be requested for all patients indiscriminately. Given this, the objective of this research was to identify the alarm signs and analyze the main criteria used for the request of upper gastrointestinal endoscopy in dyspeptic patients in order to reduce the impacts before the investigation and clinical management performed. For this, a systematic review of the literature was performed from a search in the Scielo database, using the descriptors "upper digestive endoscopy" and "dyspepsia", finding a total of 15 studies published in the period 2010 to 2020 and after reading the title and abstract, 14 articles were selected for presenting greater relevance and affinity with the subject under study. The inclusion criteria used were productions in the public domain that dealt with the proposed theme, works written in several languages and productions available in full, thus excluding the

documents that did not meet the above criteria. The literature analysis allowed us to identify the main alarm signs and to identify the criteria used to request upper digestive endoscopy.

I. INTRODUCTION

Dyspepsia is any disorder of secretion, gastrointestinal motility, or gastric sensitivity that interrupts digestion and designates any changes related to the digestive system (MARÍA ET AL., 2018). It is generally benign and curable. The origin is not known, but it may be linked to emotional factor or disorder; and, in some cases, it may be due to a tumor process. According to Luporini et al., (2020), the ROMA IV consensus criteria classify dyspepsia as having an organic cause and a specific cause.

According to Leite et al. (2020), dyspeptic symptoms affect about one-third of the world's population and about 25% of dyspeptic patients have an associated organic cause. In contrast, most of these individuals have functional dyspepsia (FD), with symptoms arising from the gastroduodenal region in the absence of any explanatory organic disease.

Dyspepsia can still be characterized by pain or discomfort in the abdomen, affecting at least 20% of the world population and has multiple causes that can be benign or malignant pathologies. It is worth pointing out that when this discomfort/pain has not yet been studied, it is called uninvestigated dyspepsia (ZULETA et al., 2019).

The investigation of dyspepsia in primary care is one of the key points for reducing the consequences caused by its signs and symptoms. In addition, the need to investigate properly, requesting the necessary tests to qualified personnel, is of utmost importance for the conclusion of the diagnosis and treatment. (STANGHELLINI et al., 2016).

There are studies showing that the prevalence of uninvestigated dyspepsia can range from 7% to 45% worldwide. In addition, about 20-40% of the world's population has some dyspeptic complaint, such as epigastric pain, postprandial discomfort, and heartburn. (HYUK et al, 2014). The approach to adult patients can be of several forms, among which is the upper digestive endoscopy.

Upper digestive endoscopy is one of the most used exams for the investigation of dyspeptic patients; however, the choice of the procedure must take into consideration, for example, factors such as age and alarm signs, since these factors are important for the realization of differential diagnoses, such as neoplasms (MCNICHOL ET AL, 2012). Besides this, when selecting the patient, the risks must also be evaluated, even if minimal, because there are diseases and morbid conditions that can be contraindications and that can even make the exam difficult (BAJAJ ET AL, 2020).

In this context, the objective of this study is to identify the alarm signs and analyze the main criteria used to request upper gastrointestinal endoscopy in dyspeptic patients in order to reduce the impacts on the investigation and clinical management performed.

II. MATERIAL AND METHODS

This work is a systematic review of literature of a descriptive nature, with a qualitative approach, which focuses on the knowledge produced and published in books, journals and articles about the criteria used to request upper digestive endoscopy in dyspeptic patients' records. It is worth pointing out that bibliographical research is a fundamental step in all scientific work that will influence all the stages of research, aiming to compare studies that can reach a conclusion or provide new lines of thought within the theme addressed.

Thus, a bibliographical survey was carried out in Scielo databases, using the following descriptors in English: upper digestive endoscopy AND dyspepsia.

In the search, 15 studies were found, published in the period from 2010 to 2020, and after reading the title and abstract, 14 articles were selected for presenting greater relevance and affinity with the theme under study. The inclusion criteria used were productions in the public domain that dealt with the proposed theme, works written in several languages and productions available in full, thus excluding the documents that did not meet the above criteria.

III. RESULTS AND DISCUSSION

Dyspepsia is according to María (2018), any functional alteration of the digestive system that is generally benign and curable. It is further defined as any disturbance of digestion either by disturbance of secretion, gastrointestinal motility or gastric sensitivity. Dyspepsia is divided into two groups: a secondary one that is defined by specific lesions, such as peptic ulcer, esophagitis, gastric cancer, and cholelithiasis that result from distinct diseases, and functional dyspepsia (RAMIREZ-VASQUEZ, 2018). According to Leite (2020), these symptoms affect about one third of the world's population.

According to Mikito (2010), dyspepsia is defined as digestion disorders in the upper gastrointestinal tract and has symptoms such as pain, burning in the abdominal region, postprandial stuffiness, nausea, vomiting and abdominal distension, which may or may not be related to food or stress. However, when in the diagnosis, it is not possible to identify the cause by the symptoms, there is the functional dyspepsia, which is characterized by periods of slowdowns and exacerbations. Some of the symptoms that may have associations with functional dyspepsia are: chronic or recurrent pain, burning or discomfort, nausea, vomiting, and abdominal distension.

Thus, it is important to identify the alarm signs and analyze the main criteria used to request upper gastrointestinal endoscopy in dyspeptic patients. Therefore, table 1 shows a summary of the articles selected with the respective authors, journal published, and year of publication (Table 1).

*According to its source language

Table 1 – Studies addressing alarm signs and criteria for requesting upper endoscopy.

Title	Authors	*Journal/Year
Endoscopic and Histopathological Patterns in Dyspeptic Patients at the Maputo Central Hospital, Mozambique	Modcoicar et al.	Jornal Português de Gastrenterologia/2011
Comparison of sequential therapy with standard triple therapy in the eradication of Helicobacter pylori	Zuleta et al.	Jornal Português de Gastrenterologia/2011
Sensitivity of gastric biopsy in detecting Helicobacter pylori in patients treated with proton pump inhibitors	Azaña et al.	Revista Médica Herediana/2012.
Relatives of gastric cancer patients have a high frequency of hypochlorhydria and premalignant gastric lesions	Zuleta et al.	Revista Colombiana de Gastroenterología/2014.
Double-pylorus in the era of proton pump inhibitors	Mansur et al.	Revista de Gastroenterología del Perú/2014.
A day of upper digestive endoscopy in a southern European country	Areia et al.	Jornal Português de Gastrenterologia/2014.
Approach to the patient with dyspepsia and functional dyspepsia: update	Otero et al.	Revista Colombiana de Gastroenterología/2014.
Early vs. gastric cancer advanced: are there any differences?	Gomez et al.	Revista de la Universidad Industrial de Santander. Salud /2015.
Gastric xanthomas are associated with malignant and premalignant injuries	Alonso et al.	Revista Colombiana de Gastroenterología/2015.
Validation of the rapid urease test for the detection of Helicobacter pylori at the Hospital Nacional Cayetano Heredia, Lima, Peru.	Idelfonso et al.	Revista de Gastroenterología del Perú/2017.
Morphological changes of the upper gastrointestinal tract in patients with new onset dermatomyositis: correlation with	Amorim et al.	Medical Express/2017.

demographic, clinical and laboratory characteristics	
Endoscopic dissection of the submucosa in the treatment of initial esophageal cancer Ughelli et al.	Revista de Gastroenterología del Perú/2017.
Association of duodenal eosinophilic infiltrate with Helicobacter pylori infection, but not with functional dyspepsia Leite et al.	Arquivos de Gastroenterologia/2020.
Malignant peritoneal mesothelioma as a rare cause of dyspeptic complaints and ascites: a diagnostic challenge Sousa et al.	GE – Jornal Português de Gastrenterologia/2020.

Dyspepsia symptoms have a high prevalence in the population and represent a large number of important causes of Primary Health Care consultations, which bring high costs of a socioeconomic nature and a major health care problem (MODCOICAR ET AL., 2011).

According to the aforementioned authors, there is a direct relationship between patients with dyspeptic complaints and Helicobacter pylori infection. This infection is more common in developing countries, with poverty being one of the most important factors for its spread. The routes of transmission can be oro-oral, gastrooral, or feco-oral. It can be acquired during childhood associated with facilitated transmission conditions, in addition to gastric diseases such as chronic gastritis, peptic ulcer disease, lymphomas, and gastric cancer.

H. pylori is an agent involved in a large number of gastrointestinal pathologies. According to Zuleta et al (2011), it affects more than 50% of the world's population and its prevalence is higher in developing countries.

In the above work, patients with functional dyspepsia who had not received previous H. pylori eradication treatment, aged between 19 and 70 years were referred for upper digestive endoscopy, and soon after the confirmation of the etiologic agent, the patients were randomized through a list to receive two treatments which were: A1- Omeprazole 40 mg/day + clarithromycin 1 g/day + amoxicillin 1 g/day. And A2- Omeprazole 40 mg/10 days + amoxicillin 2g/5 days. In the last five days, amoxicillin was replaced by tinidazole 1g/day + clarithromycin 1 g/day.

Nevertheless, in both treatments, low success was found, according to the author, it may have been because of the use of generic drugs, indicating the need for conducting similar studies with reference drugs, in addition to antimicrobial resistance in the studied population. Despite this, Chaves et al. (2017) showed no differences in the efficacy of reference and generic drugs when comparing the activity of azithromycin.

According to Azaña et al. (2012), one of the most frequent reasons for visits to the health service is chronic pain or discomfort defined as dyspepsia, recurrent in the upper abdomen. There are some strategies proposed for the treatment of dyspepsia such as the use of empirical therapy like H2 receptor antagonists and proton inhibitors, the use of non-invasive tests or referral for endoscopy. According to the author, there is a worldwide prevalence of 65% of Helicobacter pylori infection.

According to Zuleta et al. (2014), there are several alarm symptoms that may suggest presences of a tumor or complicated organic disease, some of the symptoms are: upper abdominal pain relieved by defecation associated with change in stool (either in color or shape), upper pain that bothers/worsens with eating, weight loss, anemia/digestive bleeding, and dysphagia. According to the author, the main approaches followed in patients with PD are: immediate endoscopy when there are alarm signs/symptoms, empirical treatment with antisecretory drugs, and investigation and treatment for Helicobacter pylori when positive.

According to Mansur et al. (2014), gastrointestinal abnormalities can be found during upper digestive endoscopy, with double pyloric disease being a rare, relatively benign abnormality with a prevalence between 0.06% and 0.4% and often associated with peptic ulcer of the stomach or duodenum, diseases of the respiratory system, chronic renal disease, or diabetes mellitus. Moreover, according to the author, H. pylori eradication is recommended because it prevents the formation of new ulcers and improves fistula healing.

According to Areia et al. (2014), upper digestive endoscopy is poorly described and the data found are poorly reflected in clinical decisions, besides being a relevant option for surveillance of asymptomatic high-

risk patients. In addition, the most frequent indications for this type of examination were presence or suspicion of bleeding (20%), abdominal pain or dyspepsia (18%) or reflux (12%). In a study conducted where a high prevalence of gastric lesions and H. pylori was expected, positivity for H. pylori was found to be present in 38% (95% CI: 25-51%) meaning that two-fifths of the population are positive for H. pylori. According to Areia, decision analysis studies are needed to evaluate upper endoscopy as a surveillance option for these asymptomatic patients at risk.

According to Zuleta et al., (2014), gastric cancer (GC) is a pathology that has a major impact on global morbidity, its prognosis is poor, as it has a survival rate of less than 10% in most patients. Intestinal gastric cancer is the most common, and has more risk factors identified, such as infection by H. pylori that is the etiologic agent in at least 90% of cases, so early detection through upper digestive endoscopy is extremely important.

The eradication of infection should be verified by non-invasive methods, such as respiratory test for urea or fecal antigens, four weeks after the end of the antibiotic, the author also mentions that some drugs are effective and recommended for the treatment of DF, but the studies are still few (ZULETA ET AL., 2014).

According to Gomez et al., (2015), gastric cancer has a high prevalence and mortality in Colombia, it is the fourth most present cancer worldwide, and when detected early, once the survival is 5 years in the neoplasm group is almost 100%, whereas advanced gastric has a survival of almost 10% and the diagnostic method for detection is high digestive endoscopy, but unfortunately in several countries less than 5% of patients are detected at an early stage. Furthermore, the study showed that in patients with uninvestigated dyspepsia, gastric cancer was found in 9% of patients, according to the author, in patients with dyspepsia, the detection rate of lesions by upper digestive endoscopy confers a better prognosis.

Gomez et al (2015), in another paper, cites another comorbidity, gastric xanthomas, which are gastrointestinal lesions, incidentally found in upper digestive endoscopy in the mucosa of any part of the gastrointestinal tract, but are more frequent in the stomach, is associated with increasing age of the patient, and in some cases, the origin of xanthomas although uncertain, may be linked to chronic gastritis, H. pylori infection and diabetes mellitus, do not produce definite symptoms. Previously, it was very rare, but with the massification of upper digestive endoscopy, there are more and more reports. In the study by Alvaro et al, H. pylori infection was found in 42.3% of the patients, in the

work of Hori et al, they observed almost this same rate of infected, in which infection was observed in 48% of a total of 145 patients (GOMEZ ET AL, 2015).

For patients with dyspeptic symptoms, the diagnosis of H. pylori infection, which initially is a superficial process, and may worsen to what is called chronic active gastritis, can be made by various methods requiring endoscopy, which are grouped into 2 types: the invasive ones, such as histopathological studies, the high urease test (HUR), culture and polymerase chain reaction; and the non-invasive ones, the breathalyzer test, serology and stool antigens (IDELFONSO ET AL., 2017).

Dermatomyositis (DM), is a rare systemic autoimmune disease, which is characterized by systemic proximal, symmetrical, progressive limb weakness and the presence of typical skin lesions. Presenting symptoms are constitutional, joint, cardiac, pulmonary, and gastrointestinal tract involvement. When the upper gastrointestinal tract is affected in patients with DM, they may be asymptomatic or have symptoms such as dysphagia, heartburn, nausea, vomiting, abdominal distension, and upper abdominal pain (AMORIM ET AL., 2017). Moreover, according to Amorim et al. (2017), the management and guidance of these gastrointestinal disorders in the sample performed of patients with DM relate to upper digestive endoscopy, focused on the need for prevention of esophageal and gastroduodenal lesions in these patients besides being relevant to guide potential digestive changes.

In a study of an 80-year-old patient with a oneyear history of dyspepsia who had esophageal lesions that were identified by endoscopy, and the use of chromoendoscopy, the author mentions that upper digestive endoscopy can be used as control and follow-up so that the lesions are treated at an early stage (UGHELLI, 2017). Moreover, according to Ughelli et al., (2017), by means of upper digestive endoscopy, one can diagnose patients with neoplastic lesions achieving definitive, safe and effective treatment, although it is not free of complications such as risk of perforation, hemorrhage and emphysema.

Functional dyspepsia is a multifactorial disease, in which about one third of the world population has dyspeptic symptoms (LEITE ET AL, 2020). H pylori infection is very common in southern Brazil, and it may be directly associated with functional dyspeptic patients. The hypothesis of DF etiology may include gastroduodenal motility disorders, gastric hypersensitivity, H. pylori infection (leading to pain, muscle spasms), and psychosocial distress, but must be

adapted from person to person. H. pylori infection, affects more than two thirds of functional dyspeptic patients. According to the author, different populations are influenced by local genetics and microbiota, and these factors directly influence.

According to Sousa et al., (2020), malignant peritoneal mesothelioma is a rare disease of the cells of the peritoneum, and pleural mesotheliomas are the most frequent. In the early stages of the disease, clinical manifestations are nonspecific, approximately 8% of patients are diagnosed accidentally. The patient evaluated in this case, was a 53-year-old male, a former smoker, with a previous 5-year exposure to asbestos and who had a family medical history of mesothelioma. The patient who was initially evaluated, reported 3 months of dyspeptic complaints (abdominal pain, early satiety, nausea and vomiting). Upper digestive endoscopy revealed H. pylori microorganisms.

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Identifying students' prior knowledge to enable Meaningful Learning

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Abstract— Success in the learning process is a complex phenomenon that is established by several causes. In view of this, students 'prior knowledge takes on a relevant role in their explanation, thus, seeking means and methods that make it possible to identify this knowledge is fundamental and makes teachers equipped with this information consider the students' prior knowledge in the mediation of learning. In this way, leading their students to meaningful learning. With this, the present study presents the results obtained from the application of a questionnaire developed as an instrument to identify the pre-existing knowledge of students in Professional Distance Education courses. Thus, it is intended to contribute with teachers in the formulation of learning situations that take into account students' prior knowledge, thus resulting in a teaching-learning process that provides students with meaningful learning. For this, a descriptive and quali-quantitative case study was carried out. Which is divided into three sections: in the first, conceptualization of prior knowledge and meaningful learning is done, as well as discussing the recognition of previous knowledge; in the second, the research method used is presented; and finally, in the third section, the results obtained are presented and discussed. the research method used is presented; and finally, in the third section, the results obtained are presented and discussed. the research method used is presented; and finally, in the third section, the results obtained are presented and discussed.

I. INTRODUCTION

This study aims to present the results obtained in the application of a questionnaire used to identify previous knowledge of students in Professional Distance Education courses in order to promote meaningful learning. Processes like this, become valid, since contemporary teachers need to be aware of students' difficulties and that learning is no longer based on a bank education proposal, in which they believe that the teacher is the center of the teaching-learning process and that the student must receive ready-made information and fully replicate it.

Thus, the teaching-learning process becomes more effective when new knowledge is incorporated into the student's pre-existing knowledge, as this recognition contributes to meaningful learning. Therefore, the teacher in his pedagogical practice, must observe the historical, cultural and social facts, as well as understand which methods should be used to promote this type of learning.

In order to corroborate this new reality, the objective of this article will be to discuss a proposal to identify students' previous knowledge to provide meaningful learning, structured in theoretical frameworks Ausubel [1], Freire [2], Cavaco [3], e Moreira [4]. For this, this study was organized in addition to the introduction and final considerations, in three sections, in the first one, conceptualization of previous knowledge and meaningful

learning is done, as well as discussing the recognition of previous knowledge; in the second, the research method used is presented; and finally, in the third section, the results obtained are presented and discussed.

II. PRIOR KNOWLEDGE FOR MEANINGFUL LEARNING

When we start from the following statement: "If I had to reduce all educational psychology to a single principle, I would say this: The single most important factor that influences learning is what the learner already knows. Find out what he knows and base his teachings on it "[1], the importance of prior knowledge is noted.

Thus, establishing the concept of prior knowledge and deepening its definition is fundamental for a better understanding of this study. Prior knowledge is that characterized as declarative, but it presupposes a set of other procedural, affective and contextual knowledge, which also configure the learner's previous cognitive structure [5] In this way, it is understood that it is the combination of an individual's pre-existing attitudes, experiences and knowledge.

The definition of prior knowledge is discussed in more detail by Bransford, [6], when they stated that "children begin in the preschool years to develop sophisticated understandings (whether accurate or not) of the phenomena around them". Such initial understandings have a powerful effect on the integration of new concepts and information. However, these understandings can be accurate, providing a basis for building new knowledge, and are interpreted as prior knowledge, or they can be inaccurate, which are called misconceptions.

Thus, identifying students' prior knowledge is an essential element to assist the school team in ensuring that students have a solid foundation, promoting meaningful learning. By valuing the students' pre-existing attitudes, experiences and knowledge, one breaks with the culture of banking education, which advocates the educator as the one who always knows and while the students are always the ones who do not know [2]. With that, it opens the way for problematizing education or education for freedom [2].

In this way, it provides meaningful learning, as established by Moreira:

> It is important to reiterate that meaningful learning is characterized by the interaction between previous knowledge and new knowledge, and that this interaction is non-literal and non-arbitrary. In this process, new knowledge acquires meaning for the subject and previous knowledge acquires new meanings or greater cognitive stability [4].

With this, developing resources and structuring methods to identify the knowledge that students already bring to the teaching-learning process becomes viable and extremely important, as it will provide teachers with instruments to better conduct learning, making each student be perceived in its potentialities and possible points for improvement.

III. RECOGNITION OF PRIOR KNOWLEDGE

A further point in this discussion is not only to identify previous knowledge, but that this knowledge is recognized, as explained by Inácio and Salema when stating that the recognition process aims to value the adult's experiential learning, allowing him to obtain school certification and / or professional through the validation of skills acquired throughout life. Corroborating this idea, [3] says that the learning processes are interdependent on the accumulation of experiences, making it pertinent to recognize and validate the learning that people carry out throughout their lives.

The process of recognition, validation and certification of knowledge acquired throughout life is present in education policies in several European countries [7]. Thus, these countries in their School Systems, have structured methods for the recognition, validation and certification of knowledge [3]; [7]; [8].

Given the above, the importance of recognizing the knowledge acquired throughout life is perceived, whether in the use of teachers to provide meaningful learning in the teaching-learning process or in school and / or professional certification. However, it is noteworthy that the present study is structured in an ausubelian and vigotskian conception will focus on the first possibility, that is, on the recognition of students' previous knowledge carried out by teachers to provide meaningful learning.

IV. RESEARCH METHOD

This research is a case study, as it exposes a research carried out in a specific place and reality, as [9] puts it. The case study is a research strategy that comprises a method that encompasses everything in specific collection and analysis approaches. Dice. It has a descriptive character, due to the collection, analysis and interpretation of data; exploratory, because it aims to discover the profile and previous skills of students and qualitative and quantitative nature. Its qualitative nature is justified because it aims to identify different profiles of individuals [10], and quantitative, by the use of structured data [11].

The present study was carried out in a Professional and Technological Education Teaching Institution from May

2020 to August 2020. As a data collection instrument, a questionnaire using Google forms was applied to students entering five distance technical courses, which had 28 closed and open questions. The questionnaire link was made available in the virtual learning environment - AVA, and the tutors had sent messages and made calls to students, asking them to answer the questionnaire.

V.   DISCUSSION AND RESULT

The application of the questionnaire obtained 109 respondents, who are new students in distance technical courses in: Industrial Automation, Electrotechnics, Logistics, Automotive Maintenance, Computer Networks and Work Safety, in several schools throughout the state of Goiás of the researched Educational Institution. Through the responses obtained, it was possible to establish the profile of the students and whether they already had previous skills linked to the courses they were starting.

Most students are male, as shown in Graph 1. Of these 51% are not married and 59% do not have children. Regarding the age group, 48% are between 21 and 30 years old.

Graphic. 1: Sex
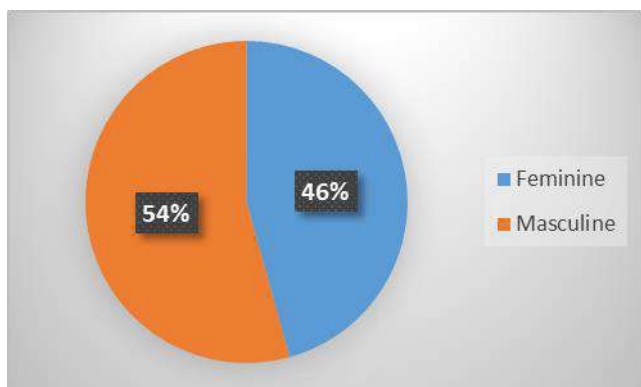
Source: authors (2020).

