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SUMARIO ● SUMMARY ● RESUMO

Editorial

This issue of MLS Project Design & Management reinforces the multidisciplinary academic and scientific participation of our collaborators in the design, development, and implementation of tools and instruments applicable to business development, education, and integrated projects. Innovation in scientific-technological development is a fundamental feature reflected in the main objectives of the journal as part of its lines of research and dissemination. This new edition presents 10 articles selected for the technological innovation and methodology implemented by the authors for their publication. The main research corresponds to the discipline of management and business development integrating methodologies that solve challenges from the optimization of various companies to the consumer's perception when choosing their goods and services designed strategies that improve the performance of the company and at the same time improve the satisfaction of customer needs. Within the education section, ICTs and civic education of students in current situations and the adaptation of teachers and students to the changes of the COVID 19 pandemic are integrated, the studies present the creation of digital applications that improve the quality of life of users, and the implementation of competency-based learning reflecting the improvement of teachers' teaching and students' understanding.

The first article demonstrates how competency-based learning in Uruguay will be the fundamental key to creating a solid Education at the national level. The above derived from the adaptation of ICTs in the pandemic period, demonstrating the benefits in a small community and being implemented in large communities under the educational criteria in the New Normal.

The research presented in the second article of this edition, statistically demonstrates that the application of an adequate telework system increases job satisfaction and the emotional salary of the company's workers. The above was studied and implemented in Antel, a public telecommunications company in Uruguay.

The third article, under a systemic approach, demonstrates the attitudes and perceptions of young people from rural communities towards agribusiness in the province of South Kivu in the Democratic Republic of Congo. A Likert-type questionnaire applied to 456 randomly selected young people between the ages of 15 and 35 using the Bernoulli Urn technique in the Kabare, Walungu and Uvira territories revealed that 53.5% of the young people have a negative attitude towards agribusiness, 29.8% have a neutral attitude and only 16.7% have a positive attitude. Finally, the authors propose strategies to improve the attitudes and perceptions of young people towards agribusiness.

The fourth article, under a quantitative approach, analyzes whether the incorporation of a new AI technology as a functional requirement for the development of a product impacts the project management effort by measuring the hours invested in this task. This research highlights that the effort in management tasks does not present major differences in the development of the product.

The study developed under the theory of Barrett (2017) about the model of the seven levels of consciousness relates coaching and empowerment in the automotive sector of a company in Ecuador, is presented in the fifth article of this edition. The results showed a significant relationship between coaching and empowerment, where the association is significant with a strong positive Spearman correlation coefficient of =0.637, concluding that the implementation of strategies with coaching sessions generates a high benefit within the business environment and promotes high performance in the management of human talent of the company's workers.

Under the complexity of regulating the incorporation of the so-called "eco-design" in the creative stages of a project, the sixth article lists the challenges faced by small Mexican product companies when incorporating the ISO 14006 Standard, a description of the design processes within them and the contribution of a new design profile capable of addressing complex projects, facilitating the transition of companies towards more sustainable ones, closing with a discussion focused on the scope, challenges and limitations.

The seventh article presents a project with civic purposes, which aims to apply 4.0 technologies to the care of the city through simple proposals from students with the creation of

digital applications. The results are shown in two parts. The first as the groups of students and their pedagogical objectives and the second as the citizens and their perception of the services provided by 4.0 technologies in their daily lives, resulting in the improvement of the good for the community and a widespread use of the applications in the citizens in an effective way. The eighth article, based on consumer behavior when choosing the goods and services to be consumed, the objective of this article was to explain the main effects of the COVID-19 pandemic on the behavior of food consumers in Santa Cruz de la Sierra (Bolivia), concluding that the emergence of a new factor in consumer purchasing choices, increased purchases of antibacterial gel, alcohol, liquid soap, among other personal care items, and the importance acquired by online shopping and delivery. Such effects are positive and have been incorporated into the culture of consumers, since they facilitate the satisfaction of their consumption needs.

The ninth research developed in Popayán-Colombia, reflects a bibliographic analysis between Urban Resilience as the capacity and ability of an urban system to maintain its functionality in the face of impacts or catastrophes of natural or anthropic origin, and Adequate Social Housing, as a basic need of every human being. Qualitatively demonstrating a low inclusion of Urban Resilience in social housing regulations at the national and local levels, a medium inclusion at the academic level and a low inclusion at the professional level. It also indicates the need to generate and implement territorial strategies of a political-administrative nature that involve these concepts in the development of low-income housing at the urban level.

Finally, the objective of the tenth research was to determine the factors related to the digital maturity of manufacturing SMEs, in order to contribute to the knowledge about their digital transformation. The research design was quantitative, cross-sectional, exploratory and descriptive-correlational in scope. To test its reliability, a pilot test was conducted and Cronbach's Alpha was measured. From the statistical analysis, an equation was obtained to measure the degree of digital maturity in manufacturing SMEs in Nuevo León that contributes to the progress in the digital transformation of manufacturing companies in the state.

Before concluding this editorial, it is important for all of us who collaborate in this new project to thank the team of collaborators, IT and technical, as well as the Ibero-American University Foundation (FUNIBER) and the Universities that have provided all the material support so that this issue can be carried out, with the conviction that we are on the right path towards international recognition.

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RESPONSE CAPACITY OF THE EDUCATION SECTOR IN URUGUAY THROUGH ACCESS TO ICT BETWEEN 2020 AND 2021 IN PANDEMIC

CAPACIDAD DE RESPUESTA DEL SECTOR EDUCATIVO EN URUGUAY A TRAVÉS DEL ACCESO A LAS TICS ENTRE 2020 Y 2021 EN PANDEMIA

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ABSTRACT

The article is oriented to analyze how the educational sector in Uruguay adapted using ICTs in a period of pandemic, as well as the measures that were taken to mitigate these secondary effects and their changes. This was the product of a solid Competence-based Education; This has been possible due to the measures taken by the National Government, and in a summarized planning emphasizing the Competences. In particular, the benefits of competency-based learning in a small community and its implementation in large communities are investigated. The example of the suspension of classes at the national level in the Oriental Republic of Uruguay is presented, and later the learning data is analyzed according to the levels of everyone. From these analyzes it is observed that, in the reformulation of the teaching methodology in education, it has its fundamental complement in the Competences for the correct implementation, adapting to the New Normality. The implications of those who do not have the Competences of people or team members, do not adapt to market demands, lose their position and remain stranded in time. Competence-based learning will be the fundamental key to achieving the success of the stipulated objectives.

Palabras clave:

RESUMEN

El artículo se orienta a analizar cómo el sector educativo en Uruguay se adaptó mediante el uso de las TICs en un período de pandemia, así como las medidas que se tomaron para mitigar dichos efectos secundarios y sus cambios. Esto fue producto de

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TIC, educación, proyectos, Competencias.	una sólida Educación basada en Competencias; ha sido esto posible debido a las medidas tomadas por el Gobierno Nacional, y en una planificación resumida haciendo hincapié en las Competencias. En particular se indaga en los beneficios del aprendizaje basado en competencias en una comunidad pequeña y su implementación a las grandes comunidades. Se presenta el ejemplo de la suspensión de clases a nivel nacional en la República Oriental del Uruguay, y a posterior se analizan los datos de aprendizaje acorde los niveles de cada individuo. A partir de estos análisis se observa que, en la reformulación de la metodología de enseñanza en la educación, tiene su complemento fundamental en las Competencias para la correcta implementación, adaptándose a la Nueva Normalidad. Las implicancias que tienen quienes no poseen las Competencias de las personas o los integrantes de los equipos, no se adaptan a las demandas del mercado, pierden su posicionamiento y quedan varados en el tiempo. El aprendizaje basado en Competencias será la clave fundamental para alcanzar el éxito de los objetivos estipulados.

Introduction

In Uruguay, it was determined by law that the Uruguayan state would establish secular, free and compulsory school education, as well as the organization of its regulatory institutes and the subjects to be taught. This was in the Decree Law of Common Education on August 24, 1877 (ANEP, 2021). The education provided by the government is *secular*, that is, away from any religious doctrine, the education provided by the government is *free* for all individuals attending in the public sphere (belonging to the State) and education will be *compulsory* common and general, at the first level for School or Primary and at the second level up to three years minimum of Basic Secondary Education in Law 14.101 (Parliament of Uruguay, 1973).

In this sense, few phenomena have such a great capacity to modify a context as education, whether in socialization or social changes.

It is that, in this regional and national context, that since August 24, 1877 (Decree Law of Common Education), in Uruguay all institutions taught classes according to the traditional unilateral teaching model, the teacher speaks and exposes his knowledge, students listen, note and then study to be evaluated and graded (Educare Electronic Magazine, 2019).

In the beginning it was considered that the teaching teams had to be in the same physical place, working the stipulated hours; changes have taken place from a decade ago to the present, where they are carried out with virtual means, including people from different places, in order to achieve each of the deliverables, according to the established study plan (Oviedo, 2014).

It is in this sense that, in February 2017 in Uruguay began to insert the teaching methodology called ABPC (Competency-Based Project Learning), starting an introduction to young people of this new methodology being the basis for the preparation to the new multicontext of globalization that is presented in the formation of students (Pérez Aguirre, González Espada, & Sarasola Bonetti, 2022).