Regarding the level of education, 58% of students have completed high school, and the vast majority come from public schools, as shown in Graph 2. On the other hand, when observing the level of employability, 72% are employed. And the salary range varies from 1 to 3 minimum wages, as shown in Graph 3.

Graphic. 2: School Origin
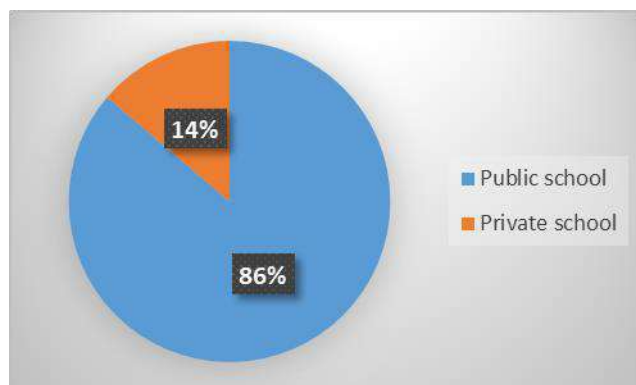
Source: authors (2020).

Graphic. 3: Salary range
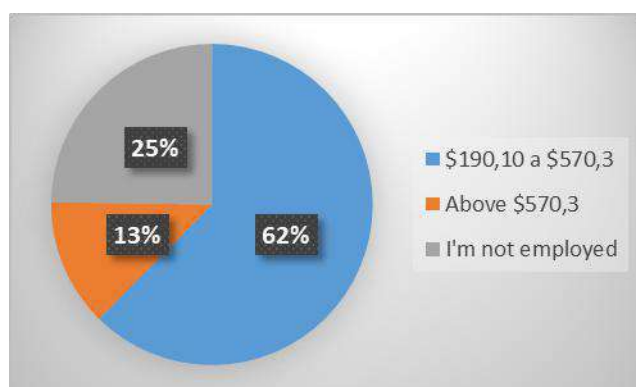
Source: authors (2020).

When verifying computer and internet accessibility, he identified that 90% of students have a computer, 85% access the internet at home and that 93% also use their cell phones to access the internet, as shown in graph 4.

Graphic. 4: Another form of internet access
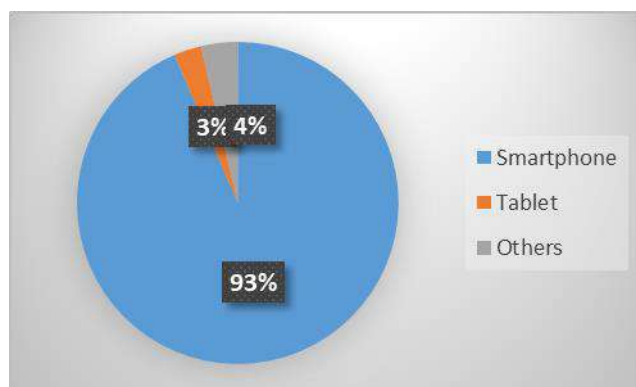
Source: authors (2020).

Another important factor observed in this study is that 62% of the students answered that the availability for study is during the night period, and that 61% have to travel up to 30km to face-to-face moments at school and use different means for that, as shown in the graph 5.

Graphic. 5: Driving to the Classroom

Source: authors (2020).

Graphic. 6: Q. 1 and 2: Basic concepts
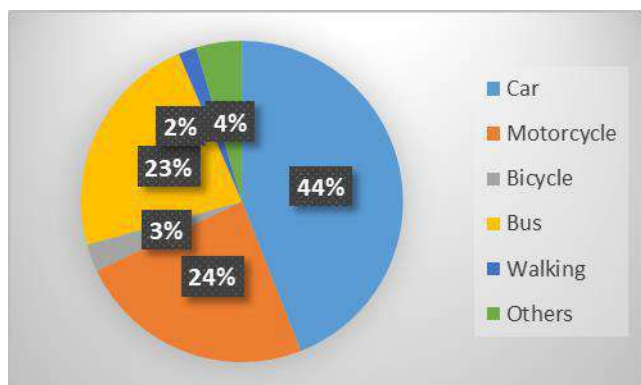
Source: authors (2020).

It should be noted that the results related to the profile of the students are in agreement with the profile presented of the students of technical courses and distance courses, as far as the majority are men, it is motivated by the area of the courses covered, as [12], there is a marked predominance of men, among students in the areas of hard sciences, technology, engineering and mathematics. In addition to this fact, in professional training according to [13], men had higher percentages than women.

Another common point is in relation to employability, which when observing the CensoEaD.BR - 2016/2017, of the Brazilian Association of Distance Education - Abed, shows that most students work. It is also noteworthy, regarding the forms of access, the [14], shows that among Internet users aged 10 or over, 94.6% connected via cell phone.

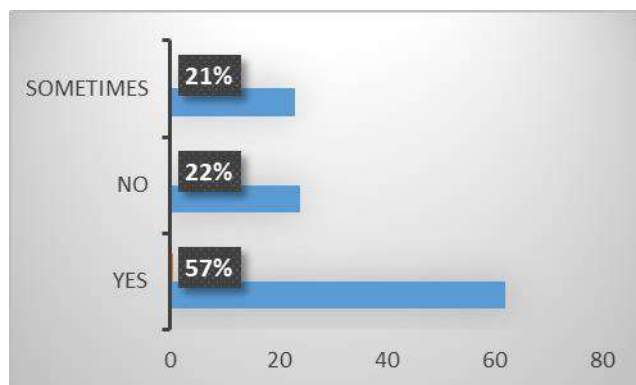In order to identify whether students had previous skills linked to the technical distance courses they would take, eight questions were asked involving concepts: basic, medium and advanced. Such questions were linked to the students' daily situations, so that they could measure in a coherent way the level of experience with the approached concept. Thus, through the answers we can establish the level of prior knowledge of each student.

In this way, we obtained the following results, with respect to the basic concepts we demonstrate in Graph 6, referring to the average concepts we expose in Graph 7 and already with regard to advanced concepts, it is described in Graph 8.

Graphic. 7: Q. 1 and 2: Average concepts
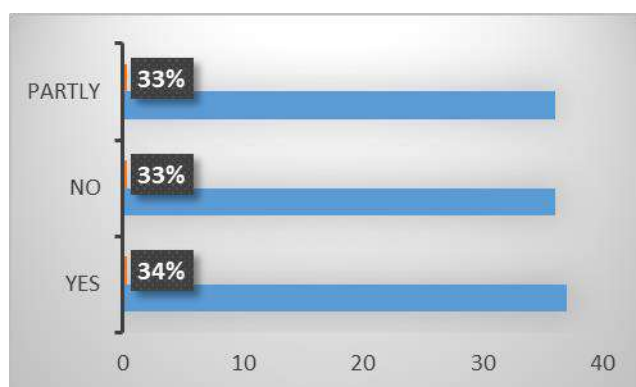
Source: authors (2020).

Graphic. 8: Q. 1 and 2: Advanced concepts
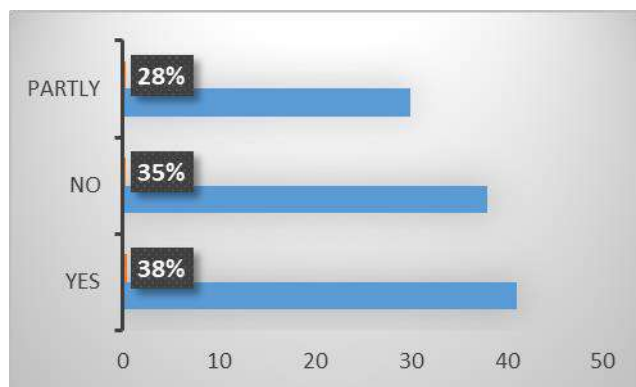
Source: authors (2020).

When verifying that 78% of students have basic concepts, 67% average concepts and 66% advanced concepts in the area of the course they were entering, it is clear that students have, to some extent, previous knowledge, thus strengthening the ausubelian approach and Vygotskian who advocates that teachers should take such knowledge into account in order to devise ways that provide students with meaningful learning.

VI.   CONCLUSION

The result obtained in this research meets the objective that was advocated when the questionnaire was developed and applied it to the students right at the beginning of the courses, which was to identify their profile and their previous skills linked to the professional training they were entering. Because, with this information, learning situations and activities were developed according to the reality of each student, thereby stimulating everyone's learning. In this way, significant knowledge was obtained through the management of this prior knowledge.

However, it is known that the results obtained with this research are only a small step, given the great journey that we have to travel, towards a meaningful learning. Because, developing resources, methods, forms, etc., so that we can take into account the students' experience is fundamental in the teaching-learning process. Only in this way will we be successful in building education that is emancipatory for individuals, allowing them to have a critical awareness of the reality to which they are inserted.

ACKNOWLEDGEMENTS

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Social Distancing and University Teaching in the middle of the Covid-19 Pandemic: Implications and Benefits

Distanciamento Social e a Docência Universitária em meio à Pandemia de Covid-19: Implicações e benefícios

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Abstract— *This manuscript analyzes teaching in higher education in times of pandemic. In the process of its composition, it sought to systematize the evidence on the implications and benefits of social detachment in the COVID-19 pandemic, given the complete configuration of its implementation in Brazil. It is a bibliographic and documentary research, of a qualitative interpretive nature. Regarding the conditions for the effectiveness of classes in higher education, it is suggested that the social distance adopted by the population is essential to reduce serious cases of diseases and deaths caused by the virus. It is understood that, for the effectiveness of teaching in higher education, measures of social distance and social protection policies are necessary to guarantee the population the maintenance of life.*

I. INTRODUCTION

É fato incontestável que a Pandemia provocada pela disseminação do coronavírus (SARS-CoV-2)[1] acarretou

mundo inteiro com graves problemas respiratórios (O GLOBO, 2021) e tendo ocasionado mais de 300.000 (trezentas mil) mortes no Brasil (MINISTÉRIO DA SAÚDE, 2021), esse cronotopo pandêmico demanda da ação conjunta do poder público em suas variadas esferas de proteção social, mas também a qualificação

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[1] A pandemia de Covid-19 tornou-se uma problemática complexa e de alta gravidade, que afetou diretamente a vida de pessoas no

medidas protetivas e de contenção da saúde pública, o que acabou exigindo dos profissionais que mantivessem a atitude ética do distanciamento social (necessário) (OMS, 2021; BRASIL, 2021). Evidencia-se que, para alguns setores comerciais, seria impossível fechar as portas, a exemplo dos sistemas sanitário e hospitalar. É então que surge, nessas condições de alarme, desequilíbrio emocional e vulnerabilidade social, a imprescindível atuação da Estratégia de Saúde da Família (ESF) que, além de atuar na prevenção, promoção e manutenção da Saúde, conforme descreve a Política Nacional da Atenção Básica (BRASIL, 2012), age como "porta preferencial de entrada para os usuários que necessitam ter acesso as Redes de Atenção à Saúde (RAS)" (Oliveira et al., 2021, p. 45364).

No entanto, setores não menos importantes, porém mais adaptáveis nesse período de ebulição (Medeiros, 2005), como a Docência do Ensino Superior, precisaram se reinventar, de forma ética e responsiva (Silveira; Santana, 2020), em um processo de adaptação às condições de produção em que se inserem os discursos em torno da vida e da morte (UFVJM, 2020). Desse modo, a partir do momento em que a população se viu configurada em condições pandêmicas (PAHO, 2021), ação conjunta do poder público em suas variadas esferas de proteção social (Oliveira et al., 2021), precisou criar ações e medidas que horizontalizassem o acesso à saúde pública e promovessem a permanência profissional via distanciamento social.

Esse é o foco de nosso estudo: realizar um estudo descritivo-analítico que discuta sobre a Docência no Ensino Superior em tempos pandêmicos. No processo de sua composição, procurou sistematizar as evidências sobre as implicações e benefícios do distanciamento social na epidemia de COVID-19, diante de toda a configuração de sua implementação no Brasil. Trata-se de uma pesquisa bibliográfica e documental, de cunho qualitativo interpretativista.

Para consolidação de nosso estudo, dividimos o manuscrito em duas seções. A primeira consiste na *metodologia da pesquisa*, em que detalhamos o estado da arte da pesquisa. A segunda insere em discussão a docência no ensino superior em meio ao distanciamento social.

de profissionais da saúde para o enfrentamento das sequelas advindas pela contração do coronavírus.

II. ASPECTOS METODOLÓGICOS DA PESQUISA

Esta seção abarca a metodologia da pesquisa, em que traçamos o percurso de sua classificação. Quanto à abordagem, a pesquisa se constitui qualitativa, pois é caracterizada pela qualificação dos dados coletados e sua interpretação. "Assim, os pesquisadores qualitativos recusam o modelo positivista aplicado ao estudo da vida social, uma vez que o pesquisador não pode fazer julgamentos nem permitir que seus preconceitos e crenças contaminem a pesquisa" (Goldenberg, 1997, p. 34). Na percepção de Goldenberg, "A pesquisa qualitativa não se preocupa com representatividade numérica, mas, sim, com o aprofundamento da compreensão de um grupo social, de uma organização etc." (Goldenberg, 1997, p. 34).

No percurso de nossa pesquisa, incidimos sobre uma população de oito (oito) estudos científicos, tendo em vista o cronotopo dos últimos 5 (cinco) anos. No entanto, apenas 4 (quatro) artigos estiveram na base de nossa pesquisa, sendo essa a nossa amostra, a qual se explicita no quadro a seguir:

Quadro 1: Amostra de estudos Distanciamento Social e Docência Universitária

ARTIGO CIENTÍFICO	*OBJETIVO GERAL*
Santana, W.K.F; Oliveira, R. L et al., 2021. "Docência no ensino superior: questões teórico-metodológicas em tempos pandêmicos", **International Journal of Development Research**, 11, (04), 45918-45921.	Discutir sobre a docência no Ensino Superior em tempos pandêmicos, focalizando aspectos da identidade profissional tanto da saúde quanto da educação e setores interdisciplinares.
Garrido, F. A. Z et al., Docência universitária durante a pandemia da COVID-19: um olhar do Chile. **Revista Docência do Ensino Superior**, Belo Horizonte, v. 10, p. 1–9, 2020.	Apresentar um relato livre sobre uma experiência pessoal de docência universitária durante a pandemia da COVID-19 no contexto do sistema universitário chileno.
Fior, C A; Martins, M. J. A docência universitária no contexto de pandemia e o ingresso no ensino superior. **Revista Docência do Ensino Superior**, v. 10, p. 1-20, 2020.	Analisar as características da docência universitária na pandemia de Covid-19 que favoreceram a transição de estudantes ao ensino superior.
Aquino, E. M. et al. Medidas	Averiguar possíveis

de distanciamento social no controle da pandemia de COVID-19: potenciais impactos e desafios no Brasil. **Ciência & Saúde Coletiva,** v. 25, p. 2423-2446, 2020.	impactos e desafios provocados pela Pandemia no Brasil, e refletir sobre medidas de distanciamento social no controle da pandemia de COVID-19.

Fonte: dados coletados pelos autores no Portal Regional da BVS

Nossos critérios de seleção para o presente estudo estiveram na delimitação do tema que centralizasse discussões em torno da Docência Universitária e do Distanciamento Social. O manuscrito *Docência no ensino superior: questões teórico-metodológicas em tempos pandêmicos* (Santana et.al, 2021), na medida em que discute sobre a docência no Ensino Superior em tempos pandêmicos, focalizando aspectos da identidade profissional, reconhece a natureza complexa e dinâmica que conduz à configuração de representações subjetivas acerca da profissão docente, e com intensidade no período da pandemia provocada pelo coronavírus.

O estudo *Docência universitária durante a pandemia da COVID-19: um olhar do Chile* (Garrido, 2020) delimitou como objetivo apresentar um relato livre sobre uma experiência pessoal de docência universitária durante a pandemia da COVID-19 no contexto do sistema universitário chileno. Já a pesquisa *A docência universitária no contexto de pandemia e o ingresso no ensino superior* (Fior; Martins, 2020) se propôs a analisar as características da docência universitária na pandemia de Covid-19 que favoreceram a transição de estudantes ao ensino superior. Em vias paralelas, com uma proposta voltada para o distanciamento social, o manuscrito *Medidas de distanciamento social no controle da pandemia de COVID-19: potenciais impactos e desafios no Brasil* (Aquino et al., 2020) remonta a uma discussão que averigua possíveis impactos e desafios provocados pela Pandemia no Brasil, e reflete sobre medidas de distanciamento social no controle da pandemia de COVID-19.

Já que o movimento teórico-analítico do estudo agrega natureza teórica, entendemos que se trata de um trabalho de cunho bibliográfico. Defendem Marconi e Lakatos (1992) que "A pesquisa bibliográfica é o levantamento de toda a bibliografia já publicada, em forma de livros, revistas, publicações avulsas e imprensa escrita" (Marconi; Lakatos, 1992, p. 75). Desse modo, "A sua finalidade é fazer com que o pesquisador entre em contato direto com todo o material escrito sobre um determinado assunto, auxiliando o cientista na análise de suas pesquisas ou na manipulação de suas informações" (Marconi; Lakatos, 1992, p. 75).

Diante de tais considerações, sequencia-se esta pesquisa com uma discussão teórica sobre o distanciamento social e a docência universitária em meio à pandemia de Covid-19.

III. DISTANCIAMENTO SOCIAL E A DOCÊNCIA UNIVERSITÁRIA EM MEIO À PANDEMIA DE COVID-19

Iniciamos com um pequeno painel de acontecimentos que constituíram as exigências de distanciamento social. Após os primeiros casos de divulgação de casos de "pneumonia de causa desconhecida" (OMS, 2019) em Wuhan, na China, em 30 de dezembro de 2019, grande parte dos países europeus e americanos, por meio de seus Ministérios de Saúde, solicitaram esclarecimentos à OMS (CONASEMS, 2020). Assim, no decorrer do ano de 2020, gerido um quadro evolutivo de epidemiologia no mundo inteiro, centros universitários e núcleos escolares precisaram abnegar do estado presencial de aulas, adaptando-se a um sistema de aulas remotas - à distância (Fior; Martins, 2020; Garrido, 2020).

Em um período de alastramento da doença em vastos campos do planeta terra, sistemas de vigilância laboratorial, na medida em que explicitavam casos suspeitos, descartados, confirmados e superados, decretaram a necessidade de Distanciamento Social como uma das formas mais eficazes de conter a disseminação do coronavírus (BRASIL, 2021; Wilder-Smith; Freedman, 2020)[2]. Torna-se, então, válido, mencionar algumas medidas protetivas e de contenção da Covid-19:

> O isolamento de casos; o incentivo à higienização das mãos, à adoção de etiqueta respiratória e ao uso de máscaras faciais caseiras; e medidas progressivas de distanciamento social, com o fechamento de escolas e universidades, a proibição de

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[2] Nota pública da *Secretaria de Estado de Saúde de Minas Gerais* enfatiza que "O **distanciamento social** é uma das medidas mais importantes e eficazes para reduzir o avanço da pandemia da covid-19. A doença é causada pelo vírus SARS-CoV-2, mais conhecido como o novo coronavírus. A transmissão ocorre de pessoa para pessoa, pelo ar ou por contato pessoal com secreções contaminadas, como: gotículas de saliva, espirro, tosse, catarro, contato pessoal próximo, como toque ou aperto de mão, contato com objetos ou superfícies contaminadas, seguido de contato com a boca, nariz ou olhos. Esse vírus tem a capacidade de ser passado de uma pessoa infectada para outra, mesmo que ela não apresente nenhum sintoma. Nesse sentido, apenas a **prevenção adequada** com o distanciamento social, o uso de máscaras e correta higienização das mãos, pode nos proteger" (BRASIL, 2021).

> eventos de massa e de aglomerações, a restrição de viagens e transportes públicos, a conscientização da população para que permaneça em casa, até a completa proibição da circulação nas ruas, exceto para a compra de alimentos e medicamentos ou a busca de assistência à saúde (Aquino et al.,, 2020, p. 2424).

Na perspectiva dos autores supracitados, essas medidas, que incluem o isolamento social[3], têm sido implementadas de modo gradativo, no entanto, seus resultados, irão depender de aspectos socioeconômicos, culturais, de cumprimento de regras prescritas pelos Sistemas de Saúde.

> Sua implementação na realidade brasileira é sem dúvida um grande desafio. As marcantes desigualdades sociais do país, com amplos contingentes em situação de pobreza e a parcela crescente de indivíduos vivendo em situação de rua, aliados ao grande número de pessoas privadas de liberdade, podem facilitar a transmissão e dificultar a implementação do distanciamento social. Além disso, a grande proporção de trabalhadores informais exige que, para assegurar a sustentabilidade e a efetividade das medidas de controle da COVID-19, sejam instituídas políticas de proteção social e apoio a populações em situação de vulnerabilidade (Aquino et al.,, 2020, p. 2424).

Quando, então, pensamos na configuração da Docência Universitária em meio ao distanciamento social, precisamos compreender que se trata de um corpo coletivo cujos sustentáculos continuam agindo e funcionando à distância, sem danos à vida nem à saúde da população. Garrido especifica o caso do Chile e menciona que "el sistema universitario ha funcionado con regulaciones flexibles que han permitido que una parte de él pudiese orientar sus actividades" (Garrido, 2020, p. 3). Tal enredo não teve o Brasil, país devastadoramente atingido pelo coronavírus (BRASIL, 2020; OMS, 2020), em que "O ensino remoto trouxe novas demandas à

docência universitária e evidencia preocupações com a possibilidade de essa situação excepcional potencializar desigualdades" (Fior; Martins, 2020, p. 4). Concordamos com Fior & Martins (2020), uma vez que as condições de trabalho dos docentes e dos discentes envolvem um repertório socioeconômico, cultural, e de saúdes física e mental, em um hall de efetividade de políticas públicas (IBGE, 2020).

> Entende-se, portanto, que a docência universitária na pandemia vive uma excepcionalidade e as práticas pedagógicas influenciam a transição do estudante para o ensino superior, podendo tanto facilitar o ingresso nesse nível de ensino como criar barreiras que dificultem tal adaptação. Dessa forma, permanecem indagações sobre as características da docência universitária remota e das adaptações realizadas que favoreceram o ingresso dos estudantes ao ES (Fior; Martins, 2018, p. 05).

Em nosso ponto de vista, na medida em que são evidenciadas "preocupações em relação ao aumento das desigualdades, faz-se necessário repensar as condições de trabalho dos docentes e dos discentes, já que o domínio e acesso às novas tecnologias, "de situações econômicas, sociais e de saúde física e mental são distintas" (Fior; Martins, 2018, p. 03). Santana et al., (2021, p. 45.018) defendem que "a docência não é algo acabado nem fechado, mas uma atividade em processo, uma construção epistemológica, didática e profissional, que agrega uma mescla de saberes que se articulam".

Autores como Cohen (2020) e Mahasen (2020) nos ajudam a compreender que o fechamento de escolas e universidades, medida adotada por todos os países, tem sido muito debatida. As crianças raramente adoecem por COVID-19 e não está claro com que frequência elas desenvolvem infecções assintomáticas e transmitem o vírus (Aquino et al., 2020). Alguns dos efeitos negativos da continuidade de ida em sistemas presenciais seriam o aumento do número de pessoas que tem contato com avós idosos e um possível colapso na Universidade. Por essas razões, na Áustria, Holanda e Inglaterra, as escolas foram fechadas, exceto para filhos de trabalhadores em setores essenciais, como os profissionais de saúde (Cohen, 2020; Mahase, 2020).

Em nosso ponto de vista, em um momento em que o Brasil é gestado pela seccionalidade em diversos ramos trabalhistas para contenção do coronavírus e efetividade do distanciamento social (Aquino et al., 2020), a Docência Universitária também precisa ter seus atos

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[3] Para Aquino, "O isolamento é a separação das pessoas doentes daquelas não infectadas com o objetivo de reduzir o risco de transmissão da doença. Para ser efetivo, o isolamento dos doentes requer que a detecção dos casos seja precoce e que a transmissibilidade viral daqueles assintomáticos seja muito baixa. No caso da COVID-19, em que existe um maior período de incubação, se comparado a outras viroses, a alta transmissibilidade da doença por assintomáticos limita a efetividade do isolamento de casos, como única ou principal medida" (Aquino et al., 2020, p. 2424)

concretos vinculados às prescrições advindas dos campos da saúde, por meio de seus Sistemas, afinal de contas, o que tem sido mais eficaz são "a quarentena, o distanciamento social e as medidas de contenção comunitárias" (Wilder-Smith; Freedman, 2020, p. 27). Tal processo de reestabelecimento da população, especificamente de docentes universitários, constitui um *continuum* de desafios, mas que têm superado diversas expectativas em decorrência do fator inovação.

Em linhas não findas, corroboramos o pensamento de Santana et al., (2021), que consideram que independente dos campos aos quais Docência Universitária vinculada, a identidade profissional se afigura num processo evolutivo de experiências. Essa perspectiva, para os docentes, deve ser pensada e articulada em meio às novas demandas.

IV.   CONCLUSÃO

No que diz respeito às condições cronotópicas atuais para efetividade das aulas no sistema de docência universitária, sugere-se que o distanciamento social seja adotado pela população até que haja redução dos casos. Esse posicionamento assumido reflete ações imprescindíveis para diminuição dos casos graves de doenças, e mortes provocadas pelo vírus. Deve-se considerar, conforme nos orientam Aquino et.al., (2020), que a pandemia da COVID-19 ainda está em fase de contenção, e especificamente no Brasil une-se a um cenário de crise política, "agravada pela troca do Ministro da Saúde, coloca mais incertezas quanto às políticas que serão adotadas pelo Governo Federal" (Aquino et.al., 2020, p. 2443).

Compreende-se que, apesar de todos os sintomas vivenciados por docentes nos mais diversos ramos de saber, para efetividade da Docência no ensino superior, são necessárias medidas de distanciamento social e de políticas de proteção social no intuito de garantir à população o mantimento da vida.

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Application of entrepreneurship in small businesses

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Abstract— The present work aims to know the importance of entrepreneurship as a business strategy. The field research was carried out with camelodromo/popular trade entrepreneurs, Palmas-TO, Brazil. The field research was conducted in the month of October 2014, with a universe of research 40 popular trade entrepreneurs, of whom 35 contributed to the survey with a sampling of 87.5% of the interviewees. The data were tabulated, presented in the form of graphs, thus making a descriptive and critical analysis of the results. Entrepreneurs are satisfied with their ventures and most are aware of the foster agencies.

I. INTRODUCTION

Undertake represents a social action and not the only individual because it involves a team of employees, suppliers and a variety of customers in a value chain that needs to be properly integrated and consolidated over time [1]. The word "entrepreneur" comes from the French entrepreneur, which means an individual willing to invent or reinvent something without fear of the risks he will take. It can be affirmed that entrepreneurial actions have existed since an early age when man began to create several ways to live better. The entrepreneur makes it happen, seeks to achieve his goals always seeking innovations in better conditions, and if he fails, he will see this as the learning and not a defeat. According to Vale et al. (2014) [2], most research aims to show the prevalence of need or opportunity as the main reason for entrepreneurship. Some have suggested that there is no such dichotomy; other reasons may interfere with the interaction between them.

Entrepreneurship is the involvement of people and processes that together lead to the transformation of ideas into opportunities, whose implementation leads to the creation of a successful business. The growth of entrepreneurship in the world accelerated in 1990 and increased in proportions in 2000, which can be observed in the actions developed related to the theme. Some examples are incubation programs for companies and technological parks; government subsidies for the creation and development of new businesses; creation of an agency to support entrepreneurship and business generation;

debureaucratization and access to credit for small businesses, among others [3]. According to Barros et al. (2017) [4], and discusses Entrepreneurship and Education, referencing the teacher who dedicates efforts daily to prepare citizens to meet and respond to the demands demanded by the world of work. We tried to know the positions of teachers regarding the importance of entrepreneurship as a strategy for teacher training.

The entrepreneurship movement in Brazil began to take shape in 1990 when entities such as the Brazilian Micro and Small Business Support Service (SEBRAE) and the Brazilian Society for Software Export (SOFTWARE) were created. According to Brandão et al. (2018) [5], and she article aims to show the evolution of factors that influence corporate entrepreneurship through the analysis of variables (e.g. entrepreneurial activity, perceived opportunity, and perceived capacity) that interfere in the innovation process and entrepreneurship in Brazil.

Before that, there was practically no talk of entrepreneurship and the creation of small businesses. The political and economic environments of the country were not conducive, and the entrepreneur could hardly find information to assist him on the entrepreneurial journey [6]. According to Chiavenato (2012) [1], entrepreneurship reflects the 'generation of wealth within a country, promoting economic growth and improving the living conditions of the population. Ac- cording to Santos et al. (2016) [7], this article aims to 'demonstrate the social, cultural and financial values that contribute to the development of an entrepreneurial culture'. Considering that the entrepreneur is someone who has perseverance, has energy, sets goals and does everything to achieve them; which is innovative and creative and, mainly, that knows and likes what it does, the text came from the question: "In the 21st century, that sociocultural and financial values contribute to the development of an entrepreneurial culture?", with the conviction that entrepreneurship is important in the Brazilian business and socioeconomic landscape in the face of the world context.

The entrepreneur is not only a founder of new companies, the new business builder or current business booster. It delivers energy that moves the entire economy, leverages changes and transformations, produces the dynamics of new ideas, creates jobs and drives talent and skills. It is the person who starts and/or streamlines a business to carry out a personal idea or project taking risk and responsibility and continuously innovating [1]. According to Souza et al. (2013) [8], and site work is a study on entrepreneurship in university management, in which a theoretical overview of the approaches and lines of the study identified in the literature on the subject is presented. The entrepreneur, in essence, is the person who can idealize and accomplish new things [9].

Based on the constant technological progress, companies aim to reformulate their production systems to suit the competitive market, since the changes required by the new economic context have reached the profile of the strength of determining the need to adapt to this newly competitive market [10]. According to Carreira et al. (2015) [11], the growing increase in the number of women entrepreneurs in various business branches, changes in their role in society and their achievements were the factors that guided the development of this work, whose objective is to present the profile of the interviewed entrepreneurs, their personal characteristics, as occurred the development of their enterprise, as well as their current and future view on their respective business. The way of restructuring that reaches all sectors of the economy has an innovative character, however employees who cannot level the requirements of the process become impossible for wage work in companies, because, through the adversities found in the current context, employees have faced numerous difficulties in their admission and consolidation in the salaried labor market [10]. Searching for work alternatives on its own has significant growth.

It is noteworthy that there are some characteristics present in successful entrepreneurs, which were cited by Dornelas (2007) [12] being as follows: Visionaries – In addition to seeing the future of their business and life, they are also able to make safe and correct decisions at the right time, including in times of adversity, which is a determining factor in success. They make a difference – They modify something difficult to define, an abstract idea, into something concrete, with functionality, transforming what was once considered impossible into reality. Besides, they add due value to the services and products they put on the market. They are determined and dynamic – they program their actions with total commitment, trampling adversity, overcoming obstacles, possessing an odd desire to "make it happen". They always remain dynamic and cultivate a certain nonconformism in the face of routine.

They are optimistic, organized, independent always seeking to build their destiny, create something new and determine their steps, open their paths, be the boss himself and generate jobs.

They create value for society – since entrepreneurs use their intellectual capital to create value for society, with job creation, boosting the economy and innovating, always using their creativity in search of solutions to improve the lives of people.

Thus, the following question was raised: entrepreneurship as a business strategy generates positive results? To obtain answers to the question raised, a survey was conducted with the entrepreneurs of the popular trade de Taquaralto, Palmas-TO, during October 2014.

The popular trade (Arca) of Taquaralto is located in the center of the Taquaralto district of the capital Palmas-TO, in a great commercial point due to the large flow of people who pass through the site daily, thus contributing to the sales of products and services offered. The authentication of this popular trade was the result of political investments. In 2008, Mayor Nilmar Ruiz, to legalize entrepreneurs who sold their products on the sidewalks of the shops of Taquaralto, donated the land to popular trade, and the following year its successor, Mayor Raul Filho, made the construction of tents for each entrepreneur.

However, the tents were built canvas and were not worth the entrepreneurs' businesses, because they could not withstand the winds and rains of the region. Dissatisfied with this situation was formed by the association of Palmas-TO entrepreneurs to seek improvements for the business. Currently, each entrepreneur has its place legalized and structured without concern with heavy rains and winds. Each pays its energy fee and the association collects a fee that is intended for cleaning, security, and organization of the site. The water used is provided without a charge fee by the city.

The present work aims to know the importance of entrepreneurship at the popular trade-in Palmas-TO, as a business strategy.

II. MATERIALS AND METHOD

For Marconi & Lakatos (2010) [13], research is a systematic, controlled and critical reflexive procedure that allows us to discover new facts or data, relationships or laws, in any field of knowledge. Research, therefore, is a formal procedure, with a method of reflective thinking, that requires scientific treatment and constitutes the way to recognize reality or to discover partial truths.

For Andrade (2006) [14], research is the set of systematic procedures, based on logical reasoning, which aims to find solutions to proposed problems, through the use of scientific methods.

This work is based on bibliographic research, qualitative and quantitative research, and interviews at the popular trade de Taquaralto, Palmas-TO. Thus, it follows the characteristics of the research, as well as the methodological instruments, the research subjects, and the data collected for analysis and interpretation.

To show the importance of entrepreneurship as a business strategy, field research was conducted in October 2014 with the entrepreneurs of the popular trade de Taquaralto, Palmas-TO.

According to Marconi & Lakatos (2010) [13], field research is used to obtain information and/or knowledge about a problem, for which an answer is sought, or a hypothesis, that is intended to prove, or discover new phenomena or the relationships between them.

One should select and enunciate a problem, taking into account the appropriate methodology; present the objectives of the research, without losing sight of practical goals; establish the sample correlated with the research area and the universe of its components; establish the experimental and control groups; introduce stimuli; control and measure effects. Then, the following tools were used to perform this research.

1. Bibliographic research: It is based on the collection of material from several authors on a given subject. Bibliographic research is a general survey on the main works already carried out, coated with importance because they can provide current and relevant data related to the theme.

Qualitative research: It is concerned with analyzing and interpreting deeper aspects, describing the complexity of human behavior. It provides a more detailed analysis of investigations, habits, attitudes and behavior trends.

Quantitative research: Quantitative research considers that everything can be quantifiable, which means translating into numbers, opinions, and information to classify and analyze them [13].

In the preparation of questions from a questionnaire, it is essential to take into account that the informant will not be able to count on additional explanations of the researcher. For this reason, the questions should be very clear and objective [14].

According to the definition of Marconi & Lakatos (2010) [13], a questionnaire is a data collection instrument, consisting of an orderly series of questions, which must be answered in writing and without the presence of the interviewer.

The interview is a meeting between two people, so that one of them obtains information about a particular subject, through a conversation of a professional nature.

The sample is a conveniently selected portion of the universe (population); is a subset of the universe. This study had as a research universe about 40 (Forty) entrepreneurs located at the popular trade of Taquaralto, Palmas-TO, of which 35 (thirty-five) contributed to the survey with a sampling of 87,5% of the interviewees. The

failure to reach 100% of the survey was the lack of contribution of some of the interviewees. Thus, workers perform their activities as the owner of their own business believing this is a great choice.

According to Marconi & Lakatos (2010) [13], an analysis is an attempt to highlight the relationships between the phenomenon studied and other factors. These relationships can be established according to their cause-effect, producer-product, related properties of content analysis. Interpretation is the intellectual activity that seeks to give a broader meaning to the answers, linking them to other knowledge.

The research was conducted at the popular trade Arca Terminal the Taquaralto, Palmas-TO. The Questionnaire of Silva et al. (2014) [15] was applied for data collection.

The research had open and closed questions; then they were tabulated, placed in tables to facilitate the representation and verification of responses and assembled graphically, thus making a descriptive and critical analysis of the results.

III. RESULTS AND ANALYSIS

Regarding the gender of the interviewees, 66% are male and 34% female. Data from the research conducted by Silva et al. (2014) [15], in the same popular trade, presented a percentage of males (52%), and females (48%). Male entrepreneurs in 2013 have a lower percentage compared to 2014. A 14% increase was observed in the field research. This increase occurred due to the entry of new entrepreneurs and men taking the place of women in the popular trade.

As for the marital status of entrepreneurs, 43% are married, then singles with 29%, 6% stable union and 11% separate and/or widowers. In the survey by Silva et al. (2014) [15], 40% married and 35% single. Comparing the number of married people was higher in 2013 than in 2014.

Regarding education, 31% of entrepreneurs have complete high school, then come with completed higher education with 26%, 14% completed elementary school, 11% incomplete higher education, 6% with incomplete elementary school, incomplete high school, incomplete high school, and not literate. Entrepreneurs seek through higher education knowledge for better management of their business.

Regarding the age of entrepreneurs, 37% of entrepreneurs are between 21 and 30 years old, 26% between 31 and 40 years old, 11% (up to 20 years), 11% (between 41 and 50 years), 9% (51 to 60 years) and 6%

(over 60 years). Noting that entrepreneurship has been developed by younger and younger people.

As for the main sector of activity of entrepreneurs (Figure 1), trade is the predominant sector with 66% and that the services sector with 34%. When compared to the survey by Silva et al. (2014) [15], 65% of trade, 35% services, it is noted that in 2014 there was a small decrease in the amount of entrepreneurship in commerce, but that this model of entrepreneurship remains on the rise.
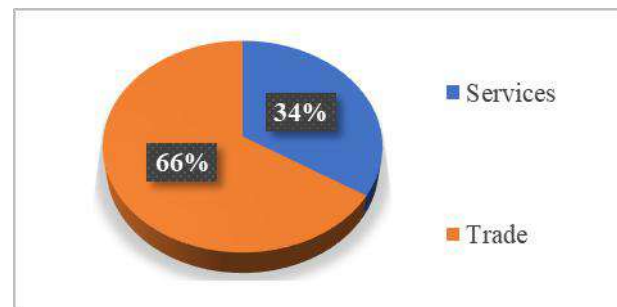
Fig.1: Mainsector of activity of popular trade entrepreneurs.

Regarding the degree of satisfaction of entrepreneurs in the current situation of the business, 31% say they are very satisfied, 63% satisfied and 6% dissatisfied due to financial problems. What is understood that most have had good results with their enterprise? In the survey by Silva et al. (2014) [15], 55% very satisfied and 35% satisfied. The percentage of "many satisfied" was lower than that shown in the research by Silva et al. (2014) [15]. You can understand that maybe it's the current financial situation that is experiencing.

As for the reasons for the assembly of the entrepreneurs' own business (Figure 2), 29% was due to necessity/unemployment, and the desire to own a business (29%). It is then noted that entrepreneurship is seen as a good deal.
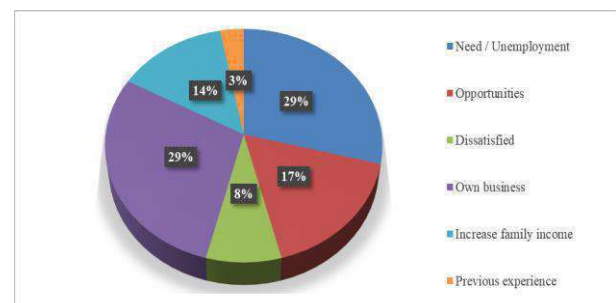
Fig. 2: Reasons to set up popular trade entrepreneurs' own business.

Unemployment, retirement, willingness to have their own business, are causes that lead people to

entrepreneurship. With each experience, personal and professional, regardless of the result, people are strengthened, matured and more aware of what they can face [16].

As for the knowledge of entrepreneurs about the promoter of microenterprises, it presents a percentage of 80% of those who know about the fomentation (E.g. SEBRAE). This percentage is higher than Silva et al. (2014) [15], which presents 70% with knowledge about programs that foster institutions provide. Comparing, there was an increase in the knowledge of the promoting agencies.

Entrepreneurs updated with their business information allows higher profitability rates. The other 20% are unaware of the focus on microenterprises. They may be new entrepreneurs or those who are accommodated.

The knowledge of entrepreneurs about the benefits of fomentation is great, with 91% informed and 9% uninformed. In the research by Silva et al. (2014) [15], 75% knew the benefits that the fostering provides to entrepreneurs. Comparing the two surveys there was an increased knowledge of the benefits offered, which helps in improving business.

Regarding the improvements in the entrepreneurs' businesses, 40% of the interviewees say that after the participation of programs that promote entrepreneurship improved the quality in services/products, which motivates more programs aimed at entrepreneurship (Figure 3). These programs are of paramount importance for business improvement.
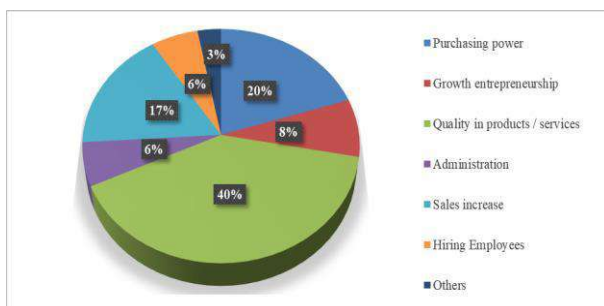

Fig. 3: Improvements in the business of popular trade entrepreneurs.

In the survey by Silva et al. (2014) [15], 30% stated that after participating in the training programs for entrepreneurs in Palmas-TO, there was a growth in the quality of their products and services. Comparing the research, the number increased in the quality of products and services after the participation of the training programs.

Promoting improvements in products and services offered to customers or even promoting innovations, creating new business and opportunities in the market is a means of increasing profitability [17].

Often the circumstances that promote the development of such characteristics are the improvement of professional activities through the initiative of the entrepreneur in the face of the challenge required by the need for their continuous stay in the market [10].

As for the main advantages of the legalization of entrepreneurs, 40% believe that the biggest advantage is having their business regularized and 26% is having access to credit which facilitates investment (Figure 4). In the survey by Silva et al. (2014) [15], 35% stated that the regularization of the business was one of the advantages after legalizing, then 30% said it was access to credit and 15% the social security benefits. Comparing the research, the advantage of having the regularization of the business increased.
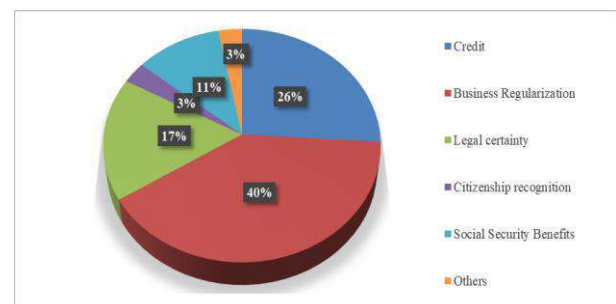
Fig. 4: Main advantages of the legalization of popular trade entrepreneurs.

As for the favorable scenario for the emergence of new entrepreneurs at popular trade, 97% say that Palmas is a capital that favors entrepreneurship because it is a place in growth, while 3% believe that the scenario is not favorable. In the survey by Silva et al. (2014) [15], 100% said that the city of Palmas has a favorable environment for the emergence of new entrepreneurs. Comparing the research, the city of Palmas shows a favorable environment for new entrepreneurs.

According to the entrepreneurs interviewed, 49% say that in order for an improvement in the business, it is necessary to develop more projects of financial plan in order to teach how to manage and acquire working capital, and 37% say that the creation of partnerships government would also increase business growth (Figure 5).
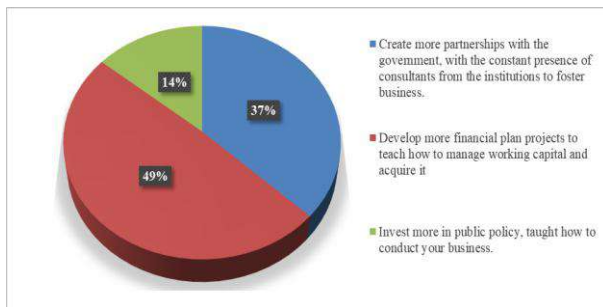
Fig. 5: Developmentof business improvements of popular trade entrepreneurs.

In the survey by Silva et al. (2014) [15], 45% of microentrepreneurs said they should develop more projects of financial plan, in order to teach how to manage working capital and acquire it, already 25% said they need to make more partnerships with the government, with the constant presence of consultants of the institutions in the business.

Comparing research, there has been an increase in both of those who say that for business improvement it is necessary to develop more projects of the financial plan to teach how to manage and acquire working capital the also those who say that the creation of partnerships with the government would also increase business growth.

IV.   CONCLUSION

1 Assuming that entrepreneurship generates positive results for those who are undertaking, for the economy of the city and the country, it is concluded that the vast majority of entrepreneurs of the popular trade de Taquaralto, Palmas-TO, are satisfied with their business because they had an increase in their family income and in the satisfaction of achieving a challenge of having their own business, these being the main reasons that led the interviewed entrepreneurs to invest in their enterprise.

2   Considering   positive   the   statement   that entrepreneurship as a business strategy generates positive results by leading people to have their own business because they make dreams come true because it allows job opportunities because it generates sources of income. There are many advantages to undertaking. However, there are difficulties, doubts, challenges, and especially the collection and demand by both customers and the owners themselves, thus determining that the quality in products /services and greater purchasing power are the points that need improvements in their enterprises.

3 Finally, according to the majority of respondents, Palmas-TO presents itself as a favorable scenario for the emergence of new entrepreneurs in the popular trade, enabling the positive results mentioned to be generated, as

well as profitability, mainly with the help that foster agencies offer to entrepreneurs.

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Qualitative analysis of microbiological reports of Minas Frescal Cheese observed in a dairy from 2017 to 2020 in the municipality of Dourados-MS

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Abstract— Available to the consumer an innocuous product, without the presence of any type of pathogen, It has to be the goal of any type of industry that produces and markets, foodstuffs for human consumption. Throughout this study, dozens of authors, in their respective works, have alarming rates of contamination of Minas Frescal cheese. Conduct an analysis of the results of official reports, collected by the state inspection service, of routine microbiological examinations in a dairy in the municipality of Dourados MS, in the period from 2017 to 2020, was the objective of the present study, to quantify the results of CONFORM / NON CONFORM reports of thermotolerant coliforms, count of Staphylococcus spp., mold and yeast research, Salmonella spp. and L. monocytogenes. In the period studied were analyzed 212 reports results conducted by state inspection service, resulting in 11 reports (5.18%) reports NOT CONFORM. Although the index is very small, when compared to the works mentioned here, it's necessary for the industry in its production and storage processes of its products, to observe and put into practice by all its employees the Good Manufacturing Practices. In addition, with regard to the work performed by the official inspection service, it should be noted that the procedures for inspecting the production and marketing of any and all products intended for human consumption are of paramount importance.