This meant a big change for everyone: a) teachers had to change the planning they had been doing for years, b) students had to change the model they were used to. For this, it was necessary to maintain the dynamic that, for the same objective, there are different motivations

This methodology is based on the premise that the learner must maintain the importance of learning by doing. In the opinion of the writer, information is obtained instantaneously through ICT (internet, laptop, tablet, cell phone, etc.) being these used as a means of support to students and teachers in order to achieve the desired objectives, i.e., the student can research and have the definition or subject to give at the time, and the important thing is to learn that knowledge with practice, i.e., with practical example cases.

It is understood that it is essential that the institutions take care and help their collaborators to learn and capitalize on this experience by developing resources and strengthening the teams, in order not to affect the students. This, in turn, makes it possible for the team to emerge stronger in confidence and leadership on a daily basis, thus empowering teachers, students and institutions.

In 2006, at the initiative of the Presidency of the Oriental Republic of Uruguay, the CEIBAL Plan (Conectividad Educativa de Informática Básica para el Aprendizaje en Línea) was implemented, being a plan aimed at social and technological inclusion that implemented the delivery of one computer per child and per teacher belonging to the Public Education system (Annual Report 2011, Presidency of the Republic)

This plan delivered laptops, connected people and study centers to the Internet and installed the infrastructure for their connectivity. This was a great step forward for the country, as it stood out as the pioneer in Latin America in carrying out this campaign to update educational tools so that its teachers and students could improve their learning performance.

With this plan, Uruguay began to move forward in favor of quality education, mainly oriented to people from a compromised social context, thus avoiding exclusion and their disintegration from the educational system. The plan was oriented towards the equality of people from the beginning of their learning in educational centers, using ICT at the service of education.

The final result was that 100% of the school population has its own computer equipment, thus equalizing opportunities for all of society and its future.

Since the beginning of the Ceibal Plan, Uruguay's educational system has been strengthened with nationwide Internet connectivity, as well as the ability for all students included in the system to have a computerized tool that allows them to advance in their studies.

In 2008, with the Ceibal Plan already in place, ICTs took on an important role in the daily work of both teachers and students; therefore, the need arose to rethink school administration in order to transform it, make it more agile and efficient, and that is why a software called GURI (Unified Management of Records and Information) was developed and implemented in the educational system, aimed at having an updated database of teachers and students and unifying management at the national level. In the same way, the GURI Teacher applications are being developed, with the objective of maintaining interaction between the central organization and all teachers at the national level, as well as the GURI Family application, which maintains the communication links between the organization (school, management) and the students. Both applications facilitate communication, speed in obtaining information, as well as improving access to it.

In March 2020, the Uruguayan educational system - as well as the entire population - faced an unprecedented reality in its history: the closure of all educational centers and the suspension of classes at all levels due to the COVID19 pandemic. The government decreed a national health emergency on March 13, 2020, and one day later, a 14-day suspension of classes in public and private schools was ordered, which was extended several times (Presidencia de Uruguay, 2020). And CODICEN's (Central Board of Directors) resolution No. 1 dated March 14, 2020.

According to data from the United Nations Educational, Scientific and Cultural Organization (UNESCO), in the 2020 school year (between March and August), educational institutions worldwide were closed for an average of 11 weeks. Adding 3 weeks of partial closures, i.e., a) in some regions of the country closed and in others not; b) when some grades worked face-to-face and others not, and c) when all centers are open, but there is a reduction in the time load of face-to-face classes (UNESCO, 2020). Based on these points, it can be said that on average the closure of educational institutions lasted approximately 14 weeks (three and a half months out of the six months taken into account). For the same period, the Oriental Republic of Uruguay had a total closure of 4 weeks of classes, since the centers in all grades in rural areas were only closed during that time. In the rest of Uruguay the closure was 10 weeks of classes. In addition, there were 4 weeks of partial closures; therefore, Uruguay is close to the world average, and below the average for Latin America, where the total closure of centers was approximately 18 weeks. (INEEd, 2021b).

Unlike other countries where the emergency generated the paralyzation of activities, in Uruguay the educational system addressed the new reality in a responsible, proactive and innovative manner, appealing to the existing strengths in its organization and human resources that allowed it to provide emergency remote education, as well as taking advantage of the potential of the various technological resources, with the exception of rural schools in 17 of the 19 departments of the country (in Canelones and Montevideo they remained closed), which reopened in three previous stages: from April 22 those with up to 30 students, from April 28 those with 31 to 50 students and from May 4 the remaining ones (UNICEF, 2020b).

On the one hand, the success of this strategy relies on the access of students and teachers to the necessary resources for distance education: computers or other electronic devices, platforms through which exchanges can take place between the parties and a stable connection to the Internet; given all this with 14 years of experience in the implementation of the Ceibal Plan. On the other hand, as shown by the International Computer Literacy and Information Literacy Study (ICILS), the access of students and teachers to information and communication technologies is a necessary but not sufficient condition for the effective use of these tools for educational purposes. Digital literacy and the use of computer resources for teaching and learning require training and support for teachers in their use, and preparation of students to use computers for these purposes, which is considered both an educational objective in itself and a cross-cutting competency (Fraillon, 2020).

Although the use of computers and online platforms has been incorporated into the teaching processes in our country, these resources became vitally important as of 2020, when the health emergency led education to be developed in virtual or blended mode. Access to these technologies became necessary not only in educational centers, but also in students' homes, as they are essential tools for studying and solving exercises at home.

In order to succinctly understand the study of this work, it is important to describe what is competency-based project learning, what is a project, what are competencies, and what are information and communication technologies.

The ABPC methodology (project-based learning by competencies), is where the student carries out learning by doing, fundamentally applying the competencies, where we find as elements of competencies the following: communication, creative thinking, critical thinking, scientific thinking, computational thinking, metacognitive, intrapersonal, initiative and action orientation, relationship with others and local, global and digital citizenship. Knowledge is at the student's fingertips. The teacher adds learning by doing, researching and performing individually and in groups. This is where the elements of competencies are applied (Pérez Aguirre, González Espada, & Sarasola Bonetti, 2022).

If competencies are applied (recognizing competencies as the sum of knowledge plus skill plus attitude), by applying the necessary competencies, success can be achieved in any project, be it at a personal, educational or professional level. By setting a concrete objective, designing and following a structured plan, it will be possible to achieve that objective. Competencies at the educational level are the basis for the development of more advanced competencies in the professional world. Therefore, it is increasingly necessary to change traditional learning for learning based on competencies, because it allows the application of these competencies in any context, something that we see as necessary in today's world, where changes are constant and only the use of competencies allows adaptation to them.

The education system must offer the next generation competent and not only knowledgeable about information. This is possible if an educational methodology that contemplates the development of competencies, such as ABPC, is applied. (learning based on competency-based projects), since it is not only enough to have theoretical knowledge, if we combine this with our own skills and fundamentally with the attitude of each individual, the best results are obtained, adapting to what Erik Hoefer (1983) expressed in these complex times of constant change, the competent will inherit the world, while the knowledgeable will find themselves perfectly prepared to face a world that no longer exists. According to publications and statistics, the application of educational projects based on competencies allows us to obtain the desired success, in a continuous improvement of our deliverables (Barry, 2004).

This author understands the interconnection existing between ABPC and projects at the professional level, given that today project management is a transversal axis in all professions, there being a link between educational competencies and the competencies of the project manager, for all its elements of competencies in both areas. In this sense, a project is understood as a temporary effort to carry out a product or service with a unique result. It has a well-defined beginning and end. Its completion can result in the achievement of the objectives at best (PMI, 2021). Until 2020, it was considered that a project manager was in charge of supervising a single project; nowadays, the management of Projects, Programs (set of two or more Projects) and Portfolios (set of two or more Programs) is being chosen, so that more than one project can be managed at the same time, without interfering with one another, even complementing each other (IPMA, 2015). A PM (Project Manager) used to be proven only by hands-on experience; today, Project Management has become a professional career that can be applied to all sectors, where individuals must be trained and certified to stand out from others; just like teachers in educational competencies, where preparation and certification surpasses them in pursuit of their students' education.

Competence is the sum of knowledge plus skill plus attitude; that is, it is not enough to have only theoretical knowledge, it must be complemented with the skills and attitudes of each individual; that is when one becomes competent. Competencies in education are divided into two domains, where domain 1 contains the elements of competencies: Communication, Creative

Thinking, Critical Thinking, Scientific Thinking, Computational Thinking and Metacognitive; and domain 2 contains the elements of competencies: Intrapersonal, Initiative and action orientation, Relationship with others and Local, global and digital citizenship (ANEP, 2022). At the same time in Project Management the competencies, are divided into three areas: perspective, people and practice, and these areas contain their elements of competencies (IPMA, ICB, 2018). The perspective area contains five competency elements (strategy, governance, regulations, power and interest, culture and values), the people area contains ten competency elements (self-reflection, reliability, communication, participation, leadership, teamwork, conflict and crisis, resourcefulness, negotiation, results orientation) and the practice area contains fourteen competency elements (project design, objectives, scope, time, organization, quality, finance, resources, procurement, planning and control, risks, stakeholders, change, balance).

In order to identify each of these elements in their use, key competency indicators are used, as an example for the competency element personal values and leadership, the key competency indicators are: Identifies and reflects on the ways in which own values and experiences affect work; Builds self-confidence based on personal strengths and weaknesses; Identifies and reflects on personal motivations for setting goals and maintaining focus; Organizes personal work depending on the situation and own resources; Assumes responsibility for personal learning and development. These indicators are fundamental in their contribution to the educational methodology implemented in Uruguay and, fundamentally, in the use of ICT as a tool to support education.

Applying these elements of Competencies with their key indicators makes projects achieve the desired success. If we say that a project is everything we do in our personal and professional life, it is because all plans (ideas, problems or needs) are unique and temporary, therefore, they become projects. The actions we perform on a daily basis are associated with projects, and the statistically studied logic indicates that I must have competencies if I want to successfully complete a large part of my activities.

In its beginnings, projects were the fiefdom of architects and engineers; with the passage of time, the experience gained we have understood that the project profession is horizontal and encompasses all professions and sectors; in this sense is that it has been transforming and including the terminology of projects in all professional fields and sectors, including education, which is part of the context of this research, with the transformation from unilateral and traditional learning to project-based learning (IPMA, ICB, 2018). Where there is a continuous interrelation of action between the elements of project competencies and the elements of education competencies, with ICTs being a basic tool for the training of students.

Project Based Learning (PBL) can be defined as a task-centered teaching and learning modality, a shared process of negotiation among participants, with the main objective of obtaining a final product. This method promotes individual and autonomous learning within a work plan defined by objectives and procedures. Students take responsibility for their own learning, discover their preferences and strategies in the process. They can also participate in decisions regarding content and learning assessment (Thomas, 2000).

Empirical evidence suggests that PBL has a positive effect on students' acquisition of knowledge, development of skills such as collaboration, critical thinking, and problem solving (Mergendoller, Maxwell, & Bellisimo, 2006). In addition, students who participate in PBL activities become more engaged in learning. However, (Brush & Saye, 2008) they claim that PBL is a real challenge for teachers, as they need support to plan and disseminate PBL effectively, while students need help to organize their time and be able to complete the tasks, as well as to integrate technology into the projects in a meaningful way (García-Varcálcel, 2017).

ICTs are developed from the scientific advances produced in the fields of information technology and telecommunications, that is, the digital era has begun to be part of both education and all professions, so the use of ICTs has also become a transversal axis for the achievement of objectives, at all levels access to technology has been essential to face the constant changes in recent years.

There are multiple definitions of ICT: According to (Cabero, 2002) iCTs are those that revolve around three basic media: computers, microelectronics and telecommunications; but they

revolve, not only in isolation, but more significantly in an interactive manner that allows new communicative realities to be achieved. The characteristics specified by different authors as representative of ICTs, as described by Cabero, are as follows (Cabero, 2002)are: Immateriality, Interactivity, Interconnection, Instantaneity, High image and sound quality parameters, Digitalization, Greater influence on processes than on products. (Belloch Ortí, 2021)

This paper seeks to analyze the response capacity of the educational sector in Uruguay to adapt through access to ICTs the activities at primary and secondary education levels between 2020 and 2021 during the pandemic, as well as to analyze the measures taken to mitigate the secondary effects of the changes.

All of this was oriented towards teachers and students, who were forced to remain at home, but had to continue with their jobs, students with their educational classes and interacting with their families and friends. This was carried out with the support of ICT at the service of people and their adaptation to this new normality.

The pandemic raised a big question for authorities and teachers about the near future of education. The black swan appeared (a risk that cannot be prevented due to the unusual nature of its activity). With this, teachers and students lost contact, it was not known how they would continue with the established study plan and whether the measures established by the National Government to deal with the health emergency caused by the COVID-19 coronavirus should be maintained. It is at that moment that the elements of educational competencies (communication, creative thinking, critical thinking, scientific thinking, computational thinking, metacognitive, intrapersonal, initiative and action-oriented, relationship with others and local, global and digital citizenship) began to be applied in an agile way in order to alleviate the situation, mainly to ensure that students do not lose contact and can continue with their studies. For all these reasons, the educational system, schools, high schools, universities, public schools and technical institutes, had to adapt their methodology. In the adaptation process, principals, teachers, students and even ICT personnel had to be trained in the new methodology. This led to the application of the elements of educational competencies, intertwined with project competencies in the planning was critical to achieve the desired success as on Monday, March 23, 2021 (ten days after the pandemic was declared), classes resumed throughout Uruguay. The capacity for a rapid response was due to the application of the elements of competencies such as communication, computational thinking and action orientation; being fundamental to face the pandemic, being measured based on the applications developed for communication with teachers and students (GURI Teachers and GURI Family), being Uruguay the country that had the fastest response in the region, unlike, for example, the Republic of Argentina, which remained more than 16 months without any educational activity

The implementation of Competency-based Educational Projects allows each educational organization (in view of the ABPC curricular projects already planned and in execution) to adapt to its use, using ICT as a base tool, in order to increase the number of teachers day by day because it allows them to obtain the desired results, with the defined budget and without exceeding the timeframe, allowing them to achieve pedagogical efficiency. The guiding premise should be to recognize that projects begin and end with people and that competent performance is essential for any successful project.

In Uruguay there are multiple strengths to support this modality, such as the previous experience in different subsystems that already offered blended learning modalities, which implies that a significant number of teachers were familiar with this type of proposals and the use of educational platforms. In addition, there is a large repository of resources available to make the practices effective (DGEIP, 2020).

Method

This article consists of a research with a non-experimental work methodology, because the study variables were not manipulated, descriptive type because only a description of the interaction of the variables, their dimensions and indicators was made, with a mixed approach, being these indicators (measured by surveys), the access to ICT that students and teachers had, if

they had internet access, if the computer was shared, conditions prior to the pandemic of computer use; these surveys were conducted through the applications GURI Teachers and GURI Family, measuring the results to compare why the response was so fast and with the scope of analyzing the responsiveness of the education sector in Uruguay to adapt through access to ICTs the activities at primary and secondary education level between 2020 and 2021 in pandemic. Analyzing the measures taken to mitigate the secondary effects of the changes that arose during the process.

The target population consisted of institutions under the Ministry of Education and Culture of Uruguay.

The census sample, selecting the educational institutions under the CODICEN (Central Board of Directors) by sampling among the 2300 urban and rural schools among the 19 departments, 230 were taken, maintaining the socio-cultural characteristics in order to maintain the descriptive percentage and thus obtain access to complete information. This evaluation assessed the family context, computer use, workspace, internet connection.

In the aforementioned schools, teachers and students were surveyed, with 230 principals, 2760 teachers and 55200 children (18400 girls and 36800 boys) participating and responding to the survey.

The study sample used for this study was determined on the basis of the complete universe of student centers in Uruguay; taking into account the size of the population, the confidence interval, the confidence level, among others, the percentage defined for the research, defined above, was reached.

The tools used were surveys, interviews with the heads of the educational centers, as well as with teachers and students. With stipulated variables as follows:

1. Responsiveness of the education sector in terms of: access to technology (did they have equipment?) and digital competencies for the use of ICTs (were they trained to use them?).
2. Side effects of changes in the process (did isolation cause slowing down during learning?).

All oriented to achieve the desired objective of the work, to analyze the response capacity of the educational sector in Uruguay to adapt through access to ICTs the activities at primary and secondary education level between 2020 and 2021 in pandemic. Analyzing the measures taken to mitigate the secondary effects of the changes that arose during the process.

Results

From the results obtained from the research carried out, it can be seen that:

Figure 1

Percentages of access to ICTs before and after the pandemic

Directors			
Access to ICT			
Before 2020			
Respondents	**Low Level**	**Medium Level**	**High Level**
230	12	21	197
100%	5%	9%	86%
After 2020			
Respondents	**Low Level**	**Medium Level**	**High Level**
230	3	24	204
100%	1%	10%	89%

Teachers			
Access to ICT			
Before 2020			
Respondents	**Low Level**	**Medium Level**	**High Level**
2760	523	816	1421
100%	19%	30%	51%
After 2020			
Respondents	**Low Level**	**Medium Level**	**High Level**
2760	119	912	1729
100%	4%	33%	63%

Students			
Access to ICT			
Before 2020			
Respondents	**Low Level**	**Medium Level**	**High Level**
55200	4544	18231	32425
100%	8%	33%	59%
After 2020			
Respondents	**Low Level**	**Medium Level**	**High Level**
55200	4446	11028	39726
100%	8%	20%	72%

Figure 2

Percentages of educational competencies before and after the pandemic

Directors			
Educational Competencies			
Before 2020			
Respondents	**Low Level**	**Medium Level**	**High Level**
230	73	124	33
100%	32 %	54 %	14 %
After 2020			
Respondents	**Low Level**	**Medium Level**	**High Level**
230	28	76	126
100%	12 %	33 %	55 %

Teachers			
Educational Competencies			
Before 2020			
Respondents	**Low Level**	**Medium Level**	**High Level**
2760	475	1583	704
100%	17 %	57%	26%
After 2020			
Respondents	**Low Level**	**Medium Level**	**High Level**
2760	239	867	1654
100%	9%	31%	60%

Students			
Educational Competencies			
Before 2020			
Respondents	**Low Level**	**Medium Level**	**High Level**
55200	19712	23614	11874
100%	36%	43%	22%
After 2020			
Respondents	**Low Level**	**Medium Level**	**High Level**
55200	16873	25786	12541
100%	31%	47%	23%

Figure 3

Percentages of content adaptation to the curriculum before and after the pandemic

Directors			
Adaptation of the contents of the study plan			
Before 2020			
Respondents	**Low Level**	**Medium Level**	**High Level**
230	4	51	174
100%	2%	22%	76%
After 2020			
Respondents	**Low Level**	**Medium Level**	**High Level**
230	2	29	198
100%	1%	13%	86%

Teachers			
Adaptation of the contents of the study plan			
Before 2020			
Respondents	**Low Level**	**Medium Level**	**High Level**
2760	259	521	1980
100%	9%	19%	72%
After 2020			
Respondents	**Low Level**	**Medium Level**	**High Level**
2760	89	828	1843
100%	3%	30%	67%

Students			
Adaptation of the contents of the study plan			
Before 2020			
Respondents	**Low Level**	**Medium Level**	**High Level**
55200	8251	22853	24096
100%	15%	41%	44%
After 2020			
Respondents	**Low Level**	**Medium Level**	**High Level**
55200	6432	23497	25271
100%	12%	43%	46%

Product of the analysis of statistics and documentation extracted from the Ministry of Education and Culture of Uruguay, the gradual implementation since 2017 of the ABPC methodology has reflected that the educational system if it applies the Methodology of Management of Educational Projects based on Competencies and according to the reality we live in, they get to obtain better results to finish their cycle, and feasibly reach to achieve their objectives in the stipulated deadlines.