I. INTRODUCTION

For thousands of years, cheese of animal origin has been used for human consumption, several authors report on the use of this product, in the diet of man in the beginning of human civilization, a source of animal protein, which at that time was kept at temperature environment, enabling its storage for later consumption [1][2][3]

Already in the most read and commercialized book in the world, the Holy Bible, both in the Old Testament, as well as in the New Testament, we carry out the reading as for example, in the book of Genesis chapter 18 verse 8

account of the cheese being used for human food, the first report happened around 3,500 years before Christ.[4]

In the history of Brazil, especially with the advent of the arrival of the Portuguese royal family in the 17th century, there is even more news of the use of cheese by the entire Brazilian population, which over the years has become a product that is part of the diet of the Brazilian people, making this product a popular product in a country of continental extension.

Even though it is a product, popular and consumed all over the national territory, in Brazil, in the southeastern region, mainly in the states of Minas Gerais and the

interior of the state of São Paulo, they are states that produce more and sell cheeses.

Since the 17th century with the arrival of the Portuguese royal family, due to their habits of having daily cheese consumption in their food and in every meal, the history of cheese production in the southeast region has been registered, mainly in the states of Minas Gerais and São Paulo, in these states due to the environmental and geographical conditions for the implantation of the dairy industries in these regions, in Rio de Janeiro and Espírito Santo it was also suitable for this type of production.

Minas Frescal cheese, is the most popular cheese in Brazil, where the population has the habit of consuming at every meal, from the extreme north to the extreme south, there is a report of its consumption, however, it is a product that due to its production characteristics it has to be consumed immediately after manufacture because it has a short shelf life.[5]

When analyzing the Technical Regulation for Identity and Quality Fixing of Minas Frescal Cheese, by "Minas Frescal Cheese", you understand the fresh cheese obtained by coagulating milk enzymes with rennet and / or other appropriate coagulating enzymes, supplemented or not with action of specific lactic acid bacteria.[6]

In 1950, through the Regulation of Industrial Inspection, Sanitary of Products of Animal Origin, its annexes have an exclusive chapter regulating the production of cheese in Brazil, including Queijo Minas Frescal, a regulation that recommended the routine exams in order to inspect and to authorize dairy products that their products were in disagreement with the legislation.[7]

The official inspection service implanted in the industries that process milk and its products such as cheese, carry out official laboratory analyzes of monthly routine, where, the reports that present nonconformities, the industry is assessed, notified, fined and or even closed, due non-conformities. [7]

The dairy in which the object of this study was located is located in the state of Mato Grosso do Sul, in the Brazilian Midwest, which for more than 40 years is one of the 5 states that have the largest cattle herd in the country, and which in 2019 occupied the fifth position with more than 19,407,908 head of cattle [8]. The industry is located in Dourados - MS, a municipality with an estimated population of 225 thousand inhabitants, located in the southern center of the state of Mato Grosso do Sul, 220km away from the capital Campo Grande [8]. Livestock and agriculture are one of the main economic activities of the state having an important contribution to the municipal GDP, therefore the predominance of livestock in the state has a direct relationship with the production of dairy products, specifically cheese, the result of dairy farming activities.

Conducting an analysis of the results of the official reports, collected by the State Inspection Service (SIE), of routine microbiological examinations in a dairy in the municipality of Dourados MS, in the period from 2017 to 2020, was the objective of the present study, to quantify the results of CONFORMING / NON CONFORMING reports of thermotolerant coliforms, Staphylococcus spp. count, mold and yeast research, Salmonella spp. and L. Monocytogenes, will be the objective of the present work.

II.   HISTORY OF CHEESE

Cheese is one of the most consumed dairy products in the world, containing a huge variety of both flavor and appearance. It is a food produced since before the Ancient Age, it is alleged that it arose in Iraq, 8 thousand years ago, between the Tigris and Euphrates rivers. In the period known as the agricultural revolution, the discovery of cheese was only possible when human beings began to domesticate plants and animals [9].

There is evidence of consumption of solidified milk dating from 7 thousand years before a. C. and in materials found by archaeologists proving the existence of cheeses made with cow and goat milk 6 thousand a. C. In ancient Egypt there are records in Egyptian tombs that show scenes of cheese making and the Bible makes reference to cheese in various parts of the Old Testament [1].

Although several experts claim that the history of cheese is distant, there are those that delimit the Middle Ages as a reference for its manufacture [1]. Although it is one of the oldest foods of civilization, it is not known when it actually appeared, however it is very likely that it must have occurred concurrently with the domestication of goats, sheep and cows [2].

The production of "Queijo Minas" in Brazil dates back to the colonial period, it is no wonder that it is one of the most famous cheeses in Brazil and of the best quality. With a strong identity, it is an important ingredient for many cultural recipes from Minas Gerais and Brazilian cuisine and an important nutritional source [10]. The production of this cheese in Minas Gerais occurred simultaneously with the occupation of the captaincies and gold mining. Mining produced a rapid demographic explosion in the state, bringing a diversification of economic activities, including livestock [2].

Milk is one of the most versatile animal products in the world, about 30% of the world's milk production is used for the production of cheeses that add up to a variety of more than 1,000 types of this product. The great part of

these varieties happened due to some local circumstance, being factors as: composition of the milk, endogenous microbiology, species and animal race. In addition, the outstanding characteristic of the cheese may have occurred during the attempt to produce or stock the product with the growth of molds or the presence of other microorganisms [9].

In comparison with the production of cheese in the world, in Brazil, this reality is no different, 33% of the milk that is produced in the country is destined for the manufacture of cheese, which is one of the most consumed dairy products in the country. According to estimates made by the Brazilian Association of Cheese Industries (Abiq), in the Brazilian market there are more than 70 types of cheese available to consumers of national origin, with the inclusion of imported cheeses, this quantity exceeds 200 options. In 2017, Brazil produced 1 million tons of cheese, growing 2% over the previous year. The leading cheeses on the market are Muçarela with 30% of the market, followed by plate cheese with 20%, curd cheese 8% and Minas Frescal 6%. This group corresponds to almost 70% of the market.[11]

Cheese production has grown over the years, consequently the milk for the production of these dairy products has increased, the percentage went from 33% to 35% of the milk produced in Brazil for cheese production from 2018 to 2019 [11]. In the country there are about 2 thousand dairy products, 10% of which is responsible for 80% of cheese production, this activity moved 23 billion in 2019. Brazil is among the five largest cheese producers in the world, however the country it has a low consumption per inhabitant reaching only 5.5 kg / year, while countries like Argentina and Uruguay correspond to double 11 kg [12].

Contamination on the Minas Frescal cheese production line and Good Manufacturing Practices

Contamination of Minas Frescal cheese occurs due to poor hygiene along the chain. This contamination can happen since before the production process, happening during the milking of the milk, as well as during the production or even in the storage of the product until it is destined for the consumer. To guarantee the safety of the product, it is necessary to go through a strict quality control, adoption of Good Manufacturing Practices, and the qualification and training of specialized professionals [13][14]

Santos (2009) and Garcia (2016) state that the presence of chemical and physical contaminants in cheeses is associated with the poor quality of the raw material and the adoption of hygienic techniques in non-compliance with legal standards, evidently affecting the safety of the final product.[10][15]. However, the author points out that the adoption of GMP plus the appropriate techniques for personal, operational and behavioral activities in the production process are decisive strategies to ensure a quality product suitable for human consumption.

Brant, Fonseca and Silva (2007) and Rocha, Buriti and Saad (2006) agree that contamination can occur since before the start of the production process, due to the health conditions of the herds and the quality of the milk [16][17][18]. As well as in the production process due to the lack of hygienic sanitary conditions in manufacturing through contamination during the process. In addition, contamination can occur after processing, transportation, marketing and shelf life of cheeses during storage can result in contamination making consumption improper .[19].

Collegiate Board Resolution - RDC number 12, published on January 2, 2001 by the National Health Surveillance Agency (ANVISA) linked to the Ministry of Health, determines the Sanitary Microbiological Standards for food, establishing the criteria for the conclusion and interpretation of microbiological results of food. For foods with very high humidity above and 55% such as Minas Frescal cheese, the limits of the presence of microorganisms in the samples were determined, such as Coliforms at 45ºC, positive coagulase Staphylococcus, salmonella and L. monocytogenes. [20].

These pathogenic microorganisms, in addition to molds and yeasts, are contaminants of Minas Frescal cheese. Contamination of Minas Frescal cheese is very susceptible given its high moisture content, enabling the development of undesirable microorganisms [21]. Some of these microorganisms are pathogenic due to contamination in the production process without adequate quality control and the lack of Good Manufacturing Practices (GMP) [22]. Pathogenic bacteria are totally harmful to human health and can cause diseases due to the high power of multiplication and dissemination of tissues as well as the production of toxins. [13]

In this sense, microbiological analyzes, in addition to being a legal obligation to be made in the manufacture of dairy products, are essential to assess the risks that products such as cheese may present to the health of the consumer. Due to the large consumption of this type of cheese by the population, it is increasingly necessary to adopt practices that maintain the integrity and safety of the product. [23][24].

The occurrence of contamination in Minas Frescal cheeses is a problem that lasts for many years, despite the evolution of legislation in order to ensure quality products to the consumer free from contamination, however, these

contaminations are something present in Brazil. This is evidenced by several studies carried out by researchers, this situation does not depend on the period studied and the origin of manufacture, as can be seen in the studies performed shown in Table 1.

Table 1 brings together several surveys carried out by several researchers over the years in order to analyze the

microbiological condition of Minas Frescal cheese in Brazil. The table is composed of 5 columns that describe the author who carried out the research, as well as its objective that led him to carry it out, the type of inspection that the production of this cheese was subjected to, and lastly, the results obtained by each researcher. .

Table 1 - Analysis studies of the microbiological conditions of Minas Frescal cheese in Brazil.

Author	Objective	Type of inspection	Results
Loguercio and Aleixo, 2001	To evaluate the sanitary hygienic conditions of the Minas Frescal cheese produced by hand in Cuiabá - MT, a microbiological analysis of thirty samples obtained at two points of sale was carried out.	Not identified	In the determination of faecal coliforms, 28 samples (93.33%) had a more probable number (MPN)> 10^2 MPN / g and only two samples (6.67%) were within the required legal standards. In the count of S. aureus, in 29 samples (96.67%) values greater than 10^3ufc / g were obtained, with only 1 sample (3.33%) in compliance with the legal standard.
Salotti et al., 2006	To evaluate the microbiological quality of Minas Frescal cheese produced by hand and inspected by the State and Federal Inspection Service, through the quantification of fecal coliforms, positive coagulase Staphylococcus and researches of Salmonella spp., Listeria monocytogenes and Campylobacter spp.	With inspection (SIE and SIF)	Of the analyzed samples, regarding the presence of fecal coliforms 83.4% (25/30) and for industrial samples 66.7% (20/30) were not in accordance with what was established by ANVISA. For the values obtained in the count of positive coagulase Staphylococcus, 20% (6/30) of artisanal samples and 10% (3/30) of industrial samples exceeded the legal limit. Regarding the detection of Salmonella spp., Listeria monocytogenes and Campylobacter spp., Presented standards within the legal limits.
Brant, Fonseca e Silva, 2007	Evaluate the microbiological quality of artisanal Minas cheese from Serro and observe the variation of the microbiota of the newly manufactured cheese and on the last day of the shelf life.	With inspection	Thirty-seven samples (92.5%) were found to be unfit for human consumption, according to the parameters established by the resolution: RDC ANVISA nº 12/01, with the main cause of condemnation counting positive Staphylococcus coagulase 82.5% (33/40) and 60% (24/40) of coliforms at 45ºC above $5x10^3$UFC / gram ..
Komatsu et al., 2010	Avaliar a presença de *Staphylococcus coagulase positiva* em queijos artesanais produzidos no município de Uberlândia-MG e determinar a incidência de amostras analisadas dentro e fora dos padrões permitidos pela legislação vigente.	Not identified	The results showed that 88% (44/50) of the samples presented revealed unacceptable levels of coagulase positive Staphylococcus.
Pinto et al., 2011	To evaluate the sanitary quality of Minas Frescal cheese with artisanal production and with production inspected by the State and Federal Inspection Service of the Municipality of Santa Helena, PR, through the quantification of thermotolerant coliforms, Staphylococcus spp. Counting,	With inspector (SIE e SIF)	Regarding the presence of thermotolerant coliforms, 90% (18/20) of artisanal samples and 55% (11/20) of those inspected were at odds with what was established by ANVISA according to Resolution No. 12 of January 2, 2001 . Regarding the enumeration of Staphylococcus spp., 100% (20) of the artisanal samples and 25% (5/20) of the inspected samples were in disagreement with what was established by the legislation. Salmonella spp. and Listeria

mold and yeast research, Salmonella spp.		monocytogene were within the standards. Of the total samples analyzed, only 15% (6/40) were within the limits established by ANVISA, while 100% (20) of artisanal samples and 70% (14/20) of those inspected were above the limits established by legislation.
Wolupeck et al., 2012	Evaluate and compare the microbiological quality of Minas Frescal cheese marketed in the city of Curitiba (PR) in the years 1999 and 2009, verifying the evolution in the hygienic-sanitary quality of this product in the period of 10 years.	With inspector (SIE e SIF)	Of the 55 cheese samples, 41.82% and 78.18% (43/50) had an E. coli and total coliform count above the permitted limit, respectively. Only one sample (1.82%) of the total evaluated was found to disagree with the standards for positive S. coagulase and one for Salmonella spp. Both samples were acquired in 2009. Comparatively, the cheeses evaluated in 1999 showed microbiological quality superior to the cheeses evaluated in 2009 (p <0.05). Of these, 100% presented at least one microbiological parameter in disagreement with the current legislation, indicating that the quality of the Minas Frescal cheeses evaluated in 2009 was lower than that of the cheeses evaluated in 1999.
Lombardi and Rezende, 2014	To evaluate the microbiological quality of Minas Frescal cheese produced under Municipal Inspection in Uberlândia - MG from August 2012 to October 2013	With inspector (SIM)	Dairy factories "A" and "B" presented 100% and 50% of the raw milk samples satisfactory, respectively, for total bacterial count. Of the cheese samples analyzed, regarding the presence of thermotolerant coliforms, 12% (2/17) were at odds with the standards established by ANVISA and, as for the survey of coagulase positive Staphylococcus and Salmonella sp. 100% of the samples were within the legal standards required.
Apolinário, Santos and Lavorato, 2014	To evaluate the microbiological quality of Minas Frescal cheese, produced and commercialized by dairy products in the state of Minas Gerais, by analyzing the presence of total coliforms, thermotolerant coliforms, Salmonella spp., Listeria monocytogenes and coagulase positive staphylococci.	With inspector (SIE e SIF)	77.4% (24/31) of the samples were found with counts higher than that recommended by the legislation for total coliforms, 54.8% (17/31) for thermotolerant coliforms, 16.12% (5/31) for coagulase positive staphylococci and 9.6% (3/31) for Listeria monocytogenes. There were no samples with contamination by Salmonella spp. Thus, 80.6% (25/31) of the analyzed samples were unfit for consumption.
Feitosa et al., 2016	Identify and describe possible contaminants in cheese; investigate people's knowledge about the origin of the food they consume and correlate the data obtained with others described in the literature.	Not identified	The level of contamination obtained in the water period was 100% (37) for Total Coliform; 78.38% (29/37) for Fecal Coliform; 35.14% (13/37) of Staphylococcus aureus and 5.41% (2/37) of Staphylococcus sp. In the dry season, 86.49% (32/37) was found for Total Coliform; 62.16% (23/37) for Fecal Coliform; 27.03% (10/37) for Staphylococcus aureus and 2.7% (1/37) for Staphylococcus sp.

Souza et al., 2017	To evaluate the microbiological quality of Minas Frescal cheese as to the Most Probable Number of coliforms at 30ºC and 45ºC, positive coagulasse staphylococcus count and the presence of Staphylococcus aureus, Escherichia coli, Listeria monocytogenes and Salmonella sp., In order to assess their compliance current legislation.	With inspector (SIF ou SIM)	All samples, regardless of origin, presented coliforms at 35 ºC, with values ranging from 1.5 x 101 to 1.1 x 106 NMP / g. The presence of E. coli was confirmed in 16 samples (32%). Coagulase positive staphylococcal counts were also above the accepted limit in 16 (32%) samples and 10 (20%) contained S. aureus. There was no presence of L. monocytogenes, however, Salmonella sp. was confirmed in 20 samples (40%). It was found that only 11 samples (22%) were in compliance with Brazilian legislation.
Pinto et al., 2020	To evaluate the presence of microorganisms harmful to human health, contaminants of Minas Frescal cheeses, sold in commercial establishments in the municipality of Rolim de Moura - RO.	With inspector	Of the 30 cheese samples evaluated, there were three positive samples (9%) for coliforms at 45 ° C, 13 positive samples (43.3%) for Escherichia coli, and all 30 samples (100%) positive for Staphylococcus sp.
Amaral et al., 2020	Assess the quality of cheeses produced and marketed informally in open markets in the Federal District. Thirty cheese samples were collected without a health inspection certificate, marketed at ten fairs in the Federal District, in which the moisture content, the presence of Salmonella spp., Psychrotrophic microorganisms and the development of limosity and apparent mold were evaluated.	Not identified	The results obtained demonstrated the absence of Salmonella spp., And high counts for psychrotrophic microorganisms. The moisture content varied between 43% (13/30) and 61% (18/30), indicating a lack of standard in this product, concomitant with the appearance of limosity on the surface of 40% (12/30) of the samples and development of molds in 33% (10/30). Regarding the presence of Salmonella spp. was not detected in the analyzed samples.

Source: Prepared by the author (2021).

GMP is a set of practices that aims to guarantee the quality standards of products / services in the production area, which are included in the entire production process [10]. In addition, the GMP compliments improve the quality of the cheeses produced, preventing contamination and, consequently, the involvement of diseases related to bacteria resulting from bad manufacturing practices, in addition to reducing economic losses guaranteeing the continuity of the business.[21][25].

Food security is of utmost importance, considering that it refers to the health of the population, and not only the quality of the products. In addition, Foodborne Diseases

(DTA's) are affected by the ingestion of contaminated food, to ensure that this factor does not occur it is essential that the industry has assiduous quality management by developing control and prevention programs in GMP.[26]

Therefore, it is essential that hygienic practices be adopted throughout the cheese chain, and above all that the GMP of Minas Frescal cheese is followed, taking into account the serious dangers that microbiological

contamination poses to the consumer, in addition to the great financial losses [1]. Therefore, it is extremely important to ensure the integrity and quality of the cheeses produced for human consumption.[23]

III. PROBLEM FORMULATION

What are the main pathogens found in routine examinations, carried out by the Official Sanitary Inspection Agency, of Minas Frescal cheese in a dairy in the municipality of Dourados MS in the period from 2017 to 2020?

IV. HYPOTHESIS

Hygienic-sanitary handling in Minas Frescal cheese processing tend to cause bacterial contamination.

V.   OBJECT

Conduct a survey in the routine microbiological analysis of Minas Frescal cheese in a dairy in the municipality of Dourados/MS in the period from 2017 to 2020.

VI.   MATERIALS AND METHODS

a)   Types of Study to be carried out

In the official microbiological analysis reports, a survey of the compliant and non-compliant results was carried out in the period from 2017 to 2020. The study will be descriptive and quantitative. Descriptive studies are carried out through observed, registered, analyzed, classified and interpreted facts, without explorer interference made with standardized data collection techniques using a questionnaire and systemic observation [27]. Quantitative research seeks results that can be quantified through data collection in a structural and intuitive way.[28].

b)   Research Ethical Considerations

This research will be carried out with the collection of secondary data, analyzed and used only for what refers to the objectives of the study, without any prejudice for the people involved in the analysis process, and without mentioning the names of the company and also of the inspection professionals.

With written authorization by the business owner.

c)   Research location

The research was carried out in a dairy located in the region of Dourados / MS, under inspection (SIE) of the State Agency IAGRO (State Agency for Animal and Plant Health).

d)   Minas Frescal Cheese Making Procedure

In Brazil, there are legal provisions that classify cheeses in terms of moisture and fat content, such as Portaria n° 146, of March 7, 1996 and Portaria n° 352, of September 4, 1997 (SANTOS, 2009). These ordinances discriminate characteristics such as moisture defining very hard, hard, semi-hard and fresh cheeses, and regarding the content of lipids as fatty, semi-fatty, lean and skimmed. In addition, the 1996 document addresses the types of additives and adjuvants in technology or preparation that may be used in production, contamination factors, hygiene, determines the general technical regulation for setting the microbiological requirements of cheeses, among other aspects (BRAZIL) , 1996; BRASIL, 1997b).

In the production of Minas Frescal cheese according to Santos (2009, p.1) "The technology for producing this cheese occurs through the enzymatic coagulation of milk with rennet and / or other appropriate coagulating enzymes, complemented or not by the action of specific lactic acid bacteria. "It is usually sold in 0.5 kg to 3 kg forms (SILVA, 2005). Given the high humidity of Minas Frescal cheese, this factor increases the possibility of contamination of microorganisms, some of which are highly pathogenic (DUARTE, 2019).

As shown in the flowchart in figure 1, the manufacture of Minas Frescal cheese goes through a rigorous manufacturing process from the arrival of the raw material to storage. The milk arrives at the dairy in the truck with a temperature that should reach a maximum of 7ºC. Upon arrival, a sample is collected from each of the tanks to be analyzed. While the milk is being analyzed, the tank truck goes through a washing and sanitization process to avoid the contact of the truck dirt with the milk at the time of unloading on the platform. Front desk.

The milk goes through several analyzes before unloading to check if it is among the standards for production. In this way, analyzes are made: of acidity (14 to 18); alizarol (stable); fat (minimum 3.0); density (1.028 to 1.034); total dry extract (minimum 11.8); defatted dry extract (minimum 8.4); percentage of water in milk; antibiotic residue (absent); acidity neutralizer (absent); and density replenisher (absent). The better the microbiological quality the better the cheese [9]. After the analysis of the milk, if it conforms to the standards, it is authorized to discharge it, on the other hand, if it does not meet the criteria, the milk is discarded.

The unloading of the milk is done in refrigeration tanks where the milk will be stored, staying at a maximum temperature of 3ºC. After this stage, the acidity of the milk is measured for quality control, and then the pasteurization process begins. The pasteurization used is fast, in which the milk is subjected to a temperature of 72ºC to 75ºC for 12 to 15 seconds.[9]
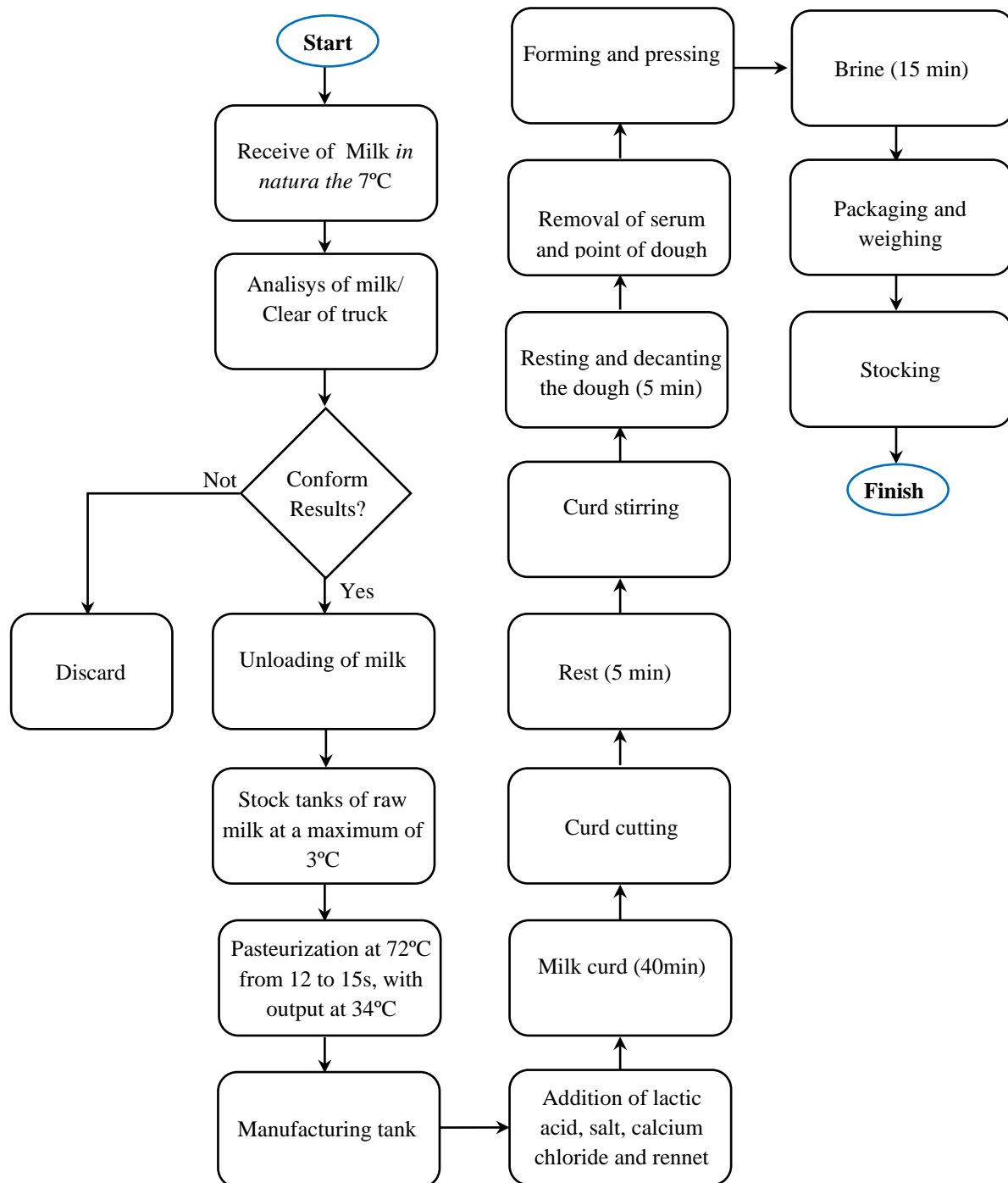
Fig.1: Flowchart of the manufacture of Minas Frescal cheeses in the Dourados dairy - MS.

Pasteurization is a mandatory thermal process that aims to destroy pathogens and mitigate the maximum number of microorganisms in general, since the microbiological quality for the production of fresh cheeses is essential [1][32]. Vinha (2016) warns that pasteurization is the main activity of the production process to reduce contamination of matter and eliminate pathogens. This elimination of pathogens is extremely important for products suitable for consumption that are free of thermostable enterotoxins

associated with gastroenteritis. Pasteurization is the means of ensuring that the cheese is free of contaminating microorganisms harmful to human health, such as bacteria and fungi.[25][31]

After this process, the milk is transferred to the receiving tank to cool. Then, lactic acid, salt, calcium chloride and rennet are added. It is expected 40 minutes for the milk curd, with the curdled milk the curd is cut. After cutting the dough there is a 5-minute rest. After these

steps, with the help of a stainless steel lyre, mixing occurs, which constitutes the agitation of the dough after coagulation, remaining at rest for settling for 5 minutes [33]. Subsequently, the serum is removed, separating it from the mass. With the dough separated and the defined point of moisture, the baking and pressing of the dough begins. Soon after the previous process is finished, the brine is made for 15 minutes, and with the ready cheese it is packed, weighed and stored.

e) Production of Minas Frescal Cheese

In the industry where this study was carried out, the main product in its manufacturing line is the Minas Frescal cheese, among several factors for this production choice, it is the acceptance in the market and also because it is a product that does not have any difficulty in its graph 1 shows the production of Minas Frescal cheese over the period studied.
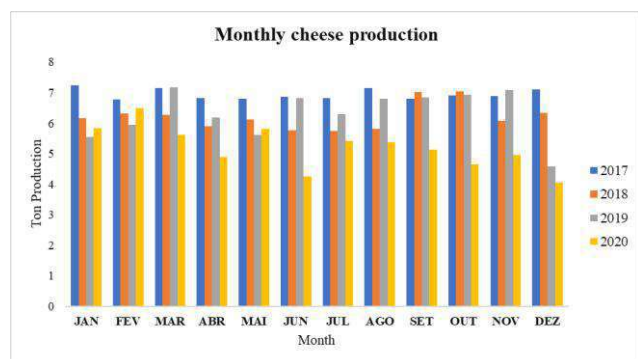
Graph 1: Production of Minas Frescal cheese from 2017 to 2020.

Source: Build by authors (2021).

f) Sample Characterization and Recruitment

The participants of this research will comprise the professionals of the IAGRO organ responsible for the sanitary inspection of the dairy, providing analysis data with the owner of the enterprise obtained in the period from 2017 to 2020.

g) Research Procedures and Instruments

The method consists of a study of the results of official routine examinations, observing the results, relating them to production activities (Good Manufacturing Practices), routine microbiological analyzes of the industry's water. With participant observation in the field and with a monographic report. The steps in these processes are; what is the objective to be investigated, the location and the expected length of stay for data collection.[34]

Simple frequency calculations and percentage calculations were performed regarding the data collected, analyzed and provided by the dairy. As this is a qualitative

study (nominal variables – COMNFORM/NON CONFORMING), with independent samples from each other, year by year, the statistical test to be applied in the results of the reports in the period from 2017 to 2020 will be the chi-square (X^2). The groups will be divided by etiological agent (Count of Molds and Yeasts; Count of Thermotolerant Coliforms at 45ºC; Research of Salmonella spp; Count of Total Coliforms and Count of coagulase positive Sthaphylococcus) and year, according to the release of the reports by the dairy.

VII. RESULTS AND DISCUSSION

Throughout the study period (2017-2020) official collections of samples produced from Minas Frescal cheese were carried out, due to the variation in production related to the availability of milk for production, there was variation in the production of Minas Frescal cheese in the studied period.

212 collections were carried out in the period, resulting in the official reports studied here according to the graphs represented.
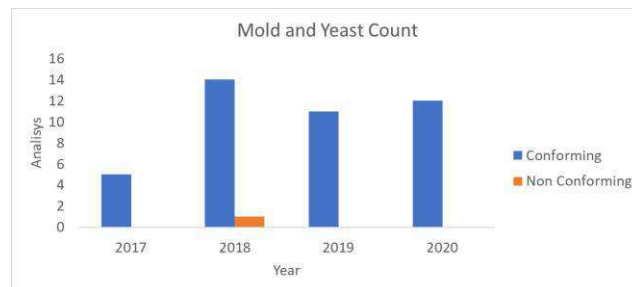
Graph 1.1 - Result of the analysis of the Count of Molds and Yeasts in the period 2017 to 2020

Source: Build by authors (2021).

During the study period, 43 reports referring to the count of Molds and Yeasts were analyzed, resulting in 1 report (2.63%) NOT CONFORMING, in the same study carried out by Pinto et al., (2011) detected contamination in samples of Minas Frescal cheeses corresponding to 65% (13/20) and 40% (8/20) of artisanal and inspected samples, respectively. This demonstrates that in the question of the studied microorganisms related to Molds and Yeasts in the dairy in which the present study was carried out, the index of this contamination is well below the study referenced here and according to the statistical test X^2 (chi-square and p-value 0.944), in this item of molds and yeasts, found a significant difference between the number of CONFORMING analyzes in relation to the number of NON CONFORMING analyzes.
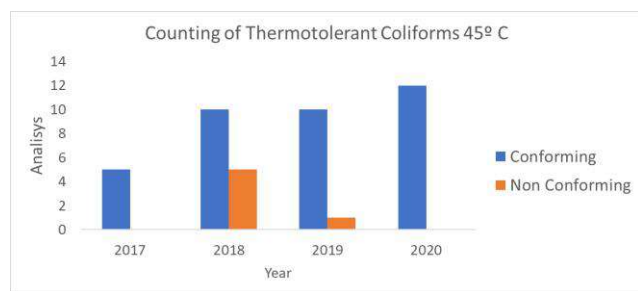
Graph 2 - Result of the analysis of Thermotolerant Coliforms 45º C in the period 2017 to 2020

Source: Build by authors (2021).

During the study period, 43 reports were analyzed regarding the Count of Thermotolerant Coliforms at 45ºC, resulting in 6 reports (13.95%) NON-CONFORMING, featuring 5 reports (11.63%) in the year 2018 and 1 (2.32%)) report in 2019. In 2018, 15 reports were made and 11 reports were made in 2019. In the same study by Dias et al., (2016) where 5 samples of industrialized cheeses and 5 of artisanal cheeses were analyzed, contamination was detected in all samples (100%) of industrial cheeses and two (40%) in samples handcrafted. Of the 10 samples analyzed, 7 (70%) were contaminated. The high contamination by this type of bacteria outside the established standards is an indication of the presence of microorganisms such as Escherichia coli (VINHA, 2016)

Visotto (2011) reports that several studies demonstrate the occurrence of pathogenic bacteria in Minas Frescal cheeses, with high counts of Thermotolerant Coliforms being frequent. A research carried out by Apolinário, Santos and Lavorato (2014) identified the presence of contamination of 54.8% (17/31) by Thermotolerant Coliforms of the analyzed samples. The research carried out by Feitosa (2016), on the other hand, identified the contamination of 12% (2/17). This demonstrates that in terms of the studied microorganisms related to Thermotolerant Coliforms 45º C in the dairy in which the present study was carried out, the index of this contamination is well below the studies referenced here, emphasizing that in the years 2017 and 2020 there were no, Non-Conformities in the samples officially collected by the supervisory body (IAGRO). And according to the statistical test X2 (chi-square and p-value 0.264) applied in this item of Counting of Thermotolerant Coliforms 45ºC, found a significant difference between the number of CONFORMING analyzes in relation to the number of NON CONFORMING analyzes.
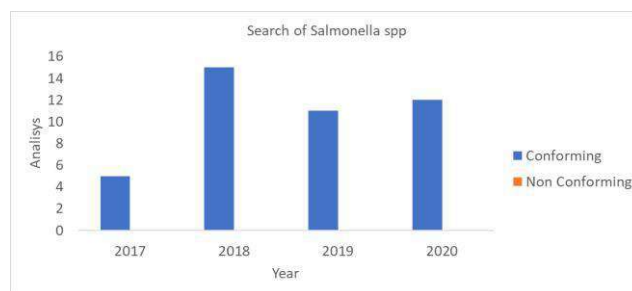
Graph 3 - Result of the analysis of the Salmonella spp survey in the period 2017 to 2020

Source: Build by authors (2021).

During the study period, 43 reports referring to Salmonella spp Research were analyzed, resulting in none (0%) of NON-CONFORMING reports. In a study by Morais and Rezende (2013); Valiatti et al., (2015); Salotti et al., (2006) something similar was detected and no contamination was found in the analyzed samples. On the other hand, in the studies by Pinto et al., (2011) 25% (5/20) of the inspected samples showed contamination by Samonela ssp. This demonstrates that, regarding the studied microorganisms related to Salmonella ssp Research, in the dairy where the present study was carried out, no index of this pathogen was detected in the official routine analyzes over the 4 years studied here. In this item it was impossible to perform the statistical test X^2 (chi-square), since all the reports presented results in CONFORMING
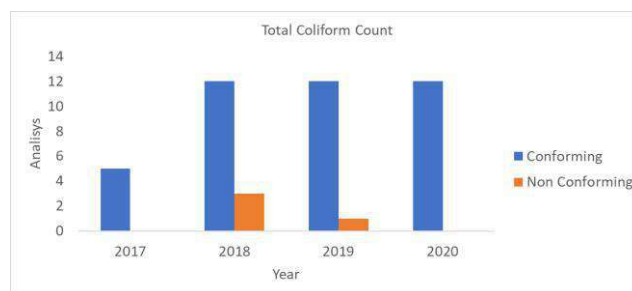
Graph 4 - Result of the Total Coliform Count analysis in the period from 2017 to 2020.

Source: Build by authors (2021).

Over the period studied, 45 reports on Total Coliform Counting were analyzed, resulting in 4 reports (8.88%) of NON-CONFORMING reports, with 3 (6.66%) reports in 2018, and in 2019 1 report (2.22%). In the same study carried out by Wolupeck et al., (2012) 78.18% (43/50) of the analyzed samples presented Total Coliforms above the allowed. Similar indices were found in studies Apolinário, Santos and Lavorato, (2014) and Dias et al., (2016), with respectively 77.4% (24/31) and 100% (10/10). Garcia et al.

(2016), on the other hand, found the contamination of 89% (17/18) with the presence of Total Coliforms from the analyzes performed.

Valiatti (2015) states that the presence or absence of Total Coliforms denotes the sanitary hygienic quality, so that the higher the quantity detected, the more inept is the hygienic sanitary condition of the cheese. This demonstrates that in the question of the microorganisms studied, the Total Coliform Count in the dairy where the present study was carried out, the index of this contamination is well below the studies referenced here. Furthermore, it is worth mentioning that in the years 2017 and 2020, the years when the greatest production of Minas Frescal Cheese occurred, as shown in Graph 1 of this study, with no Non-Conforming report, with respect to the Fecal Coliform Count. And, according to the statistical test $X2$ (chi-square and p-value 0.681) applied to this item of Total Coliform Count, it found a significant difference between the number of CONFORMING analyzes in relation to the number of NONCONFORMING analyzes.
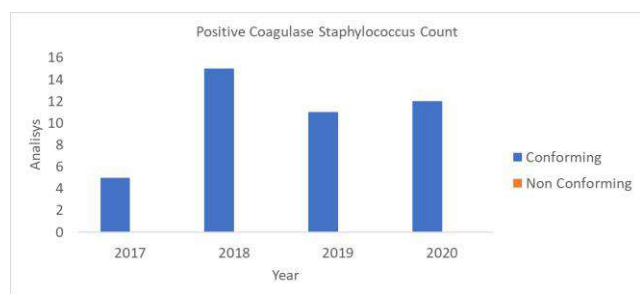
Graph 5 - Result of the analysis of Staphylococcus Coagulase Positive Count in the period from 2017 to 2020.

Source: Build by authors (2021).

During the studied period, 43 reports referring to the Count of Staphylococcus Coagulase Positive were analyzed, resulting in none (0%) of NON-CONFORMING reports. In the same study by Pinto et al., (2020) they detected contamination in samples of Minas Frescal cheeses, corresponding to 100% in the 30 samples analyzed. In the study by Morais and Rezende (2011), samples contaminated by Staphylococcus Coagulase Positive were not identified. Unlike what occurred in the research results of Valliatti et al, (2015) that there was 100% contamination of the samples and Brant, Fonseca and Silva (2007) that the contamination of 92.5% (37/40) of the samples was detected samples. This demonstrates that, regarding the studied microorganisms related to the Survey of Positive Coagulase Staphylococcus in the dairy in which the present study was carried out, there was no index of this type of contamination in the four years referred to in this study. In this item, it was impossible to

perform the X2 statistical test (chi-square), since all reports presented CONFORMING results.

VIII. CONCLUSION

Making a harmless product available to the consumer, without the presence of any type of pathogenic agent, has to be the goal of any type of industry that produces and sells products for human consumption. Throughout this study, dozens of authors, in their respective works, have alarming rates of contamination of Minas Frescal cheese. In the industry where the present work was carried out, in the official routine analyzes, collected by the official body responsible for the state inspection service, (11/212) reports, that is, 5.19% of Non-Conforming reports, a very small index when analyzing the studies referenced here, but it is necessary to have an even stricter control of good manufacturing practices by the present company, that this work be sent to the official inspection body and that a quality control project be carried out in which the annual targets that, each year, there will be a result even lower than the one presented here, that is, zeroing in the official reports of Non-Conforming results.

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Updating the Economic Profile of Açaí (*Euterpe precatoria* Mart. and *E. oleraceae*) Fruit in the states of Amazonas and Pará

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Abstract - *This study aimed to updatethe açaí (E. precatoria Mart.and E. Oleraceae) fruit economic profile using secondary data. According with secondary data analyzed, Brazilian total production(1,621,034 tons in 2019) and production value (R$ 3,615,468.00 in 2019) have been growing steadily with upward trend in the last years, pushing prices to rise. Cultivated açaí has been consolidated as the major productive system in Amazonas, with 60.7% of total state production, according to IBGE. Fruit origin has also been changing more recently, with Amazonas state remaining in second position with 111,612 tons and R$ 195,924.00 worth production in 2019, sharing 20.9% of Brazilian extractive açaí production.*

I. INTRODUCTION

The Amazon and its rich biodiversity hold an enormous potential in developing a variety of products of singular nature, which are under increasing demand both in the national and international markets (Bayma, Wadt, Sá, Balzon, & Sousa, 2008; Nogueira, De Santana, & Garcia, 2013). In this scenario, the palm trees of the *Euterpe* genus attract attention. The species *E. precatoria* (Mart.) and *E. oleraceae* (Mart.) are, in particular, considered the most important of the genus due to the great commercial use of the fruit for açaí pulp production. Although *E. oleracea* dominates much of this market, the Central and Western Amazonia are home to a high density of *E. precatoria*, from which the fruit properties have aroused great interest from different industry segments (Costa, Garcia-Diaz, Jimenez, & Silva, 2013; Yamaguchi, Pereira, Lamarão, Lima, & Da Veiga-Junior, 2015).

It is known that açaí has been undergoing structural changes in production and marketing system as well as in the consumption pattern. In this sense, the lack of information systematization and quality standards can lead to consumers being mistakenly purchasing certain products found on the market (Bezerra, Freitas-Silva, & Damasceno, 2016). Therefore, it is necessary to seek for quality standardization that can meet market specifications and requirements, ensuring the public health of final consumers.

Researches on the economic activityof *E. precatoria*fruit commercialized in the state of Amazonas remain restricted.Thus, this study aims to analyze the açaí fruit production and update market profile for later suggestion on strategies and plans for improvements in the production chain of *E. precatoria*.

II. BIBLIOGRAPHICAL REVIEW

2.1 Genus and species description

The *Euterpe* genus (*Arecaceae*) is composed of native tropical palm species abundantly distributed in South and Central America (Andrew Henderson & Galeano, 1996; L.

C. Oliveira, De Oliveira, Davide, & Torres, 2016). There are two predominant species that are commercially used for fruit production and found widely dispersed in the Amazon: *Euterpe precatoria* (Mart.) and *Euterpe oleracea* (Mart.) (Bussmann & Zambrana, 2012; Blair e Matos et al., 2017; A. O. Silva et al., 2020; Ter Steege et al., 2013; Zambrana et al., 2007).

As it is popularly known, Açaí solteiro, Açaí de terra-firme or Açaí-do-Amazonas, *E. precatoria* is a solitary, single-stemmed, monocaule palm that can reach about 20 m in height and 25 cm in diameter (Avalos & Schneider, 2011). It is considered a hyperdominant species, the most abundant palm tree in the Amazon (Ter Steege et al., 2013). It can be found widely distributed across Central America and northern South America, especially in Central and Western Amazonia (Bovi, Castro, Clay& Clement, 1993; A Henderson, 1995). In Brazil, it occurs in the federal states of Amazonas, Acre, Rondônia and Roraima (Ferreira, 2005), growing naturally on terra-firme (upland areas), in non-floodable areas, as well as on river banks, várzeas (lowland areas), alongside streams, lakes and high floodplains, with higher density in low floodplains when compared to plateaus.

The spherical fruits measure from 1.0 to 1.3 cm in diameter, of violet black colour with a fine white layer when ripe (Gordon et al., 2012), presenting considerable variation in size and weight between plants of the same origin, given the species plasticity. Each fruit contains a single globose seed, with a solid endosperm (Ferreira, 2005; A Henderson, 1995).

2.2 Usage and applications

There are several possibilities for using and taking advantage of all parts of açaí palm trees (Bussmann & Zambrana, 2012; Nogueira, 1998; da Silva, Souza, & Berni, 2005). Most commercially important, the pulp represents about 15% of the fruit total weight (Pessoa, Arduin, Martins, & de Carvalho, 2010; Yuyama et al., 2011), from where the vinho – as the energetic açaí juice is known in the Amazon region – is produced. It is a food of singular importance for the development of the Amazon region and traditionally present in the diet of traditional local populations (Brokamp et al., 2011; Brum, 2019; Zambrana et al., 2007). It is also used in the manufacture of ice cream, liquor, jelly, nectar, gelatin, among others.

Industrially, it can be used for cosmetics production (Bravo et al., 2020; Funasaki, Barroso, Fernandes, & Menezes, 2016), as well as dye (Teixeira-Neto, Izumi, Temperini, Ferreira, & Constantino, 2012) and anthocyanin extraction. The latter stands out due to the high antioxidant activity as scientific research evidences its power to fight free radicals, decrease aging, increasing cell life, promoting blood circulation and protecting the body against accumulation of lipids in the arteries (Duarte-Almeida, Santos, Genovese, & Lajolo, 2006; Galotta, Boaventura, & Lima, 2008; Kang et al., 2012; Odendaal & Schauss, 2013; Schauss, Wu, Prior, Ou, Huang, et al., 2006). Also due to its ability to decrease the effect of Alzheimer's disease (Rogez, 2000).

Other parts of the plant are also useful: fibres are used in the manufacture of furniture, plywood, acoustic panels, tree fern, as well as in the automobile industry and others (Barbosa, Rebelo, Martorano, & Giacon, 2019; de Oliveira et al., 2019; Martins, Pessoa, Gonçalves, Souza, & Mattoso, 2008; Quirino, 2010; Wataya, Lima, Oliveira, & Moura, 2016); the heart of palm, obtained from the region close to the apical meristem, is consumed naturally, preserved, in the form of cream and others (Vallejo, Galeano, Valderrama, & Bernal, 2016); Leaves are used against muscle pain and snake bite; the leaf straw can be used to cover houses and walls (Galotta & Boaventura, 2005), in the manufacture of baskets, rugs, shakers and others; the seed can be used to produce seedlings, but it can also be used as raw material for making handicrafts and bio jewels, also as a fertilizer, or even in the preparation of oil, popularly used as an anti-diarrheal (Schauss, Wu, Prior, Ou, Patel, et al., 2006a); from the trunk it is possible to obtain slats and rafters for rural buildings, in addition to firewood and cellulose; the roots are used as dewormer. For instance, (Macía et al., 2011). bring together these mentioned studies and others that describe 89 different uses for *E. precatoria* in Brazil, Colombia, Ecuador and Peru.