The elements of educational competencies (such as those detailed in its two domains) that are included in the curricula to be taught, allow for flexibility in the planning projection, its implications and thus maintain the operability of all members of the multidisciplinary team of the educational project, achieving success in the best way and mitigating the side effects of the changes that arise in the process.

Discussion

The final analysis shows that before 2020, access to ICT and educational competencies were being developed as part of the educational growth program in Uruguay, which is reflected in the fact that when the pandemic began, the response was rapid, even more so than in other countries in the region. Although they were not prepared for the transformation of the curricula and based on the competencies and access to ICTs, the adaptation of the contents took place quickly so that education would not stop and continuity would be maintained, unlike what happened in the region.

It has been fundamental to apply the Competency-based Educational Projects in a substantial way with the support of the tools provided by ICT, being essential for the development of people, their jobs and social interrelation, fundamentally responding to what has been the analysis of the response capacity of the educational sector in Uruguay to adapt through access to ICT the activities at the primary and secondary education level between 2020 and 2021 in pandemic. Analyzing the measures taken to mitigate the secondary effects of the changes that arose during the process.

With the experience and lessons learned, at the beginning of the year 2022, a mixed system (face-to-face and distance learning) began to be implemented in the educational system, increasing the application of competency elements and with a great effort in project-based education based on competencies. At the same time, it is being applied in different government agencies and increasing the training of their personnel in competency-based certification.

During the time when face-to-face contact was interrupted, due to the impossibility of daily face-to-face physical contact that characterizes exchanges between teachers and students, teachers, professors and students had to make use of ICT for communication, course delivery and the planning of activities. In all grades (primary, secondary and university), teachers favored the use of digital platforms. (INEEd, 2021a, 2021c).

There were strategies of various kinds to give continuity to the educational process, which has been the least interrupted in the region. Distance education played a key role in maintaining the link between teachers, families and students, which resulted in a significant increase in the use of ICTs.

As a result of the methodology used and the results obtained in the research, the analysis of statistics and research documents reflects the vision of how Competency-based Educational Projects supported by NICT tools have contributed to formulate the provision of services at a distance and in interaction with the population, in a permanent

way beyond the emergency, as a contribution and from the lessons learned from the current vision resulting from the pandemic that became a reality.

The COVID-19 pandemic has made virtual study and learning-by-doing a necessity; however, this trend is here to stay. Some teachers will return to face-to-face work after the pandemic, but most will continue to collaborate virtually as employees in remote or hybrid environments.

The impact of COVID-19 has been profound. The world is different and teaching staffs can operate everywhere. The findings of this study indicate that people will continue to work together to overcome obstacles and that technology will continue to play a key role in defining the future.

This is the starting point for the ABPC research in conjunction with NICTs, which are accessible to all, such as those investigated, oriented to families; by means of these tools we want to understand and work on a reality that is reflected in many educational institutions, fundamentally taking into account a precision for the response capacity of the educational sector in Uruguay to adapt through access to ICTs, as well as keeping in mind the risk analysis to mitigate the secondary effects of the changes.

Conclusions

The main objective of this research was to analyze the response capacity of the educational sector in Uruguay to adapt the activities at the educational level between 2020 and 2021 to the pandemic through access to ICTs. Analyzing the measures that were taken to mitigate the secondary effects of the changes that arose during the process, arriving at the conclusion from the research data, that the educational sector having implemented the ABPC methodology supported by ICT was a necessary tool to achieve the continuity of student learning in Uruguay, between 2020 and 2021, as well as the mitigation of the risks that arose as a result of the pandemic.

If we start from the concept of competency already developed, learning and integrating the different elements of competencies implies changing or transforming the internal resources of the person, i.e. attitudes, knowledge, skills, interests, motivations, in order to orient them towards the personal objectives to be achieved or common objectives of the organization and thus achieve a satisfactory response to the demands of the context. This is not a simple task and for which more than one learning strategy should be used to develop competencies, given the various dimensions involved.

The application of Competency-based Educational Projects has come to remain in the planning of people and educational centers; perhaps not with the intensity with which they were carried out in this period, but applied in accordance with the new demands of innovation, communication between people and the optimization of resources.

We must be aware that if we apply the methodology of competency-based project learning, future generations will be better than us and we will be able to continue moving towards a sustainable future.

In other words, although the COVID-19 coronavirus imposed several changes in the way of educating, the educational system maintained its objective, that of training citizens for the 21st century, in competency-based project learning. This presents the proposition that, if planning precautions are taken, it will further mitigate the risks that students will not lose the quality of their studies.

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IMPACTS OF TELEWORK ON JOB SATISFACTION AND EMOTIONAL SALARY. CASE OF A TELECOMMUNICATIONS COMPANY IN URUGUAY

IMPACTOS DEL TELETRABAJO EN LA SATISFACCIÓN LABORAL Y EL SALARIO EMOCIONAL. CASO EMPRESA DE TELECOMUNCACIONES DE URUGUAY

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ABSTRACT

The work carried out analyzes whether the implementation of a telework system provides benefits to the workers of the public telecommunications company of Uruguay, Antel. The research arises after the company completely abandoned the telework application carried out during the global pandemic of Covid-19, leaving many workers dissatisfied and demanding the continuity, at least partially, of that form of work organization. In the study, telework was selected as the independent variable, while the dependent variables chosen were job satisfaction and emotional salary. A quantitative methodology was used with the application of a questionnaire validated in previous research, with suitable characteristics for carrying out the fieldwork. The results obtained confirmed the research hypotheses, corroborating with sufficient statistical evidence that the implementation of an adequate telework system increases job satisfaction and emotional salary of the company's workers. In turn, it is observed that the implementation of this work modality is associated with operational efficiency, digitalization of the company's processes, and the development of ICT. It is concluded that the implementation of a partial, voluntary, reversible, and agreed telework system between the parties would allow obtaining the benefits that arise from the application of this work modality, reducing the barriers and weaknesses identified with remote work.

Palabras clave:
teletrabajo, TIC, vida laboral, vida privada, satisfacción laboral, salario.

RESUMEN

En el trabajo realizado se analiza si la implementación de un sistema de teletrabajo proporciona beneficios a los trabajadores de la empresa pública de telecomunicaciones del Uruguay, Antel. La investigación surge luego de que la empresa abandonara por completo la aplicación del teletrabajo realizada durante la pandemia mundial por Covid-19, dejando a muchos trabajadores

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	disconformes y reclamando por la no continuidad, al menos en forma parcial, de esa forma de organización laboral. En el estudio se seleccionó el teletrabajo como variable independiente, mientras que las variables dependientes elegidas fueron la satisfacción laboral y el salario emocional. Se utilizó una metodología cuantitativa con la aplicación de un cuestionario validado en investigaciones previas, con características adecuadas para la realización del trabajo de campo. Los resultados obtenidos permitieron confirmar las hipótesis de investigación, corroborando con evidencia estadística suficiente, que la aplicación de un adecuado sistema de teletrabajo aumenta la satisfacción laboral y el salario emocional de los trabajadores de la empresa. A su vez, se observa que la implementación de esta modalidad laboral está asociada a la eficiencia operativa, a la digitalización de los procesos de la empresa, y al desarrollo de TIC. Se concluye que la implementación de un sistema de teletrabajo parcial, voluntario, reversible y acordado entre las partes, permitiría obtener los beneficios que surgen de la aplicación de esta modalidad laboral, reduciendo las barreras y debilidades identificadas con el trabajo remoto.

Introduction

During the global pandemic of Covid-19, in most countries of the world, remote work was adopted as a preventive measure to preserve the health of citizens. Particularly in Uruguay, a state of health emergency was declared which implied, among other things, the use of telework as a work organization mechanism implemented to contain the spread of the virus in the population (Olivera Anchete, 2021). Espino et al. (2021) explain that one of the many measures adopted at the government level was to encourage teleworking in all those activities in which it was not essential to maintain presence, both in the public and private sectors.

One of the companies that adjusted to this regime was Antel, Uruguay's public telecommunications company, which has more than 5,500 workers, the vast majority of whom teleworked during the pandemic. During this period of confinement, with the vast majority of employees teleworking, Antel maintained its sales levels, in addition to improving its operational efficiency by reducing some costs. In this sense, remote work can be related to the generation of savings in operations, fuel, electrical energy, and physical space (Carrasco-Mullins, 2021). On the other hand, telecommuting also allowed workers to benefit, obtaining greater flexibility and better reconciliation between family and work responsibilities (Villasmil et al., 2021), in addition to meaning savings in time, in transportation, and making it possible to adapt the work schedule to personal needs (Marinakis, 2021).