2.3 Fruit production and market

Due to the evident nutritional value, the commercialization of açaí fruit has been one of the main potentialities for the management of non-timber forest products (NTFPs). Under increasing demand (Bayma et al., 2008. Nogueira et al., 2013; Pagliarussi, 2010), açaí became the most collected NTFP of extractive origin in Brazil, with the highest revenue in the Brazilian Amazon, reaching a production of over 220,000 tons (IBGE, 2019). This new market dynamic has been characterized by a demand greater than supply Nogueira et al., 2013; Santana, 2004), which pressures prices to raise, especially with the increase in exports (Binois & Reis, 2012; Dos Santos Bentes, Oyama, & Nunes dos Santos, 2017; Tavares & Homma, 2015) for international consumer markets, such as NAFTA, European Union, Asian Tigers and MERCOSUR (D'Arace et al., 2019; Nogueira et al., 2013). As *E. precatoria* occurs in the off-season of *E. oleraceae*, the management of *E. precatoria* could contribute to the permanence of the supply and consequently reduce the

variation in prices throughout the year (Blair e Matos et al., 2017).

To guarantee the supply of the domestic and foreign markets, with the perspective of developing socioeconomic and environmentally sustainable activities, the extractive management of açaí in native forests presents itself as a potential alternative for valuing standing forests and maintain their ecosystem services provider capability. However, while two decades ago the production of açaí was almost entirely from the extractive sector, currently the increase in production is mainly due to the establishment of rational plantations, with or without the presence of irrigation (Nogueira & Santana, 2009; Nogueira et al., 2013). Traditionally, *E. oleraceae* occurs in flooded areas and alongside floodplains. Despite that, the Brazilian Agricultural Research Corporation (Embrapa)breeding program developed the cultivar "BRS Pará" which was launched in 2005 and "BRS Pai D'égua" in 2019. These cultivars are grown on dry land with using irrigation system. As a result of this, production was mechanized and made more productive when compared to the traditional way (Rufino et al., 2010). Since the market has been growing fast and steadily, the use of domestication technologies may become inevitable (Homma, 2012; Kingo et al., 2006).

III. STUDY DELIMITATION

3.1 Economic profile analysis

Gathering secondary data, it was possible to trace the açaí fruit apparent production and market profile, structure and its general characteristics.

The updating of the economic profile of açaí production follows the economic analysis framework proposed by Blair & Matos (2017), who used, for the first time, as a econometric analysis, the parallel between the two açaí species (*E. precatoria* and *E. oleracea*), for two production systems (cultivation and extractivism) and between two Brazilian states (Amazonas and Pará), evidencing the commercial dynamics of national fruit production.

Was based on secondary data, from to the following official agencies: Brazilian Institute of Geography and Statistics (IBGE); National Supply Company (CONAB); Agricultural and Sustainable Forest Institute (IDAM); Brazilian Agricultural Research Corporation (Embrapa); and others studies, from which the variables analyzed were the amount produced, production value and price per amount produced, using the historical data series available.

IV. RESULTS AND DISCUSSION

4.1 Economic profile results

The economic data accessed allowed a better understating of behaviour and trends regarding production, in terms of amount, value, prices and origin in Brazil and its federal estates. Fig. 1 shows extractive production historicalseries in Brazil from 1994 to 2019. An upward and mostly steady growth is notice when analysing the entire series. The amount produced has become slightly more two times the initial records, reaching 222,706 tons (IBGE, 2020). Production value have also been increasing, especially after a boom in 2011 followed by a strong growth until 2018. Prices were also forced to grow given that scenario.
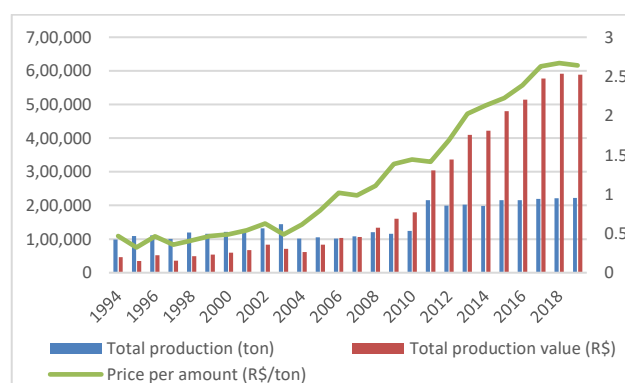
Fig.1 – Extractive production in Brazil from 1994 to 2019.

According to CONAB (2019), açaí prices have risen 308% between 2006 and 2014. In addition, the amount produced grew 95% in the same period and other 11% from 2015 to 2017. Those are clear indicators that demand for açaí is greater than supply. This great demand even stimulates traders to seek the product from increasingly distant regions, as well as promotes the açaí cultivation.

In Brazil, Pará State has always been the largest producer of açaí in Brazil as well as the largest exporter. Until 1990, Pará accounted for 95% of Brazilian extractive production(CONAB, 2019). However, in 2013, this share dropped to 54.9%(Blair e Matos et al., 2017). This switch happened due to development of açaí activity in other Brazilian states, such as Amazonas and Maranhão, since açaí has become a promising business opportunity and given the local and global demand(CONAB, 2019). Fig. 2shows the current açaí extractive production by states, with Amazonas in second place sharing 20% of Brazilian extractive production(IBGE, 2020).

Fig. 2 – Percentage of extractive production of açaí by Brazilian states.

A study (Marinho, Paula, Miranda, & Barbosa, 2013) comparing the extractive amount produced between 2006 and 2011, observed that Amazonas occupied the third place in the national production in 2006. In 2011, Amazonas moved to second place, the position it remains nowadays. Pará is the largest producer with 151,793 tons, followed by Amazonas with 43,855 tons, as can be seen on Fig. 3 (IBGE – SIDRA, 2020).
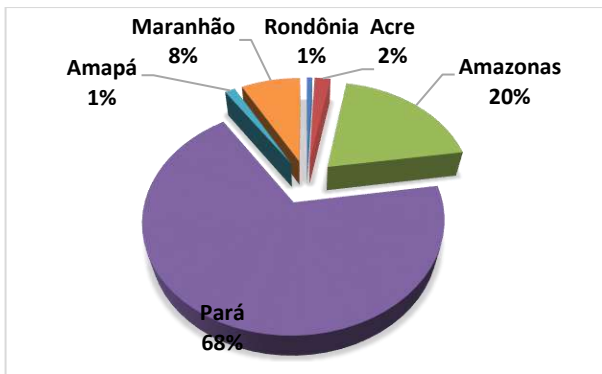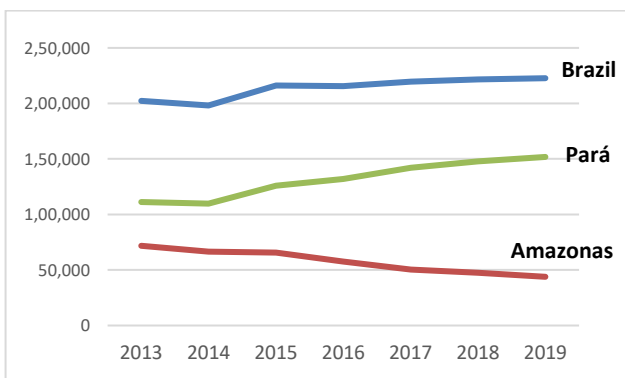

Fig. 3 – Extractive production in Brazil and the federal states of Amazonas and Pará.

(Blair e Matos et al., 2017) observed that Amazonas açaí extractive production accounted for 71,783 tons back in 2013. That represents nearly 40% drop in production and may suggest a change in the production system.

Açaí production does not only come from extractivism but also from cultivation, which for the Brazilian Institute of Geography and Statistics (IBGE) data accounts for plantations and native açaí managed areas. For instance, cultivated açaí showed a 32% increase in production from 2015 to 2017 (Fig. 4). Total cultivated production value oscillated and accounted for R$ 3,026,873.00 and price per amount remained stable and over R$.kg^{-1} 2.00 after 2018 (IBGE, 2020a).
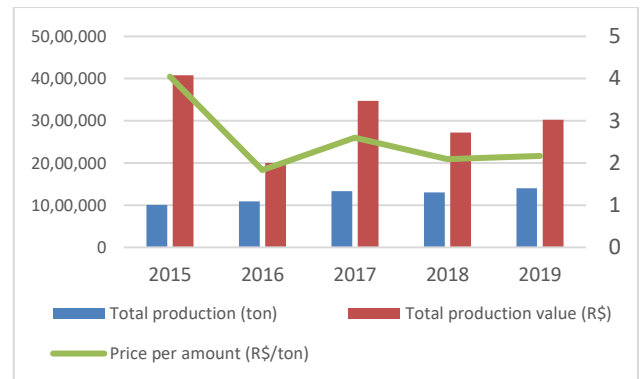
Fig. 4 – Cultivated production of açaí in Brazil.

Overall, the data points towards a more accentuated growth in cultivated production, which reflects a greater influence of management and agricultural practices more recently adopted for açaí. Such growth also shows a tendency to commoditize the fruit, with prices being the only competitive differential in the market (CONAB, 2019c).

The figure below (Fig. 5) shows the variation in production growth from both extractivism and cultivation by Brazilian states Amazonas and Pará from 2016 to 2019. Amazonas remained slowly growing throughout the analysed period, with excepting 2018 after dropping 3%. While in 2017 Amazonas showed an increase by 17% in production, Pará surpassed it with much greater 54% growth, followed by a severe fall in 2018 accounting for only 6% growth(IBGE, 2020; 2020a).
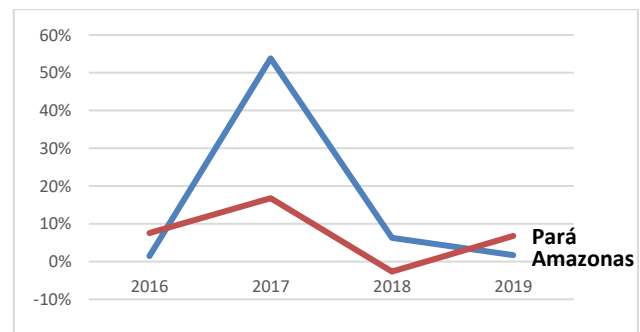
Fig. 5 – Rate of total açaí production growth by Brazilian States Amazonas and Pará.

According to CONAB (2020), the later consecutive increases in the production of açaí are result of the intensification in cultivated areas, and also in the growth of productivity which is also consequence of the continuous improvement of management techniques. And the recent stabilization in the escalation of açaí production is likely to be reflection of the growing popularization of the fruit consumption and the consequent increase in confidence of

investors involved in the açaí production chain (CONAB, 2019b).

The Fig. 6 presents the effective participation of extractive and cultivated açaí production both in Pará and Amazonas states. It is clear the difference in as Pará already accounts roughly 90% of its production by cultivated açaí. Meanwhile, in Amazonas cultivated açaí accounts for only about 60% of production, with planting both species *E. oleracea* and *E. precatoria* (IBGE, 2020; 2020a).
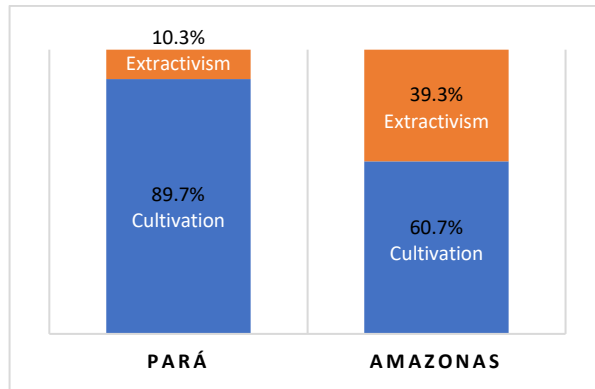
Fig. 6 – Extractive and cultivated açaí effective participation in production in 2019.

The proportion of cultivated açaí fruit in comparison to extractive have been increasing systematically in recent years. According to CONAB (2019a), the percentage of participation between extractive and cultivated açaí in the main producing states in 2017 was 14.2% to 85.8%. As a consequence of increasing production of cultivated açaí, it is the entry into the açaí market of states that did not used to have native açaí areas and did not even have a tradition in the consumption of the fruit, such as Bahia and Espírito Santo states (CONAB, 2019a). That may relativize the meaning of sustainable and social character in açaí production, which is even considered a marketing factor for the fruit, since it relates to the preservation of native açaí areas, the native Amazonian forests and the generation of income for the local traditional families.

Evaluating the production of açaí for the State of Amazonas (Table 1), it is possible to conclude that total açaí production in the state represents 6.9% of total Brazilian production, with extractive production standing for as little as 2.7%, with 43,855 tons, and cultivated production participating with 4.2% corresponding to 67,757 tons. Pará remains by far with the first place with its altogether production reaching 90.8% of total Brazilian production, with 1,471,943 tons.

Table 1 - Total production (ton) in Brazil and the states of Amazonas and Pará in 2019 (IBGE, 2020; 2020a).

	Total	Cultivated	Extractivism
Pará	1,471,943	1,320,150	151,793
Amazonas	111,612	67,757	43,855
Brazil	1,621,034	1,398,328	222,706

Similarly, as can be seen on Table 2 açaí production value in the Amazonas state represents 5.4% of total Brazilian production value, with R$ 195,924.00, from which extractive production stands for 2.1%, and cultivated production participates with 3.3%. Pará state with its altogether production reaches 92.5% of total Brazilian production value, with R$ 3,345,655.00.

Table 2 - Total production value (R$) in Brazil and the states of Amazonas and Pará in 2019(IBGE, 2020; 2020a).

	Total	Cultivated	Extractivism
Pará	3,345,655	2,880,211	465,444
Amazonas	195,924	120,381	75,543
Brazil	3,615,468	3,026,873	588,595

Açaí production in the state of Amazonas supplies the local market and industries, in addition to being exported to almost all Brazilian states, specially to Rio de Janeiro, São Paulo and Brasília, and also to European countries (Conab, 2020a).

Amazonas is one of the states where the lowest price paid to the producer is observed, which is certainly related to issues of cost and infrastructure, such as logistics and the large amount of transhipment operations between production and ports for product outflow (CONAB, 2019b). From the Amazonian cities that most produce açaí, Codajás, Borba, Coari, Itacoatiara, Anori and Manicoré, among others, can be highlighted (IDAM, 2020). They basically depend on the flooding of the rivers for their flow during the harvest period which is, depending on each region, from January until August.

Prices in the state of Amazonas, have been backed by the Minimum Price Guarantee Policy for Socio-biodiversity Products (PGPM-Bio), with occasional light highs. Therefore, the state does not follow the price increase trends observed in other producing regions, since the high cost of transportation by navigation is passed on indirectly to the producer (CONAB, 2019b). Minimum price in 2019 harvest was set to R$ 1.63/Kg, as published by Ordinance MAPA No. 141 of January 08, 2019.

According to the Agricultural and Sustainable Forest Institute(IDAM, 2020), the açaí activity in Amazonas state is practiced by family farmers and rural producers, with the registration of some business cultivation in some cities that has intensified in recent years, usually for self-supplying of pulp agro-industries. The production of açaí fruit is commonly benefited and/or processed in the producing municipalities themselves, in the 21 registered pulp agro-industries or in so called "artisanal beaters", which sell most of the production to Manaus and other regions of the country. The supply of the local population is usually carried out by artisanal 'beaters'. In Adolfo Lisboa market, prices for 50 Kg bags of açaí are sold from R$ 100,00 up to 400,00, depending on each producing region harvest season time, as well as, in terms of quality, the fruits characteristics such as size, freshness, maturity and others.

Prices per litre for the fresh açaí pulps collected on this study for sampling purposes ranged between R$ 8,00 (thin) to R$ 14,00 (thick). Back in 2014, a study held in Manaus(Silva, Chaar, Roberto, & Nascimento, 2014), observed 24 micro and small businesses with relevant and distinct roles in industry sectors, and accounted for 263±141producers and prices practised on fresh açaí pulp sales per litre was R$ 5,00±0.88. Average profits were presumed to be as little as 10% to 15% considering all costs involved in commercialization, not being a market-based trade. As a result, it was pointed that açaí pulp quality was low as there were not legal and sanitary barriers that producers would face to get in and out of market.

V. CONCLUSION

The updated analysis of the economic profile evidenced the transformation in which açaí production and market patterns are changing throughout the last few years in Brazil and its main açaí producer federal states. Total amount produced and production value have been growing steadily with upward trend. Cultivated açaí has been consolidated as the major productive system in Amazonas state. The States of origin of fruits have also been changing more recently, with Amazonas remaining in second position. However, the use of secondary data should be considered as a limiting factor for analysis of this nature and extent.

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Social Movements in Non-School Spaces: A Reflection on Educational Experiences in the Brazilian States of Pernambuco and Bahia

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Abstract— This paper aims to describe educational experiences of social movements in non-school spaces. This is a qualitative systematic review of literature carried out through an electronic search in Google Scholar databases. The inclusion criteria were composed by articles published in the last 15 years, which had as a central theme educational experiences of social movements in non-schooling spaces, in the States of Bahia and Pernambuco. Five articles were found and included in the review in order to develop a synoptic table with their synthesis. From the analysis, it was possible to emphasize the importance and evolution of educational processes in non-school spaces in socioeconomic development, making evident the importance of bringing social movements and popular groups into the decision-making processes and educational policy.

I. INTRODUCTION

Throughout history, it is possible to verify the great contribution of social movements in the search for a more just and egalitarian society. The struggle for the recognition of alternative paths to the current societal model has led to numerous educational processes taking place in the scope of these movements, outside of school spaces, and that have become fundamental for the human formation of certain social groups. Some policies were born exactly from the experiences of these movements, as is the case of the National Policy for Rural Education – or *Política Nacional de Educação do Campo* (PNEC, 2010).

To talk about education in non-formal spaces is to grant protagonism to a set of social practices that are essential for citizenship. It is to refer to educational processes that take place outside the institutional scope of the school and that are born with an educational purpose, but that are not curricular.

Gohn (2014) presents a reflection on the production and transmission of knowledge outside institutional contexts of education, pointing out that non-formal education is that which is learned "in the world of life" through processes of sharing experiences, mainly in daily collective actions and spaces. She also shows that, at the same time, it tries to understand how new practices, coming from both civil society and political society, in the field of associativism and public policies, enter into non-formal education processes, affirming that these are participative processes in popular movements, non-

governmental organizations, and other civil entities (foundations, associations, cooperatives, etc.), challenged to promote a citizen, participative, and emancipatory education.

In this premise, Néspoli (2013) brings a discussion about the experience of the Youth and Adult Literacy Movement in the city of São Paulo, or *Movimento de Alfabetização de Jovens e Adultos* (MOVA/SP, 1989-1992) – program implemented by the educator Paulo Freire when he was municipal secretary of education of the city of São Paulo/SP – seeking to analyze Freire's contributions to the construction of a transforming education in the context of contemporaneous Brazil. He also points out that Paulo Freire sought to introduce a profound change in relation to the way education was being managed in the country and, to this end, based his administration on a policy of popular participation. It was based on these conceptions that the MOVA-SP was born.

With these initiatives becoming more and more constant, what used to be delegated only to the formal school environment, now has non-school learning spaces - not opposing the school, but expanding its horizons (Ferreira, 2014). It is noted, however, that there are few studies addressing the problem of social movements in the context of Brazilian education, especially from a more regionalized perspective (Rodrigues & Tamanini, 2012).

In this sense, the objective of the present study is to identify and describe educational practices in non-formal spaces, developed within the scope of Social Movements in the brazilian states of Bahia and Pernambuco. To do so, the article is structured as follows: initially, the formal, non-formal and popular education environment is objectively discussed, and then the social movements for education. After that, the methods used for the search and selection of the articles analyzed are presented. Finally, the results are presented as a summary of the analyzed articles and a discussion, drawing, as much as possible, a parallel between the works and the theoretical foundation.

II. LITERATURE REVIEW

2.1 Formal, Non-Formal Environment and Popular Education

Education is understood as a complex phenomenon, composed of various aspects and contextualized in diverse cultures and philosophies (Gadotti, 2012). Another intrinsic aspect of education is its ability to adapt to the most different scenarios: the technological environment, for example, brought with it the need to adapt the teaching-learning process and drove the emergence of

Distance Learning (DL), as it is popularly known (Costa, Schaurich, Stefanan, Sales, & Richter, 2014).

When discussing this topic, it is common to think, first of all, of the "classic" formal environments, such as schools and universities. However, for Rodrigues and Tamanini (2012), education can - and should - be understood beyond the curricular dimensions, breaking the barrier of the school walls and reaching the spaces of home, leisure, work, and even associativism.

Gomes and Silva (2019) approach education as a living and dynamic process, present in all places, spaces, contexts, relationships, knowledge, and doings. And the brazilian Law of Directives and Bases of National Education itself presents a similar perspective by pointing out that education " embraces the formative processes that are developed in family life, in human coexistence, at work, in teaching and research institutions, in social movements and civil society organizations, and in cultural manifestations" (Lei 9.394, 1996).

So, in a context of absence and failure of the State - this, which should promote justice, equality and dignity to all citizens - the concept of non-formal education arises, which consists precisely in breaking the barrier imposed by the formal environment (Gomes & Silva, 2019). In comparison with formal education, Gadotti (2012) explains that non-formal education is more diffuse, less hierarchical and less bureaucratic. For the author, also, non-formal education should not be defined considering the formal school structure as the only paradigm.

According to Gohn (2011), a major characteristic of this educational aspect is intentionality. In other words, non-formal practices present systematization, organization, and objectives (Ferreira & Medeiros, 2012), which is far from the idea of amateurism and spontaneity.

It is also worth highlighting the concept of popular education, which, although it may refer to the same disciplinary area, is not synonymous with non-formal education. As pointed out by Gadotti (2012), popular education seeks to respect the common sense that popular sectors bring with them in their daily lives, problematizing it and incorporating a more rigorous and scientific reasoning. It was born, however, like non-formal education, outside the walls of the school institution and the spaces of official legitimization of education (Rodrigues & Tamanini, 2012).

If on the one hand the educational panorama is diverse and unequal in the same proportion, on the other, society and social movements constantly demand new actions that involve the public and private sectors (Rodrigues & Tamanini, 2012). Thus, it is valid to emphasize that the

field of non-school education is still full of obstacles to be overcome.

For Saul (2014), one of the great challenges is to combat the prejudice against education developed in non-formal spaces, which is often assigned welfare characteristics and, therefore, ends up not receiving the proper attention from the government. In turn, Santos and Oliveira (2014) present a series of challenges of the non-school environment, such as: the overcoming of the school as the only reference of the pedagogical space and the teaching-learning model; the development of the educational practice paying attention to the situation experienced by the student (health condition, crisis, medical impediments, and individual motivations, for example); the acceptance of age and cultural differences and respect for the other's limitations; the establishment of dialogical and solidary interpersonal relationships; facing the new and the construction of new educational references, among others.