Already in the post pandemic period, the organization completely abandoned the practice of teleworking, leaving aside the benefits and advantages that this labor modality had generated in the company and its workers. However, telework, which gained much relevance during the recent period of confinement, is still valid as a useful tool to be adopted in post-pandemic labor relations (Coto Aubone & Rosenbaum Carli, 2021).

In this context, the research question arose as to whether the implementation of an adequate teleworking system would generate benefits for the company's employees, improving their job satisfaction and increasing their emotional salary. This question had the objective of motivating a research work that could be useful for the adoption of a teleworking system in the company Antel, which produces benefits for both employees and the company.

The International Labor Organization (2020) notes that while the number of people teleworking has been gradually increasing over the years, the Covid-19 pandemic has accelerated this process. Benavides and Silva-Peñaherrera (2022) argue that telework is a product of the digitalization and flexibilization of companies, highlighting that in pandemic many companies have advanced in terms of equipment, connectivity, platforms, digital skills, and also in terms of teamwork, distribution of tasks and working times.

Regarding jobs, Saget et al. (2020) indicate that on average in Latin America and the Caribbean, 25.9% of jobs can be performed remotely, with Uruguay in particular showing a figure of 30.3% of jobs that can be performed from home. Despite this, only 6% of people who connected to the Internet in Uruguay during 2019 performed telework (Arzuaga-Williams et al., 2021). In this regard, Saget et al. (2020) assert that the telework tool should continue to be used after the pandemic, making the necessary adjustments to adapt it to the needs and aspirations of employees and employers.

Regarding the concept of telework, the Royal Spanish Academy defines it as "Work that is performed from a location outside the company using telecommunication networks to fulfill assigned workloads." (RAE, 2022). This definition highlights that in

order to configure teleworking, the work must be performed through telecommunications networks and from physical locations other than the company's premises.

When resorting to the legislations of the different countries of Latin America, common characteristics are found in the different definitions of the term telework, highlighting among others that it is a modality of service provision or organization of work, which occurs under a relationship of dependence, which is valid both in the public and private sector, where the teleworker does not have a specific place assigned to perform his task and does it in a place different from the employer's offices, and necessarily using information and communication technologies (Ramírez Velásquez et al., 2021).

Particularly, in the Uruguayan legislation, the law 19.978 of "Promotion and Regulation of Telework" defines telework as a voluntary and reversible agreement, and assures the teleworker equal rights and conditions with the rest of the workers (Arzuaga-Williams at al., 2021).

Carrasco-Mullins (2021) outlines a series of advantages that teleworking provides to employees, among which he mentions: virtual promotion, work-life balance, flexible schedules, reduced commuting costs, reduced work clothing costs, increased productivity, time savings, autonomy, job satisfaction, and improved nutrition. In turn, the benefits for the organization include: increased worker productivity, reduced facility costs, improved recruitment, retention of trained personnel, decentralized processes, improved organizational culture, commitment to the organization, and reduced levels of turnover and absenteeism.

It should be noted that the implementation of a teleworking system in the company is not exempt from important limitations and challenges that must be overcome, by way of example we can mention: access to adequate equipment and good internet connection (Cedeño Párraga & Intriago Mora, 2022), security measures and protection against possible computer attacks or disasters (Aguirre Parra, 2020), communication and collaboration to avoid isolation, extension of working hours, supervision and productivity (International Labor Organization, 2020; Pagès Dasunción, 2020), conflicts between work and family life, and health problems (Aguilar Huezo et al., 2021).

Despite these challenges, there are several researches that link telework with improvements in job satisfaction (Carrasco-Mullins, R, 2021; Arzuaga-Williams et al., 2021) and increases in emotional wage (Martín García, 2017; Castillo et al., (2017); Pérez Alzate, 2021, Espinoza and Toscano Moctezuma, 2020).

Method

We worked with a quantitative methodology, with the consequent generalization and objectification of the results through field work applied to a sample, in order to make inferences to a population from which the sample comes (Pita Fernández and Pértegas Díaz, 2002). Quantitative methodology is presented as an excellent tool that provides statistically reliable and relatively easy to understand information (de Pelekais, 2000).

The research is non-experimental, cross-sectional and explanatory in scope. It is non-experimental since the phenomenon was observed as such in order to record it, analyze it, and without deliberately manipulating the independent variables. It is cross-sectional as the data were collected at a single point in time, during the month of November 2022, with no follow-up over time. And it is explanatory because it quantifies the impact that teleworking has on job satisfaction and the emotional wage of the

population sample subject to the study, explaining the effects through the use of descriptive statistical tools.

The population consisted of Antel employees who work in the company's offices and do not have face-to-face contact with customers. The size of this population is 2,435 employees. For legal requirements of public companies, these are employees over 18 years of age, with natural or legal Uruguayan citizenship, and do not have any other relationship with the state (except teaching). The sample, calculated with a confidence level of 95% and a maximum permissible error of 5%, was finite and non-probabilistic and consisted of 332 volunteers.

The independent variable in the research is Telework. This is a concept widely known in the company and among the workers, since during the Covid-19 pandemic period, a teleworking regime was adopted in order to avoid contagion and promote preventive measures for health care, so there is a close experience in the application of the concept.

As for the dependent variables, 2 were defined: Job Satisfaction and Emotional Salary. The study investigated whether the application of the independent variable (telework) has increasing effects on these dependent variables.

The Operational Variables used to measure job satisfaction are 6: satisfaction with the job in general, satisfaction with the physical work environment, satisfaction with the way the job is performed, satisfaction with development opportunities, satisfaction with the subordinate-supervisor relationship, satisfaction with compensation. In order to measure emotional salaries, four operational variables were applied: work environment, work flexibility, work development, and work-life balance.

The instrument used to measure the variables is a questionnaire, defined with a Likert scale from 1 to 5, where 1 is totally disagree and 5 is totally agree. The technique used for data collection was the survey.

To measure the effects of telework on job satisfaction, we used the questionnaire developed and validated by Chiang, M et al. (2007), which was developed based on the S21/26 (1990) and S4/82 (1986) questionnaires of the authors Meliá and Peiró, and presented a high fidelity coefficient, with a Cronbach's alpha of 0.947, which supports its consistency. The validated questionnaire developed by Salvador-Moreno, J.E., et al. was used to measure the emotional salary variable. (2021), which in its internal consistency registered a Cronbach's alpha higher than 0.96.

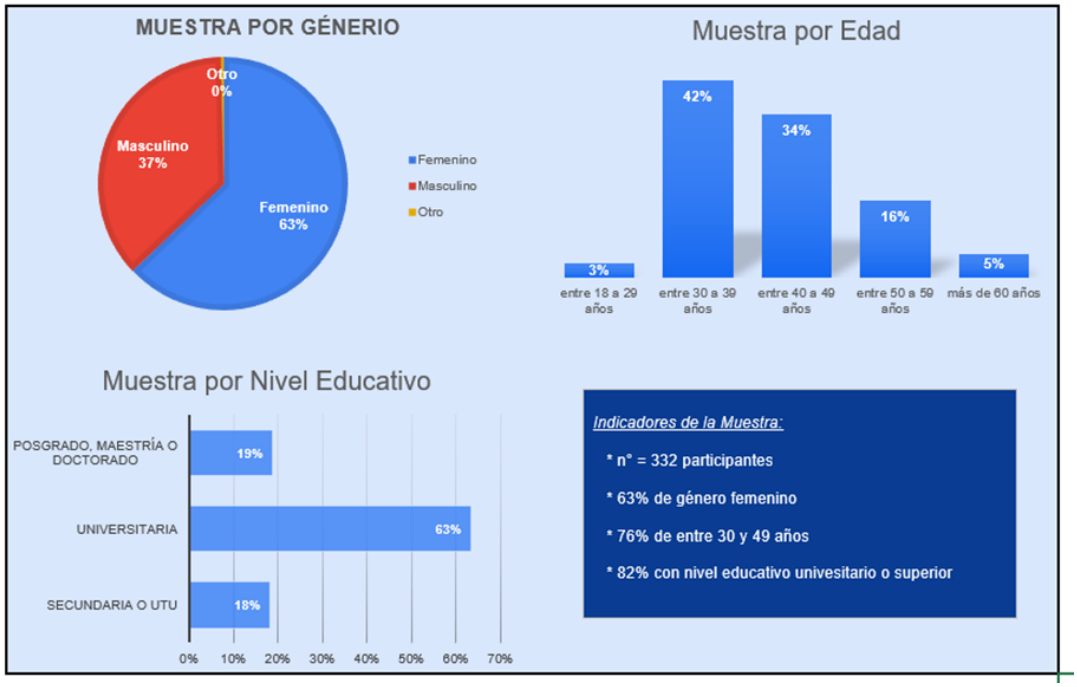
Statistical analysis was performed using two different software packages, IBM SPSS Statistics 26 and Statgraphics 19. The first was used to test the normality of the variables and to obtain the descriptive statistics of mean, median, mode and standard deviation. While the second software (Statgraphics 19) was used to perform the t-test to test the following hypotheses: H1: An adequate telework system increases workers' job satisfaction, and H1': An adequate teleworking system increases the emotional wage of workers.

Results

The results at the demographic level of the sample indicate that 63% of the participants were female, 37% were male, while one participant reported having another gender. At the age level, the majority ranges were between 30 and 39 years of age, with 42% participation, and between 40 and 49 years of age, with 34%. In other words, 76% of the sample was between 30 and 49 years of age. In terms of educational level, 63% reported having university studies, while those with postgraduate, master's or doctoral

degrees (19%), and those with high school or UTU (Universidad del Trabajo del Uruguay, 18%), are in a smaller proportion and in similar relative numbers. These results are summarized in Figure 1.