Despite the difficulties, a scenario of significant advances is perceived, with the expansion and strengthening of pedagogical practice in structured spaces within the concept of non-formal education (Ferreira & Medeiros, 2012), consolidating various non-school environments, such as museums, workshops, cultural centers, foundations and non-governmental organizations (Rodrigues & Tamanini, 2012).

The case study by Santos and Oliveira (2014), for example, presents a pedagogical experience in a hospital environment. For the authors, practices like this have become increasingly common in Brazil, being developed especially by non-governmental educational institutions or those linked to popular education and that consider the non-school environment as a way to ensure access to knowledge for the popular classes.

It is impossible to approach educational processes in non-formal spaces without mentioning the work of Paulo Freire, who, throughout his trajectory, presented the importance of a vision beyond the school walls - being recognized nationally and internationally for the direction of his studies. In this sense, Gadotti (2012) points out Freire's main contributions to the discussion and implementation of Popular Education as: the recognition of the legitimacy of popular knowledge, the defense of education as a practice of freedom and a precondition for democratic life, the harmonization between the formal and the non-formal, and the theorization of practice before transformation (and not the other way around).

Paulo Freire's work is also very close to social movements, as Stênico and Paes (2017, p. 54) point out, since they have "an educational character, not simply because of the condition of exclusion, but by understanding the reason for their condition of oppression that leads men to engage in the social struggle," strengthening the fight for equal rights and access to education, whether in formal or non-formal spaces.

2.2 Social Movements for Education

The literature covering non-formal education carries with it an almost intrinsic relationship to social movements. Gadotti (2012), for example, shows that non-formal education used to be linked to non-governmental organizations, unions and social movements, often organized in opposition to the educational methods imposed by the State.

Discussing non-formal education is also discussing the actions of social movements in the struggle for the exercise of citizenship (Ferreira & Medeiros, 2012), since, in this field, the aim is to achieve the path to the construction of citizenship, transforming both professionals and students into "subjects of law" and seeking individual and collective social well-being, autonomy, and citizenship (Santos & Oliveira, 2014).

Social movements, throughout the history of Brazil, have been interfering positively in the educational context, articulating educational processes and community (Rodrigues & Tamanini, 2012). According to Ferreira (2014), these movements began in the 1960s, with the support of populist politicians, such as the Basic Education Movement (*Movimento de Educação de Base*, MEB), the You Can Also Learn to Read by Standing on the Ground (*De Pé no Chão Também se Aprende a Ler*), and the Popular Culture Movement of Pernambuco (*Movimento da Cultura Popular de Pernambuco*, MCP).

The Basic Education Movement (MEB), for example, followed Paulo Freire's methodology and implemented distance education via radio, working on literacy and training courses for communities. The Popular Culture Movement of Pernambuco (MCP) also carried out educational practices via radio through experimental schools (Ferreira, 2014).

At least in the context of education, Social Movements arise from specific needs and, throughout their actions, they strengthen long-standing struggles - such as the cause of teacher strikes, for example - and it is mainly in these aspects that their importance lies. As Dalmagro (2016) explains, the actions of educational Social Movements are based on the questioning of social structures and the education that comes from them, which provides an education "for the new as far as they concretely point to this new" (p. 87).

III.   METHODOLOGY

In order to carry out a qualitative systematic review of the research developed on the research object proposed in this article, we chose to use an inventory and descriptive methodology, typical of the works known as the state of knowledge (Ferreira, 2002).

Considered as a tool that enables the mapping and generation of "different indicators of treatment and management of information and knowledge, (...) necessary for planning, evaluation and management of science and technology, of a specific scientific community or country" (Guedes & Borschiver, 2005, p.15), the state of the art constitutes an essential part in the process of understanding science and, when such analysis is added to qualitative research, the results acquire a greater range of interpretation (Cardoso, Mendonça, Riccio, & Sakata, 2005).

The systematic literature review, according to Souza, Silva, and Carvalho (2010, p. 103), is "a rigorous synthesis of all research related to a specific question," using a set of systematic methods throughout the process - identification, selection, and evaluation of studies.

The corpus selection criteria followed the procedures used by Vieira (1998), Tonelli, Caldas, Lacombe and Tinoco (2003), Sampaio and Perin (2006), and Cassundé, Oliveira, Alencar, Rodrigues e Rodrigues (2017), as indicated in **Table 1** (in the appendix).

We included works published between 2005-2020, indexed in scientific journals or annals of events, which had as their central theme the educational experiences of social movements in non-school spaces, in the states of Bahia or Pernambuco. We excluded all articles that did not meet the inclusion criteria, that is, those published more than 15 years ago, those that were not indexed in scientific journals or in annals of events, and those that were not contextualized in the states of Bahia and Pernambuco.

Throughout the study, some steps were followed: initially, the articles were selected based on the inclusion/exclusion criteria; then, they were read in order to build a solid theoretical basis about the educational experiences of social movements in non-school spaces so that, based on Bardin's Content Analysis method (2011), it was possible to formulate an argumentation about the theme and seek directions for the expansion of these activities; finally, a summary table was prepared with the main information about each selected article, which served as a basis for the discussion.

IV.   RESULTS AND DISCUSSION

The results interpret and discuss the relationships between the findings of the search and the theme addressed. So, in this section the results and discussions of this article are presented, and in order to provide the reader with a basic initial overview of the selected papers (refer to **Table 2** in the appendix) presents the respective authors, years of publication, titles of each analyzed paper and, briefly, the objectives of the mentioned articles.

The article by Carvalho and Santos (2020) is focused on rural education and analyzes the National Program for Education in Agrarian Reform (*Programa Nacional de Educação na Reforma Agrária, Pronera*) within the scope of the UESB - University of Southwestern Bahia, an initiative that has become a public education policy and that serves individuals coming from the areas of Agrarian Reform. The study identifies that Pronera contributes directly to the formation and socialization of rural subjects by means of professional and academic training.

The authors mention that this program, after it starts, worked as a government policy and then as a State policy - that is, of a permanent nature. This is an aspect worth emphasizing, considering that many initiatives have potential, but end up losing strength with changes in government. Thus, the importance of transforming such educational practices into State policies is clear.

The article by Hora Filho and Marques (2015) is contextualized in the context of Youth and Adult Education in Recife/PE - more specifically in the ProJovem Urbano. The work is conducted in a very interesting way, even showing factors that, in the context, led to school dropout. Another point that draws attention is the analysis of the contexts in two different neighborhoods in the same municipality, since each may have its inherent characteristics and other peculiarities.

Chaves et al. (2014) report the experience of MobilizaSUS, an initiative that seeks greater approximation and dialogue with social movements, from an initiative put into practice in the form of the course "Popular participation, social movements and the right to health". As a result, the authors report the exercise of protagonism of representatives of social movements, as well as the construction of strategies for the incorporation of demands and needs of the collective.

In the sequence, the work of Souza (2007) is contextualized in Pernambuco's capital, Recife, during the Popular Culture Movement (MCP) and the Social Promotion Foundation (FPS), when the radio - an important means of communication at the time - was used to carry out educational practices. The authors draw attention to the importance of this experience for the

construction of the history of education in Pernambuco. The way it worked was similar to today's distance learning colleges: the student had to go to a school where the classes would be given via radio.

Finally, the article by Tavares (2015) was analyzed. The work focuses on Popular Education and Paulo Freire's theory, directly addressing the campaign You Can Also Learn to Read by Standing on the Ground (*De Pé no Chão Também se Aprende a Ler*), in Natal/RN, and other important social movements for education. Although the aforementioned campaign is not contextualized in Pernambuco or Bahia, the author also addresses social movements and the Popular Education discourse in Pernambuco.

Analyzing all the articles, it becomes evident the great diversity of experiences and practices, in addition to the interdisciplinary and intersectoral character, since the pedagogical practices addressed have different natures and are contextualized in different areas. This corroborates the idea of Gadotti (2012) of plurality intrinsic to popular education.

It was also found the possibility that non-formal educational practices are formalized over time, corroborating the thought that social, popular and community education can be executed outside the formal scope and, even so, continue to be formal - considering the scientific rigor, objectives, regulation and certification (Gadotti, 2012). As an example, we mention the Agricultural Family School and the Itinerant Schools of the Landless Movement (*Movimento Sem Terra*, MST).

It is worth noting that it was not possible to identify any author network - that is, the authors and co-authors of the analyzed articles are not shared and are not repeated among themselves. This shows that, although important and necessary, the studies presented are sporadic, and not continuous research. Furthermore, they show the inexistence of study networks, whether groups or research projects that aim to analyze and evaluate this type of initiative.

In this sense, therefore, it is essential to establish a study agenda that seeks to investigate and analyze the educational practices in non-formal environments, especially in the context of the Northeastern semi-arid region - a region that presents high rates of illiteracy and other inequalities as a result of educational public policies implemented wrongly or erroneously over the decades.

V. CONCLUDING REMARKS

This analysis made it possible to emphasize the importance of educational processes in non-school spaces

in socioeconomic development not only in the national, but also in the regional context. This happens especially because such educational practices leverage the schooling process, even without a curricular function, as seen in countless youth and adult programs developed by governmental and non-governmental institutions, as well as strengthen other social practices, such as human rights, housing, and agro-ecological practices, making it possible to say that the result of these processes, which have their roots in the organized action of social movements, has effectively played a fundamental role in the process of Brazil's socioeconomic development.

The analysis also shows that there is an evolution within these educational processes in non-school spaces, because if it's made an analysis of these processes by two decades ago, it can be seen that these movements had a role much more linked to claiming demands for rights that were not guaranteed within the Brazilian social/educational policy. It was precisely these educational processes, the social organization, the struggle within these movements that made it possible to notice a change in this picture over the last two decades.

In this way, movements that in the past were in the condition of claiming rights, today occupy spaces in decision-making processes within the state policy. This implies saying, for example, that many agendas that in the past were demands, today are presented as public policy, as is the case of Rural Education, where it is possible to notice that, from 2002 to the present moment, it has presented a significant evolution in the offer and guarantee of this right.

In Bahia and Pernambuco, this situation consolidates the perspective that is presented throughout Brazil and, in this sense, it becomes evident the importance of taking social movements and popular groups into the decision-making processes and into the educational policy, just as Paulo Freire did when he took over as Secretary of Education in São Paulo. This implies placing the subjects as protagonists of their own rights, and this was a significant advance that occurred as a result of this political training.

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Appendix

Table 1 - Criteria for corpus selection

Time cut-off	Last 15 years (2005-2020)
Describers	Educação não-formal, movimentos sociais, Permanbuco, Bahia
Database	Google Scholar

Font: Elaborated by the authors (2021).

Table 2 – Articles selected for the corpus of this systematic review

AUTHORS	YEAR	TITLE	OBJECTIVE
Carvalho, M. S., & Santos, A. R.	2020	Pronera as a public educational policy at the University of Southwestern Bahia - UESB	To analyze the National Program for Education in Agrarian Reform (Pronera) as a public educational policy implemented at the University of Southwestern Bahia (UESB), demonstrating the implications and consequences undertaken by the State model for the individuals who are benefited by this educational strand.
Hora, E. A., Filho & Marques, F.	2015	Educational practices in ProJovem Urbano in Recife/PE: differentiation, locational factors and problems in the neighborhoods of Brasília Teimosa and Ibura	To develop an approach on the pedagogical practices and problems of the ProJovem Urbano. Making a differentiation on the locational perspective between the neighborhoods of the RPA6 of Recife-PE, more specifically the neighborhoods of Brasília Teimosa and Ibura. Through the view of locational factors and the dynamics of existing relations in the communities and their social processes, it intends to expose the difficulties of the educational process in youth and adult education, which is configured as an Urban Social Movement.
Chaves, L. et al.	2014	Course "Popular participation, social movements and the right to health": an experience of popular education in Health in Bahia from MobilizaSUS	Strengthen the performance of social movements in the political arena of health in Bahia.
Souza, K. F. B.	2007	Radio and Educational Practices in Recife in the 1960s	To demonstrate the use of radio as a resource to promote education in Recife in the sixties.
Tavares, M. T. G.	2015	Popular education and contemporary social movements: some notes for reflection	To reflect on Popular Education in contemporary times, thinking about and deepening questions related to its role in the current situation of brazilian society, especially in social movements.

Font: Elaborated by the authors (2021).

Real Time IOT-based Crop Protection and soil maintenance

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Abstract— Nowadays IOT is implemented in almost every field. IOT in agricultural field plays a major role. It is very easy to monitor and manage the water flow. The moisture level in the soil is measured using moisture level sensor. When the soil is dry and reaches the threshold point, the Cloud Service Brokerage triggers the relay to start the motor. Once the motor starts to pump, it pumps the water from a storage tank and the water flows to the field. pH sensor senses the pH level of the water. The sensor will check pH level of the water whether it is alkaline or acidic. DHT sensor is used to measure the humidity of the environment. Our main objective of this system is to maintain and manage the optimized moisture content in the soil, pH of the water and to have a knowledge about the humidity content in the environment.

I. INTRODUCTION

Traditional farming method and agricultural practices are transforming into smart agriculture due to the emerging importance of Internet of Things. Low cost and low power are the main factors that makes IOT network much friendly to the farmers. Water use efficiency and energy use efficiency are the key focus of the innovation in the modern agricultural fields. Irrigation ensures the proper crop yield overall also it might lead to the wastage of water resources. The key thing in IOT is communication between the devices with the help of internet connection . Agriculture is the backbone of our country and it is the main source of income for many people. Irrigation is the method of regulating the amount of water flow to the crops in a regular interval of time in order to keep the crop healthy. As our population keeps on growing, it is very hard to see a good yield. In order a yield good, we are in need for freshwater for irrigation purpose. To avoid the wastage of freshwater, we can use IOT. Unless there is need for water, the water will not be pumped. Hence wecan reduce the water consumption and

wastage. With help of IOT we can able to consume water in an optimised manner. With optimised irrigation, the growth of weed can be controlled in the field. Internet of Things is a huge network of connected devices in which data are collected, shared or canbe used for some other purpose based on the requirements.

II. PROBLEM IDENTIFICATION

Recent days agriculture plays a major role in the society. To improve this urgent need of the farmers, the youngsters have developed many technologies which are more useful for the farmers and are available at our door steps. The farmers have confusion about the cultivation in different seasons. In "REAL TIME IOT BASED CROP PROTECTION AND SOIL MAINTENANCE", we have analysed the environmental conditions like temperature, humidity, pH level of water and finally the moisture level of the soil. By measuring these fields, the growth and cultivation of the crops can be increased at a significant amount. The above mentioned parameters will be measured

and those things will be stored to a database in a cloud platform which can be used for future purpose.

III. LITERATURE SURVEY

Ayush Kumar utilized IOT and picture handling to locate the supplement and mineral deficiencies that influence the yield development [1]. M.K. Gayathri and her team had done their work on quick development on agrarian modernization and helps to acknowledge answer for horticulture and explained in detail about the issues identified with ranchers [2].

Dr.M.Suchitra and her team utilized IOT for reduce the hassle in agriculture due to migration of people from one place to another place. The Internet of factors (IOT) is remodeling the agriculture permitting the farmers with the extensive variety of techniques consisting of precision and sustainable agriculture to face demanding situations in the field [3]. In [4], they have proposed little or very less technological development is found right here that has expanded the manufacturing performance extensively. To increase the productiveness, a singular design method is supplied on this paper. Smart farming with the help of Internet of Things (IOT) has been designed. P. Munisami has proposed the farmers had failed to reflect on con sideration on the humidity, level of water and especially climate circumstance which horrible a farmer increasingly more The Internet of factors (IOT) is reworking the agribusiness empowering the agriculturists thru the massive range of strategies, as an instance, accuracy as well as sensible forming to deal with demanding situations in the subject. He installed remote cameras to monitor the situations which requires power back all the times.

IV. PROPOSED SYSTEM

In this paper, we have proposed a low power, low cost IOT network for smart agriculture. To monitor the soil moisture level an in-house development sor is used In the proposed network, the IITH mote i s been used as a sync and sensor node which gives us a low power communication. We have evaluate d for the condition of the art networks for the agricultural monitoring. The proposed network consume s less power and in average provides 83% longer lifetime at a very lower cost. The idea is to manage t he water level in the farmland which results crop protection and soil maintenance.The soil moisture sensor senses the moisture level of the soil in the farmland. The pH sensor senses the pH level of the soil.

The DHT sensor is used to measure the humidity and the temperature of the environment. These readings are then send to the cloud server brokerage using the network node.

The sensor reading transmitted to a Thing speak channel for the analysis. The cloud storage brokerage instructs the relay to turn ON/OFF the motor for managing the water level based on the analysis of the pH value and the moisture value. The proposed system is also capable of performing weather prediction based on the list o f the available records of the sensor reading.This system helps in the good and proper maintenance of the crops in case of water and nutrients availability. This results in the better yield of good crops which in turn gives the farmer huge profit.
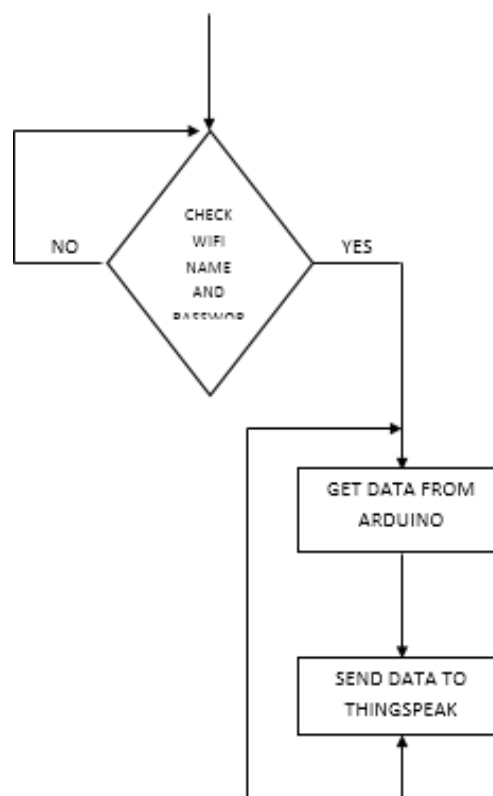
V. FLOW CHART

RECEIVER SIDE:

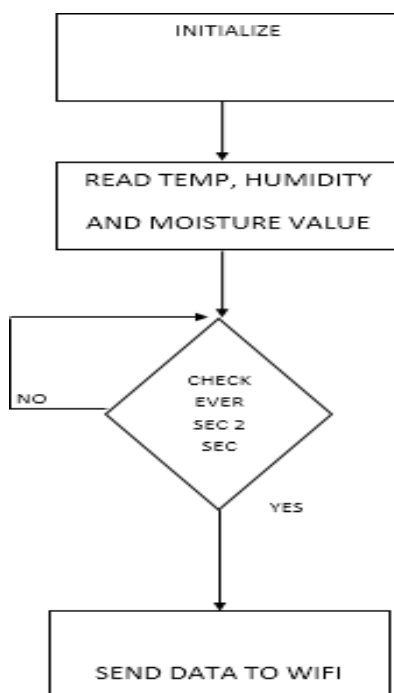*Fig 1: Block diagram of receiver side*

TRANSMITTER SIDE:
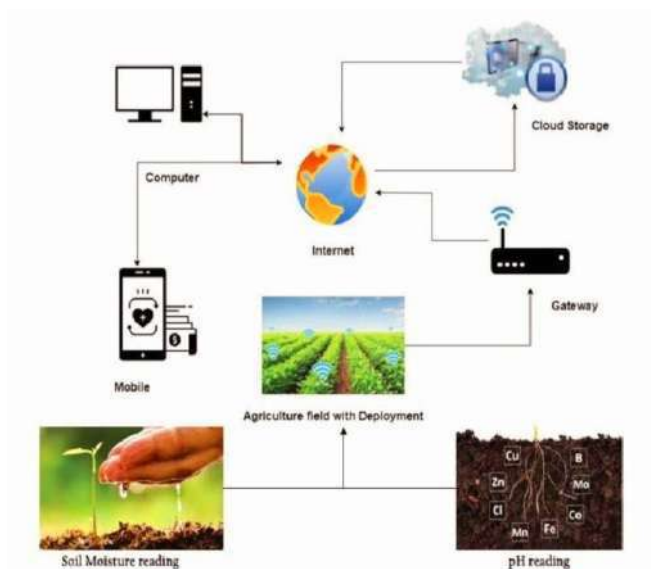

Fig 2 : Block diagram of transmitter side

VI. SYSTEM ARCHITECTURE

Fig 3: system architecture of the Real Time IOT based crop protection and soil maintenance

VII. TABULATION(DATASHEET):

Table.1: Agriculture Irrigation system by using IOT

Field Name	Attribute	Type	Size	Description
Id	Primary key	Int	10	It uniquely store id in the table
Temperature	Null	Int	12	It store Temperature of the Agriculture Irrigation
Humidity	Null	Int	12	It store Humidity of the Agriculture Irrigation
Moisture	Null	Int	12	It store Moisture of the Agriculture Irrigation

Table Description: This table stored Agriculture Irrigation information

VIII. TABULATION OF PERFORMANCE METRICS

Created_at	entry_id	temperature	humidity	pH_level	Moisture_level
2021-02-27 08:29:12 UTC	21	31	32	NORMAL WATER	10
2021-02-27 08:29:34 UTC	22	31	32	NORMAL WATER	10
2021-02-27 08:38:08 UTC	23	30	30	NORMAL WATER	20
2021-02-27 08:38:49 UTC	24	30	33	EMPTY	20
2021-03-21 06:43:31 UTC	25	30	30	NORMAL WATER	20
2021-03-21 06:51:50 UTC	26	30	30	NORMAL WATER	20
2021-03-21 06:55:24 UTC	27	31	30	NORMAL WATER	10
2021-03-21 06:55:44 UTC	28	30	43	EMPTY	10
2021-03-21 06:55:59 UTC	29	30	43	EMPTY	20

The values of temperature, humidity, moisture a variable id is created for every parameter. The value is being analysed by taking various reading of the temperature, humidity, moisture. If the moisture is zero, the motor has to be switched ON. When the moisture value reaches the threshold, the moisture content in the field is good and the motor has to be switched OFF. It gives a clear viewof the changes in the value for the respective change of time.

IX. RESULT

The implementation of new scientific methods into this field can bring about positive changes in the productivity of the crop. . Different type of sensors are used to collect the information of the farmland with the environmental conditions and this information is transmitted through network and its been stored in the cloud. With the data in the thingspeak channel we can analyze and visualize it and calculate new data.

Fig.4: Soil moisture

Fig.4: Temperature

Fig.5: Humidity

X. ADVANTAGES

The system can bring large areas of land under cultivation.It includes the design of the system that may monitor the farm by installing sensors at the boundary of farm.It has the capacity of reducing the manpower.It can use only the exact amount of water.

XI. APPLICATIONS

This proposed system can be improvised by using a sensor to note the soil ph value.the senors are successfully interfaced with Arduino and wireless communication is achieved.All observations and tests prove that this project is a complete solution to field activities irrigation problems. Implementation of such a system in the field can help to improve the yield of the crops aids to manage the water resources effectively reducing the wastage.