Figure 1
Demographic results of the sample



Considering the Likert scale of 1 to 5 used in the questionnaire, where 1 is totally disagree, 3 does not modify, and 5 totally agree, when studying the results by sex, as shown in Figure 2, it can be seen that teleworking has a positive impact on both women and men, with the same median and mode values, and a higher mean in women. Figure 3 shows the impacts according to educational level, where higher indicators are observed in those with university studies.

Figure 2
Results by Gender

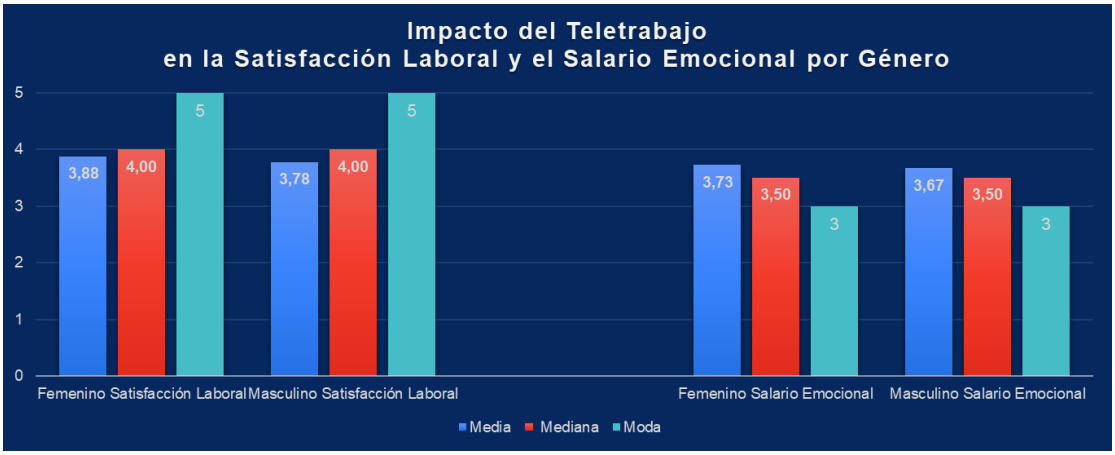
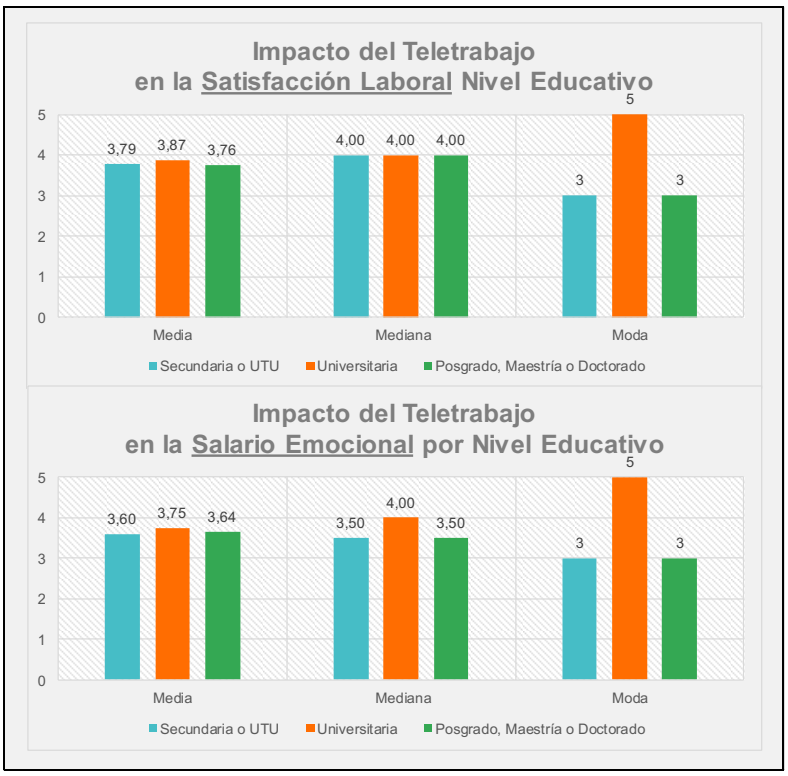


Figure 3
Results by Educational Level



These results are consistent with the statements of Benavides and Silva-Peñaherrera (2022), which indicate a more marked preference for teleworking among women, and with a more pronounced sectoral nature among professionals, scientists and technicians.

Milasi et al. (2021), point out that large-scale teleworking occurs preferably in highly qualified professionals and in ICT-intensive sectors, as is the case of the employees and the company that are the subject of the research.

In reference to the Student's t-test for hypothesis testing, the results are shown in Figure 4, where it is concluded that there is sufficient statistical evidence to accept the research hypotheses.

Figure 4
Student's t-test results

Hipótesis para la variable **Satisfacción Laboral**	Hipótesis para la variable **Salario Emocional**
• H0: u ≤ 3 El teletrabajo disminuye o no modifica la satisfacción laboral • H1: u > 3 El teletrabajo aumenta la satisfacción laboral	• H0': u ≤ 3 El teletrabajo perjudica o no modifica el Salario Emocional • H1': u > 3 El teletrabajo mejora el Salario Emocional
Prueba T: **Hypothesis Tests** Sample mean = 3,83426 Sample standard deviation = 0,657185 Sample size = 332 95,0% lower confidence bound for mean: 3,83426 - 0,0594928 [3,77477] Null Hypothesis: mean = 0,5 Alternative: greater than Computed t statistic = 92,4443 P-Value = 0,0 Reject the null hypothesis for alpha = 0,05.	**Prueba T:** **Hypothesis Tests** Sample mean = 3,70407 Sample standard deviation = 0,547281 Sample size = 332 95,0% lower confidence bound for mean: 3,70407 - 0,0495435 [3,65453] Null Hypothesis: mean = 0,5 Alternative: greater than Computed t statistic = 106,675 P-Value = 0,0 Reject the null hypothesis for alpha = 0,05.
Conclusión: Dado que el p valor de la prueba es inferior a 0,05, existe evidencia estadística suficiente para rechazar la hipótesis nula (H0) y aceptar la hipótesis alternativa (H1) con un nivel de confianza de al 95%, aceptando de esta forma la hipótesis de investigación de que el teletrabajo aumenta la satisfacción laboral.	**Conclusión:** Dado que el p valor de la prueba es inferior a 0,05, existe evidencia estadística suficiente para rechazar la hipótesis nula (H0') y aceptar la hipótesis alternativa (H1') con un nivel de confianza de 95%, por lo que se confirma la segunda hipótesis de investigación de que el teletrabajo mejora el Salario Emocional.

Regarding the results of the impact of teleworking on job satisfaction, the open percentage results by dimension are expressed in Table 1.

Table 1
Results of the impact of Teleworking on Job Satisfaction by dimension

Scale Dimensions / Scale	1 2 Negative Perception	3 Indifferent	4 5 Positive Perception	Media	Median	Fashion
SL1 - Teleworking increases overall job satisfaction	6%	32%	61%	3,89	4,00	5
SL2 - Teleworking increases satisfaction with the physical work environment	10%	29%	60%	3,90	4,00	5
SL3 - Teleworking increases satisfaction with the way you do your job	4%	31%	65%	4,00	4,00	5
SL4 - Teleworking increases satisfaction with development opportunities	10%	42%	49%	3,62	3,50	3
SL5 - Telework increases satisfaction with subordinate-supervisor relationship	7%	42%	51%	3,64	3,67	3
SL6 - Teleworking increases satisfaction with remuneration	10%	25%	65%	3,96	4,00	5
Teleworking increases job satisfaction	**8%**	**33%**	**59%**	**3,83**	**4,00**	**5**

Table 1 shows that, overall, the median response was 4, which means that 50% of the workers chose a value of 4 or higher on the scale, showing a positive perception of the impact of telework on job satisfaction. In turn, the total mode was 5, emphasizing the positive prevalence of the impact. In percentage terms, 59% of respondents stated that teleworking increases job satisfaction. In contrast, only 8% say they have a negative perception of this hypothesis.

When analyzed by dimension, four of the six dimensions show a median of 4 and a mode of 5. These are, *SL1 - Teleworking increases satisfaction with the job in general*, *SL2 - Teleworking increases satisfaction with the physical work environment*, *SL3 - Teleworking increases satisfaction with the way you do your job* and *SL6 - Teleworking increases*

satisfaction with pay. In turn, these four dimensions register percentages of positive perception above 60%, indicating that most employees see teleworking as enhancing a wide variety of aspects that benefit their job satisfaction. In contrast, the factors *SL4 - Teleworking increases satisfaction with development opportunities* and *SL5 - Teleworking increases satisfaction with the subordinate-supervisor relationship*, are those that exhibit lower median and mode numbers, although in percentage terms it is observed that the positive perception is greater than the negative in both dimensions.

With regard to the aspects most highlighted by the workers, one of the most highly rated was autonomy, present in the questionnaire in the *1SL* dimension: *Overall job satisfaction*, in item: *Telecommuting enhances the autonomy you have to plan your own work*. Eighty-three percent of the workers supported this statement as can be seen in Figure 5.

Figure 5

Main aspects with Positive and Negative Perceptions of telework impacts on Job Satisfaction

Principales Aspectos con Percepción Positiva				
Dimensión	*Preguntas destacadas*	*Percepción Negativa*	*Indiferente*	*Percepción Positiva*
SL1 - El teletrabajo aumenta la satisfacción por el trabajo en general	*El teletrabajo mejora la autonomía que usted tiene para planificar su propio trabajo*	2%	15%	**83%**
SL2 - El teletrabajo aumenta la satisfacción con el ambiente físico del trabajo	*En teletrabajo tengo mejor iluminación, ventilación y temperatura*	8%	19%	**73%**
	En teletrabajo tengo mejores condiciones de limpieza e higiene	4%	34%	**62%**
SL3 - El teletrabajo aumenta la satisfacción con la forma en que realiza su trabajo	*El teletrabajo mejora su productividad*	3%	15%	**82%**
	El teletrabajo mejora la calidad del trabajo	4%	20%	**75%**
SL4 - El teletrabajo aumenta la satisfacción con las oportunidades de desarrollo	*El teletrabajo aumenta su grado de satisfacción general con la institución*	2%	12%	**86%**
	El teletrabajo aumenta las oportunidades de continuar su perfeccionamiento	5%	30%	**64%**
SL6 - El teletrabajo aumenta la satisfacción con la remuneración	*El teletrabajo mejora sus condiciones laborales*	6%	14%	**80%**
	El teletrabajo mejora el salario que recibe	12%	19%	**69%**
Principales Aspectos con Percepción Negativa				
Dimensión	*Pregunta*	*Percepción Negativa*	*Indiferente*	*Percepción Positiva*
SL2 - El teletrabajo aumenta la satisfacción con el ambiente físico del trabajo	*En teletrabajo tengo mejor disponibilidad de recursos tecnologicos*	**19%**	35%	47%
SL4 - El teletrabajo aumenta la satisfacción con las oportunidades de desarrollo	*El teletrabajo aumenta las oportunidades de hacer carrera funcionaria en la institución*	**20%**	57%	23%

Figure 5 also shows the prevalence of telework benefits in working conditions such as physical environment, in dimension *2SL: Satisfaction with the physical work environment*, where 73% of respondents had a positive perception of the statement: *In teleworking I have better lighting, ventilation and temperature*, while 62% did the same with the item: *In teleworking I have better conditions of cleanliness and hygiene*.

Another element highlighted by the study participants was the increase in productivity associated with teleworking. In the *3SL* dimension: *Satisfaction with the way you perform your job*, in item: *Teleworking improves their productivity*, 83% of affirmative answers were observed, while the item *Teleworking improves the quality of work*, registered 75% of approval.

The highest scored item within the job satisfaction questionnaire was: *Teleworking increases their overall satisfaction with the institution*, with an 86% approval rating. This

suggests that the vast majority of employees would increase their job satisfaction with the company if they had the option to telecommute.

Skills development, training and personal growth are aspects frequently related to teleworking. In the results of the research, this is manifested in the item *Teleworking increases the opportunities for further training*, which had 65% of positive perception compared to 5% of negative responses.

Within the *SL6* dimension: *Satisfaction with remuneration*, with 80% approval, stands out: *Teleworking improves their working conditions* and with 69% the factor *Teleworking improves the salary they receive*. It is assumed, according to the workers' view, that teleworking also has a positive impact on personal retribution.

As aspects in which the negative perception of the employees stands out, the availability of technological resources and the opportunities to make a career in the institution stand out, where 19% and 20% respectively, recorded negative perceptions about the impacts of teleworking on these aspects, as shown in Figure 5.

Regarding the link between telework and emotional salary, where 4 factors were defined to dimension the dependent variable, the percentage values and the statistical indicators obtained in this respect are shown in Table 2.

Table 2

Results of the impact of Teleworking on the Emotional Wage by dimension

Scale / *Dimensions / Scale*	*1 2 Negative Perception*	*3 Indifferent*	*4 5 Positive Perception*	*Media*	*Median*	*Fashion*
SE1 - Teleworking enhances professional development	10%	48%	42%	3,48	3,50	3
SE2 - Teleworking improves the work environment	17%	33%	50%	3,57	3,7	3
SE3 - Teleworking improves labor flexibility	16%	30%	54%	3,59	3,7	3
SE4 - Teleworking improves work-life balance	7%	19%	74%	4,17	4,3	5
Teleworking improves emotional pay	**12%**	**33%**	**55%**	**3,70**	**3,50**	**3**

Table 2 shows that in total terms, the median of the responses was 3.5, i.e. 50% of the workers show a positive perception of the impacts of teleworking on the emotional wage. The mode, meanwhile, was at the mean value of 3, showing a central prevalence of indifference in many responses, while the average worker understands that teleworking produces positive effects on emotional pay, with a mean value of 3.70.

In reference to the percentages, 55% presented a positive perception towards the hypothesis that teleworking improves the emotional wage, 33% expressed indifference, while 12% had a negative perception of the hypothesis.

The dimension with the highest approval was *SE4 - Teleworking improves work-life balance*, with 74% of responses with positive perception, median of 4.3 and mode of 5. On the opposite side, the factor *SE1 - Telework improves professional development* was the one that registered the lowest percentage of approval and the highest percentage of indifference, in addition to the lowest mean and median records, as shown in Table 2.

With respect to the aspects that stood out the most in terms of Emotional Salary, shown in Figure 6, the *2SE* dimension is observed: *Teleworking improves the work environment*, with the question: *Teleworking improves nutrition during the working day*, where 83% of the workers showed a positive perception of the statement.

Figure 6

Main aspects with Positive and Negative Perception of impacts of telework on Emotional Salary

Principales Aspectos con Percepción Positiva				
Dimensión	*Preguntas destacadas*	*Percepción Negativa*	*Indiferente*	*Percepción Positiva*
SE1 - El teletrabajo mejora el desarrollo profesional	*El teletrabajo aumenta las capacitaciones que luego aplicas en tu trabajo o en tu vida personal*	6%	34%	**61%**
SE2 - El teletrabajo mejora el ambiente laboral	*El teletrabjo mejora la alimentación durate tu jornada laboral*	4%	13%	**83%**
SE3 - El teletrabajo mejora la flexibilidad laboral	*El teletrabajo aumenta la flexibilidad de horarios si tuvieras una emergencia o quisieras estudiar*	3%	13%	**84%**
SE4 - El teletrabajo mejora el equilibrio entre vida personal y laboral	*El teletrabajo permite compartir mas tiempo en familia*	5%	14%	**81%**
	El teletrabajo permite aumentar tus actividades deportivas o de recreación	7%	18%	**75%**
	El teletrabajo mejora el equilibrio entre el trabajo y la vida privada	5%	14%	**81%**
	El teletrabajo (no) aumenta los conflictos familiares	11%	31%	**58%**
Principales Aspectos con Percepción Negativa				
Dimensión	*Preguntas destacadas*	*Percepción Negativa*	*Indiferente*	*Percepción Positiva*
SE1 - El teletrabajo mejora el desarrollo profesional	*El teletrabajo aumenta las posibilidades de ascenso por mérito*	**17%**	58%	24%
SE2 - El teletrabajo mejora el ambiente laboral	*El teletrabajo expande los espacios para compartir un café o una broma con tus compañeros de trabajo*	**38%**	39%	23%
SE3 - El teletrabajo mejora la flexibilidad laboral	*El teletrabajo aumenta la posibilidad de pedir permisos para trámites bancaros, legales o de indole personal*	**17%**	45%	39%
	El teletrabajo aumenta la cantidad de veces que te interrumpen o te llamen del trabajo en tus descansos	**28%**	33%	39%

Note: Own elaboration based on field work data

Figure 6 also shows that the question that received the highest approval in the emotional salary questionnaire was the item: *Teleworking increases the flexibility of schedules if you have an emergency or want to study*, located in the *3SE* dimension: *Teleworking improves labor flexibility*, which accounted for 84% of positive responses.

One of the characteristics most associated with teleworking is the possibility it offers workers to balance their work and private lives. In this sense, within the *4SE* dimension: *Work-life balance*, there were the items: *Teleworking makes it possible to share more family time* and *Teleworking improves work-life balance*, which received 81% approval in the questionnaire. This last item was the one that registered the highest number of responses with a value of 5. Additionally within this dimension, 75% of the respondents showed a positive perception in the consultation on whether *teleworking allows you to increase your sports or recreational activities*.

Bringing work into the home poses risks of family conflicts that may affect work tasks. The item *Teleworking (does not) increase family conflicts*, refers to this issue, where 58% said they support that teleworking does not increase them, while 31% indicated that remote work does not modify this aspect, as shown in Figure 6.

On the other hand, in reference to the questions that registered higher percentages of negative perception, Figure 6 highlights the effects of teleworking on the spaces to share a coffee or jokes with coworkers, where 38% of the respondents presented a negative perception on this issue.

Another aspect with high percentages of negative perception is observed in the question: *Telecommuting increases the number of times you are interrupted or called from work on your breaks,* which exhibits a 28% negative rating.

Workers also expressed concern about the impact of teleworking on merit-based promotion opportunities and personal leave, with negative perceptions of these issues reaching 17%.

The results also allow us to estimate that the application of a teleworking system not only has effects on the workers, but also on the company. It is logical to think that an increase in productivity and in the quality of employees' work will result in benefits for the organization. A similar situation can be thought of with savings in infrastructure and physical space, with the growth of training and development of personnel skills, and with the overall satisfaction of employees with the company.

Tables 3 and 4 present a summary of the main results and findings of the research conducted.