XII. CONCLUSION

Agriculture is evolving day by day and its gradually being replaced and enhanced by more sophisticated techniques which uses electronic devices. A high percentage of agriculture revenue is lost to power loss and incorrect methods of practices. These errors can be reduced with the help of smart devices. Our proposal is to perform the agriculture in smart and more efficient way. In addition, this method advocates for the use of the Internet of Things. Internet of Things has enablesthe agriculture crop protection and maintenance in a easy and more efficient to enhance the productivity of the crop and hence profits the farmer. Different types of sensors are used to collect the information of crop conditions and environmental changes and this information is transmitted through network to the

farmer/devices that initiates corrective actions. Farmers are connected and aware of the conditions of the agriculture field at anytime and anywhere in the world.

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Assessment of monitoring in the teacher's function: A statistical study in engineering classes in a university of the state of Rio Grande do Sul, Brazil

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Abstract— Monitoring is understood as a teaching modality that enhances the learning of university students. This work aims to analyze the average of the final grades of students of the Cartographic and Surveying Engineering undergraduate course in four cases: with three monitoring schedules, with two monitoring, with one monitoring and without monitoring; thus, verifying the occurrence of improvement in students' learning according to their final average grade. The students' means were analyzed by analysis of variance (ANOVA) and were compared using the Tukey´s test. 5% was considered as the level of significance. The statistical computational system R was used for all analyzes. We found that monitoring is of essential importance in the lives of academics, its inclusion provided an increase in the average grade of students in the Statistics and Probability component in the Cartographic and Surveying Engineering undergraduate course. We can say that monitoring is a factor that influences the average of students.

I. INTRODUCTION

Monitoring is one of the programs to support teaching at the Federal University of Pampa (UNIPAMPA). The Undergraduate Monitoring Program aims to promote aid in the development of a discipline in order to support academic teaching and learning [1]. In addition, it is used as

an important tool to assist in the development of academic activities, as well as providing positive experiences for student monitors and other university students [2].

In the statistical and probability curricular component, monitoring is an alternative for students to expand their knowledge using a more informal language.

Among the different ways of carrying out monitoring activities, we can mention the case where the monitor is present in classes, helping the teacher and students and reserving time for attending students [3].

More than the expansion of knowledge, monitoring is based on the construction of a future teacher, which encourages the monitors a brief statement of what it would be like to act in the teaching area. The monitor also helps in the personal growth of the student and to maintain responsibility, the attitude towards the final averages and the abundant study outside the classroom. In addition, monitoring can contribute to the construction of knowledge and evaluation processes [4,5]

Ethics is very comprehensive in monitoring. It requires exemplary behavior on the part of the monitor, remitting to his students characteristics that are equivalent to his professional life. Instigating a planning of activities for the students, making them obtain the desire for knowledge, researching and living experiences that result in softer knowledge, it is up to the teacher/coordinator of the monitoring project together trained students.

On the responsibility for the academic education of the other, from the moment the monitor understands his role, he transposes the view that he is solely responsible for his education, starting to occupy a prominent place by exercising a privileged function, full of possibilities for the education of the monitored and the monitor itself. It requires a commitment to this occupation, which includes, among other responsibilities, observing schedules and showing zeal for the learning of others [6].

Monitoring is hard and challenging work, but it motivates many other students to experience this, bringing new learning methods and teachings, experiences in academic life and an excellent relationship between teachers and students. This is often what is necessary for the training of new teachers for the teaching institution itself during their undergraduation.

The Monitoring Program emerges as a possibility to learn the complexity and ambiguity of teaching in the early years of training. In addition, monitoring enables a cooperative relationship between the teacher and the monitors, improving the learning of both [7].

We know that it is not a commitment to teach or learn, but to pass on knowledge and let students make their choices for what is best for them. And through this to be fully evaluated by the merits achieved during the monitoring period.

However, both roles are related, as paths cross in the teaching and learning process in which everyone in a certain way teaches and also learns, exchanges infinite coexistence

leading to a constructive routine and maintaining an environment where teachers and students are in contact. the same level, which makes it irrelevant to consider that there is a high level among the participants.

The monitor is the one who helps in the training of the monitored and the one who learns from the monitored and the teacher. Monitoring is shown to be a tool that enables the fulfillment of one of the basic objectives of the learning process during under graduation, the process of learning to learn [8].

We can historically notice the structural growth of monitoring in the educational scenario. Federal Law No. 5,540 / 1968 implemented operating standards for higher education and designated academic monitoring. Article 41 says that universities should create monitoring activities for higher education students [9]. The National Education Guidelines and Bases Law provides in its article 84 that higher education students may be used in teaching and research tasks by the respective institutions, exercising monitoring functions, according to their performance and their study plan [10].

Given above, this work aims to investigate the monitoring effect on the final grades of undergraduate students in Cartographic and Surveying Engineering in four cases: three monitoring schedules offered to students in that discipline, two monitoring schedules, one monitoring schedule and no monitoring; thus, verifying the occurrence of improvement in students' learning according to their final average grade.

II. METHODOLOGY

We use the final averages of students from classes in the Statistics and Probability discipline of the Cartographic and Surveying Engineering (CSE) course at the Federal University of Pampa. For this purpose, grades from four classes were considered: A - class 2016/2 (28 students), B - 2017/1 (31 students), C - 2018/1 (38 students) and D - 2019/1 (29 students).

The students' average grades were analyzed by ANOVA (Analysis of Variance), whose model is given by

$$y_{ij} = \mu + \mu_i + \varepsilon_{ij} \qquad (1)$$

where y_{ij} is the average score of student j in class i, μ is a constant, μ_i is the effect of class i and ε_{ij} is the experimental error associated with student j in class i. The model in (1) assumes that the errors are identically distributed with a normal distribution of zero mean and constant variance, ie $\varepsilon_{ij} : N(0, \sigma^2)$. Still, in the model in (1), the inherent hypotheses of the model are:

$$\begin{cases} H_0 : \mu_A = \mu_B = \mu_C = \mu_D \\ H_1 : \text{at least one } \mu_i \text{ differs from the others (i=A,B,C,D)} \end{cases}$$

that is, the H_0 hypothesis is associated with equality between classes, so the average grade in the four classes is the same, which means that the monitoring did not provide differentiation between the average grades. In hypothesis H_1, there is at least one non-zero difference between the average grades of the classes. To test the null hypothesis (H_0) we must obtain the test statistic, which is given by the ratio of variances due to classes and due to random causalities (residual) [11]. Variations due to classes, also called sum squares of treatments (*SQTr*), and residual, also called sum squares of residuals (*SQR*) are calculated by:

$$SQTr = \sum_{i=1}^{I} n_i \left(\bar{y}_i - \bar{y} \right)^2 \qquad (2)$$

$$SQR = \sum_{i=1}^{I} \sum_{j=1}^{n_i} \left(y_{ij} - \bar{y}_i \right)^2, \qquad (3)$$

where y_{ij} is the average grade obtained by student *j* in class *i*, $\bar{y}_i$ is the average of class *i*, $\bar{y}$ is the general average, is the number of students in class *i* and *I* is the number of classes. The variances due to the classes, also called Mean Squares of treatment (*MSTr*), and Mean Squares of residuals (*MSR*) of the grades are, respectively,

$$MSTr = \frac{SQTr}{I-1} \qquad (4)$$

$$MSR = \frac{SQR}{I(n_i - 1)}. \qquad (5)$$

It can be shown that the ratio between equations (4) and (5) follows a Fisher–Snedecor distribution with parameters *I-1* and *n-I*, that is

$$F_c = \frac{MSTr}{MSR} : \ F_\alpha \left(I - 1, n - I \right). \qquad (6)$$

Thus, to decide whether or not to reject the null hypothesis, the calculated statistic *Fc* is compared with the α-th quantile of the *F* distribution, that is, H_0 is rejected if $F_c > F_\alpha \left(I - 1, n - I \right)$, where *n* is the total quantity of students. Alternatively, to decide whether to reject the null hypothesis or not, you can use the p-value. If the p-value is less than the level of significance, the null hypothesis must be rejected. More details can be seen in [12].

Therefore, we are interested in checking which of the averages are different from each other. For that, we used the Tukey´s multiple comparison test [13]. The difference between class averages is compared with the calculated critical value.

$$\Delta = q \sqrt{\frac{MSR}{2} \left(\frac{1}{n_i} + \frac{1}{n_j} \right)} \qquad (7)$$

where Δ is the critical value, *q* is the value of the total studentized range based on the Tukey distribution, n_i and n_j are the sample sizes *i* and *j* to be compared and *MSR* is the average square of the residual.

When the difference is less than or equal to the critical value, it means that the averages are different. For better evaluation of the results, different lower-case letters are used in different classes and the same classes will receive the same lower-case letters.

We used the Q–Q (quantile-quantile) plot to evaluate the model's assumptions in (1). The Q-Q plot consists of the points:

$$\left\{ \left(F^{-1} \left(p_i \right), x_i \right), i = 1, \text{L}, n \right\}, \qquad (8)$$

where $F^{-1} \left(p_i \right)$ is the inverse function of the quantile function of the Normal probability distribution, p_i are the percentiles and x_i are the data used to adjust the model, ordered in ascending order and n is the sample size (total number of students). The residues of the model in (1) have a Normal distribution if the points formed by the pair in (8) are close to a 45° line and are mostly contained in 95% confidence bands [14]. α = 5% was considered as the significance level for the tests, according to [15] and all analyzes were performed using the R Statistical Computational System [16] through the RStudio integrated interface [17] and the *agricolae* and *asbio* packages [18,19].

III. RESULTS

We can see that monitoring is a factor that influences the average of students. Through descriptive measures it can be seen that class C had greater amplitude and greater standard deviation, causing a high variability of the grades.

Table 1. Descriptive statistics of the four classes of statistics and probability of Cartographic and Surveying Engineering, UNIPAMPA-Campus Itaqui.

Descriptive statistics	Class			
	A - 2016/2	B - 2017/1	C - 2018/1	D - 2019/1
Sample size	28	31	38	29
Average	3.46	5.28	5.45	5.89
Median	2.95	6.08	6.01	6.31
Minimum	0.25	1.45	0.33	1.75
Maximum	7.55	8.76	9.43	10.00
Range	7.30	7.31	9.10	8.25
Standard deviation	2.23	2.34	2.39	2.32

While class A had less amplitude and less standard deviation, consequently the grades had very close values, with no variability. In class D, their final grade average approached the approval average established by UNIPAMPA, also reaching a maximum value in the final grade.
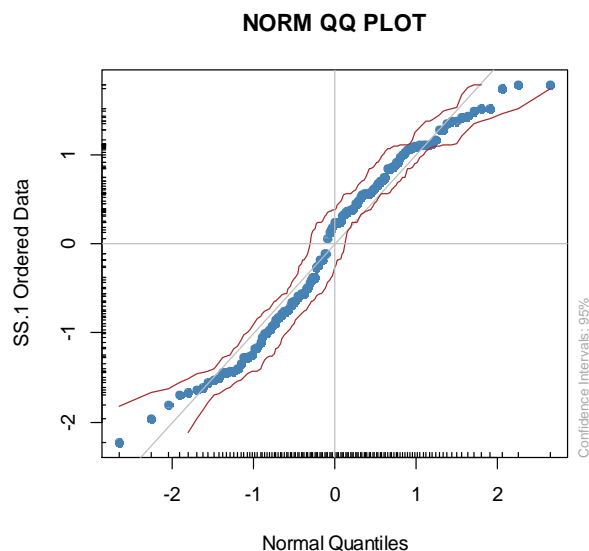
NORM QQ PLOT

Fig. 1: Normal Q-Q plot of the ANOVA residues of the students' grades of the four classes evaluated in the statistics and probability classes at UNIPAMPA-Campus Itaqui.

We can see in figure 1 that the residuals of the ANOVA model are normal, since the ordered pairs formed by the theoretical quantiles of the standard and empirical normal distribution are close to a 45 ° line and are contained in the 95% confidence bands (red lines).

In order to verify the homogeneity of the class variances, the box-plot graph was used (Figure 2), where it is possible to verify the form of data distribution, in which the center of the distribution is indicated by the median line (in the center of the box), the top line is the third quantile of the data set and the bottom line is the value of the 1st quartile. As all classes have practically the same amplitude, difference between the 1st and 3rd quartiles, it can be said that the variances of the average grades of the classes are homogeneous. Thus, and in accordance with the results of figures 1 and 2, the ANOVA results are valid.
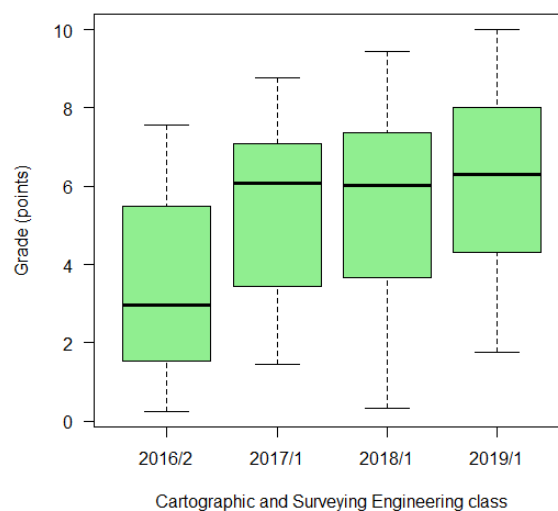

Fig. 2: Box-plot of students' grades in the four classes of statistics and probability classes at UNIPAMPA-Campus Itaqui.

In view of the results obtained, we can emphasize that the monitoring project is of paramount importance and fulfills its goals, as it brings returns to the teacher, to the monitors and is an alternative to the students, not only adding in their averages and academic history, but also in development within the educational institution.

Academic monitoring is recognized by teachers and students as a facilitating tool for achieving an effective teaching and learning process, both for those who exercise the function of monitor, supervised by a supervising teacher, and for the monitored, so that their knowledge and practices are strengthened [6].

In the dynamics of the relationship between the monitor and the monitored students, monitoring is more than a process instituted in the context of higher education, it is like a meeting point between apprentices, who identify themselves in the form of peers, under the understanding that the student's condition equals them, despite the monitor being in one or more academic periods ahead of the monitored. The literature brings some studies of situations that are beyond the reach of the monitor, such as the extra hours that the student spends to study a certain content, contents that the student is more familiar with and the time that he spends to complete an evaluation [20–22].

This conception emphasizes monitoring as a process that fosters learning, considering that the student supported by the monitor finds fertile space for clarifying doubts and consequent strengthening of skills, enhancing their knowledge with a lower degree of fear and in a more

accessible way. This happens both in terms of maintaining contact, the language closest to and adapted to the student's reality, as well as the symmetries of their academic experiences, which differs from the student-teacher relationship, which is sometimes represented by fear, shyness and verticality on the part of the apprentice [6].

Table 2 - Table of analysis of variance (ANOVA) of the four classes in the statistics and probability classes of Cartographic and Surveying Engineering, UNIPAMPA-Campus Itaqui..

Variation Source	DF	SQ	MS	Fc	F	p-value
Groups (SQTr)	3	99.6	33.2	6.14 2	2.6 8	0.00063 4
Residual (SQR)	12 2	659. 5	5.4 1	-	-	-
Total (SQT)	12 5	759. 1	-	-	-	-

* DF: Degrees of freedom; SQTr: Sum Squares of treatment; SQR: Sum squares of residuals; SQT: Sum squares of total; MS: Mean square; Fc: Fisher-Snedecor critical quantile statistic: F: Fisher-Snedecor theorical critical quantile.

After carrying out the analysis of variance, we can see through the hypothesis test that at least one of the class averages is different, since the p-value test is less than 5% (Table 2). It is then necessary to perform the Tukey´s test to know which of the averages is different.
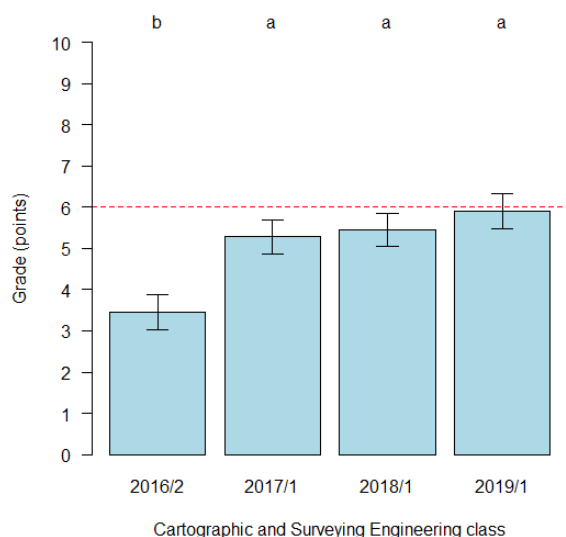
Fig. 3: Barplot of the averages of the four classes of the statistics and probability classes of the undergraduate Cartographic and Surveying Engineering, UNIPAMPA-Campus Itaqui.

Using the Tukey´s test [23] we analyzed that class A showed a difference between the others, while classes B, C and D are statistically equal and higher than the average grade of A. Although there is evidence that leads us to conclude that classes B, C and D differ from each other, when comparing their averages in table 1, neither one was significantly different.

Class A had a real average grade value significantly lower than the other classes. Considering all of this, the monitoring activity is seen as a space that promotes reflection, since different strategies are used to encourage students to review and deepen the curricular content worked in class. This practice was considered adequate to achieve better results at the end of the school semester.

Therefore, we can conclude that the presence of at least one monitor favors the class average to increase. Another observation: additional schedules / monitors do not provide a significant increase in the class average. It should be noted that the results are restricted to statistics classes in which the teacher provides lists of exercises to each class to students and the tests are given through open questions. Possibly, the result may be subject to change if the area of study were changed, for example, in human sciences area.

IV. CONCLUSION

We can conclude that there is a difference between the averages of classes A, B, C and D by the Tukey´s test. There is no difference between the average grades of classes B, C and D.

We can also state that monitoring is of paramount importance for all the people involved: monitor, teachers and students. 1) Because it is an experience for the monitor that can generate a future teaching career; 2) for the teacher, because he has someone to help him; 3) for students to have one more possibility to learn the content, to reinforce everything that is being taught by the teacher.

The program enables academic enrichment in the course area in addition to fostering interest in the teaching career of the student monitor, as the development of activities enables the skills and techniques of the teaching professional [24].

Monitoring practices are very important. They facilitate the learning process and help students to overcome problems, blocks, pressures, internalized difficulties that limit learning. The findings related to the characteristics of the monitoring emphasize the monitoring of students in their times, rhythms and advances, in personal and collective difficulties.

V. FINAL REMARKS

We understand, therefore, that the monitoring proposal is significant and is defined precisely in the way it is administered and in the commitment of those involved. Inadvertently, one might think that monitoring is an easy teaching modality; however, on the contrary, it is a demanding practice, which requires constant monitoring and care in the training and qualification of the monitors and a lot of effort by the guiding teachers. In Higher Education, taking on this pedagogical proposal can bring advances to student learning.

The work addresses the influence of the number of monitors in improving the students' average grade and other variables were not considered, such as the shift in which the students had the monitoring and classes, the socioeconomic conditions, among other variables. Very possibly, the average grade of a student is related to several other factors and several works in the literature address these characteristics [24–30]. We emphasize that the disciplines mentioned were taught by the same teacher in that discipline and the monitors involved had the same level of education and training to carry out the monitoring activities. However, it is known that different people with the same level of education can develop content in a more / less engaged way. Thus, we reinforce that our results should be interpreted with some caution when extrapolated to other disciplines in other areas, such as Humanities.

Thus, the monitoring program positively influences the Cartographic and Surveying Engineering undergraduate course, strengthening teaching and promoting interaction among the entire academic community.
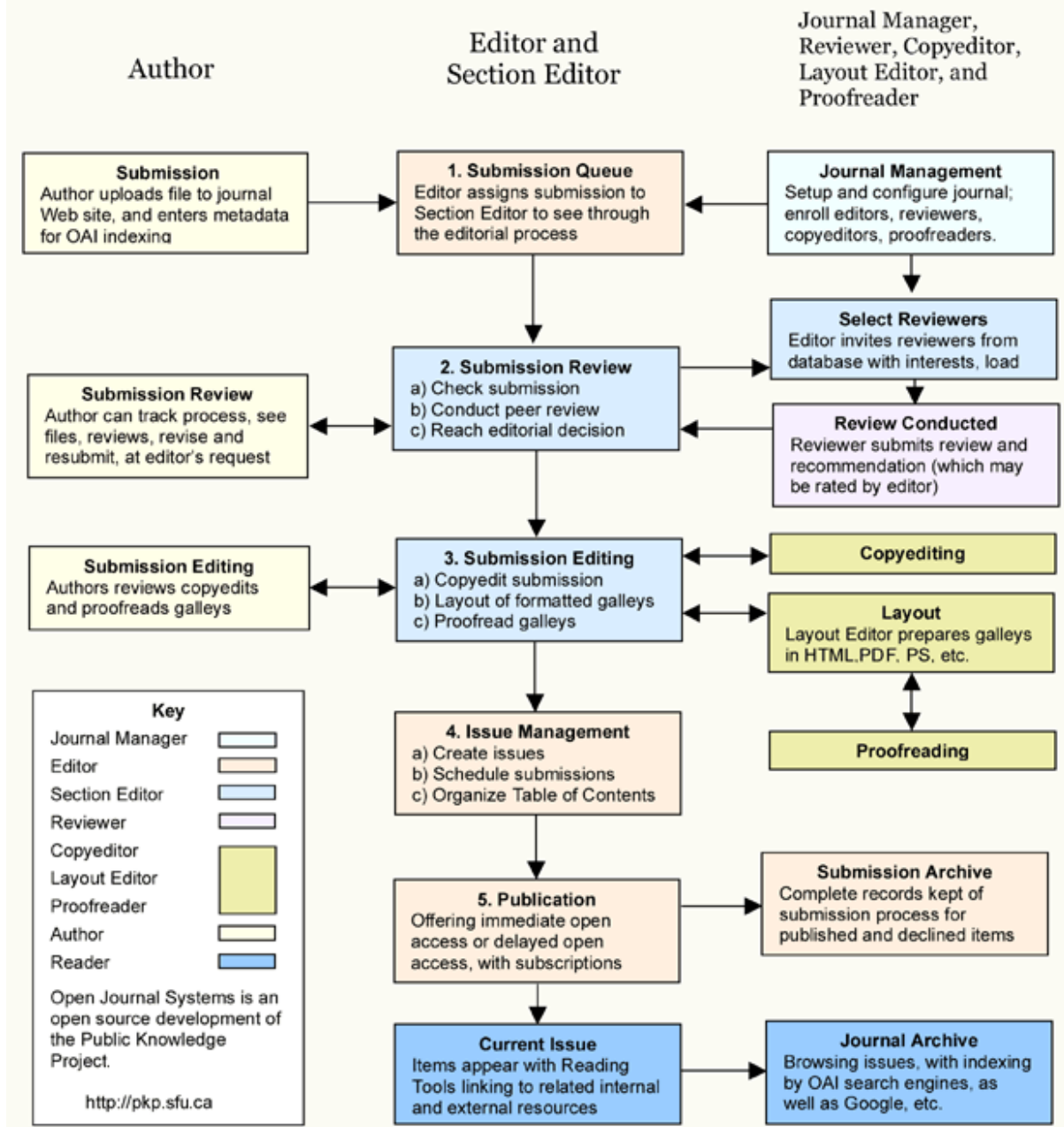
ACKNOWLEDGEMENTS

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