Table 3

Summary of Results and Findings 1

General Objective	Specific Objectives	Hypothesis	Results
To analyze whether the implementation of a teleworking system applied through the use of ICT tools provides benefits to workers	Determine whether teleworking positively impacts the job satisfaction of the company's employees.	Teleworking increases job satisfaction	59% Agree 33% No change 8% No Concordance Main findings in the Results: * Teleworking increases autonomy * Teleworking improves productivity and work quality * Teleworking improves working conditions * Teleworking increases overall satisfaction with the institution
	Detect whether teleworking increases the emotional wage of workers.	Teleworking improves the Emotional Salary	55% Agree 33% No change 12% No Concordance Main findings in the Results: * Teleworking increases labor flexibility * Teleworking improves nutrition * Teleworking improves work-life balance
	Evaluate whether teleworking improves the work-life balance of workers.	Teleworking improves work-life balance	83% Agree 31% No change 5% Not Matched Main findings in the Results: * Teleworking makes it possible to share more time with the family *Teleworking makes it possible to increase sports or leisure activities

Note. Own elaboration based on field work data

Table 4
Summary of Results and Findings 2

General Objective	Specific Objectives	Hypothesis	Results
To analyze whether the implementation of a teleworking system applied through the use of ICT tools provides benefits to workers	To estimate the relationship between teleworking and the operational efficiency of the organization.	Teleworking improves your productivity	82% Agree 15% No change 3% No Concordance
		Telework improves the quality of work	75% Agree 21% No change 4% Not Matched
		Teleworking generates savings, decreases absenteeism and staff skills	Findings in the theoretical framework: *infrastructure, transportation and electric power savings *reduced staff turnover and absenteeism *improves recruitment and employee skills
	Substantiate whether teleworking promotes the use of ICT and technological tools.	Teleworking increases opportunities for further education and training	65% Agree 30% No change 5% Not Matched
		Teleworking increases the skills that you then apply in your work or personal life	60% Agree 34% No change 6% Disagree
		Teleworking has a positive relationship with digital transformation, the development of exponential technologies, and employee skills and capabilities	Findings in the theoretical framework: *iCTs are a necessary condition for teleworking *capabilities, skills and intensive use of ICTs are required *promotes digital transformation and exponential technologies

Discussion and conclusions

The results obtained confirm that the job satisfaction of most of the employees of the company analyzed, are improved by the effects of the implementation of a telework system that takes into account the needs of people and adjusts to the context of the organization. These results are in line with several recent investigations that show greater job satisfaction in those who telework compared to those who do not (Aguirre Parra, 2020; Carrasco-Mullins, 2021; Espinoza and Toscano Moctezuma, 2020; Morales Lópes and Pérez Sisa, 2020; Pagès Dasunción, 2020).

At the same time, it was also possible to corroborate the positive perception that the personnel visualize about the increases that teleworking produces in the emotional salary of the workers. This finding coincides with different studies that classify telework as an example of labor flexibility that can be part of the emotional wage concept (Castillo et al., 2017; Espinoza and Toscano Moctezuma, 2020; Martín García, 2017; Pérez Alzate, 2021).

From the field work carried out, it was possible to identify some key factors on which teleworking has a greater impact, among them the following stand out: The increase in autonomy acquired by teleworkers when planning their tasks, coinciding with the findings in the works of Carrasco-Mullins (2021), Medina et al. (2020) and Marinakis (2021). The positive effect of telework on productivity, reaffirming the results presented

by Aguirre Parra (2020), Carrasco-Mullins (2021), Martín Hernández (2021), Morales Lópes and Pérez Sisa (2020), and Pagès Dasunción (2020). The positive relationship between telework and labor flexibility, similar to several works that have shown this relationship, such as those of Aguirre Parra (2020), Cedeño Párraga and Intriago Mora (2022), Espinoza and Toscano Moctezuma (2020), Martín Hernández (2021), Marinakis (2021), Morales Lópes and Pérez Sisa (2020), International Labor Organization (2020) and Villasmil et al. (2021). Another key element in the results is the evidence that teleworking improves work-life balance, confirming the findings of the International Labor Organization (2020). Regarding this last point, similar results are found in the work of Aguilar Huezo et al. (2021), Aguirre Parra (2020), Cedeño Párraga & Intriago Mora (2022), Medina et al. (2020), Marinakis (2021), Olivares Péndola et al. (2020), Olivera Anchete (2021), Pagès Dasunción (2020) and Villasmil et al. (2021).

From the point of view of the company, the organization also obtains a number of advantages with the implementation of a telework system, as an example we can mention: cost reduction (Aguirre Parra, 2020; Cedeño Párraga and Intriago Mora, 2022; Medina et al. 2020; Martín Hernández, 2021; Pagès Dasunción, 2020), decreased turnover and absenteeism (Aguirre Parra, 2020; Cedeño Párraga and Intriago Mora, 2022; Martín Hernández, 2021; Pagès Dasunción, 2020), and the possibility of continuing their activity in the face of catastrophic or crisis events (Carrasco-Mullins, 2021; Coto Aubone and Rosenbaum Carli, 2021; Morales Lópes and Pérez Sisa, 2020).

In this framework, the research has been successful in fulfilling its objective, achieving to establish that the application of an adequate telework system in the company Antel, brings benefits to its workers. Specifically, the results indicate that remote work is associated with an increase in job satisfaction, expressed in improvements in autonomy, productivity, training, skills, working conditions and overall satisfaction with the institution.

In the same direction, statistical evidence also allows us to conclude that teleworking increases the emotional salary of employees, providing flexibility for them to improve the balance between their work and private lives, allowing them to spend more time with their families, promoting better nutrition and creating spaces for sports and leisure activities.

On the other hand, an important aspect to take into account that emerges from the results is that teleworking does not expand the spaces for sharing jokes or moments of relaxation with coworkers, which can reduce trust and collaboration among team members. Other elements that can have a negative impact are possible reductions in career opportunities or merit-based promotions, which can lead to stagnation in the development of staff members' skills and contributions.

It is therefore necessary for the organization to adequately manage these aspects, ensuring the availability of the necessary technological resources to perform the tasks, and with efficient leadership that motivates and actively listens to the concerns of the personnel. A partial or hybrid teleworking system, combined during the week or month with face-to-face days, could help to ensure that face-to-face contact between employees is not lost, and that the physical link between workers and the company is not extinguished, thus helping to mitigate some possible negative effects.

In Uruguay, as well as at a regional and international level, more and more professionals, when looking for or choosing a job, in addition to the economic remuneration, request and value the benefits of emotional salary, where conditions such as flexible working hours, autonomy, training, work-life balance, and in general those benefits included in the emotional salary stand out.

From the analysis carried out, it can be elucidated that not only the workers would receive benefits from the implementation of a teleworking system, but also the institution. By offering a better quality of life to your employees, you can expect increases in commitment, loyalty and satisfaction with the company, leading to improvements in productivity. Additionally, remote work brings other advantages to the organization such as reduced absenteeism, reduced rental costs, reduced transportation costs, reduced energy costs, less need for equipment and physical space, and easier to recruit and retain top talent.

A partial teleworking system, combined with face-to-face work, would provide workers and the company with the benefits of its application, reducing the problems and weaknesses that this form of work organization presents if it is established in a mandatory and total way. It is considered necessary that its implementation be by common agreement between managers and employees, with the clear will of the workers, and complying with stages ranging from diagnosis, through planning and design of the system, execution of a pilot plan, final implementation, and ending with evaluation and continuous and periodic monitoring of the project.

Telework, whether as a social, technological and/or labor phenomenon, is a topic of high academic interest that can be analyzed from different perspectives. From this point of view, as a proposal for future research, this work can be taken up by other professionals to apply it in different areas, or to complement it with the study of different variables. In this sense, it may be interesting to conduct an investigation of the impact of teleworking from the perspective of the organization, to see how are the effects of remote work in other companies in the public sector, how teleworking impacts on companies in different sectors of activity, among other alternatives.

Finally, another perspective of interest is the relationship between teleworking and the spillover of social and environmental contributions, since remote work is associated, among other things, to the improvement of the environment, to the improvement of mobility in cities, to the reduction of polluting gas emissions, and to the care of natural resources such as water and energy. This leads us to think that more research is needed to investigate these aspects and provide guidelines for knowledge on these issues.

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ATTITUDES ET PERCEPTIONS OF RURAL YOUTH TOWARDS AGRIBUSINESS AS A PROFESSION IN A POST-CONFLICT CONTEXT. EVIDENCE FROM SOUTH-KIVU IN THE DEMOCRATIC REPUBLIC OF CONGO

ACTITUDES Y PERCEPCIONES DE LA JUVENTUD RURAL HACIA LA AGROINDUSTRIA COMO PROFESIÓN EN UN CONTEXTO DE POSCONFLICTO. CASO DE LA PROVINCIA DE KIVU DEL SUR EN LA REPÚBLICA DEMOCRÁTICA DEL CONGO

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ABSTRACT

The global demographic dynamics with increasing number of young people will have varying socio-economic effects on low-income countries. The extreme youth poverty, particularly in rural areas, is still much higher than the global average. Creating more and better jobs for young people is therefore an urgent priority of the century. Despite the recognized driving role of the agribusiness in economic growth, job creation and poverty reduction, there is evidence of youth disengagement towards agribusiness. The main objective of this study was to analyze the attitudes and perceptions of rural youth towards agribusiness as a profession in South Kivu, a post conflict area. To deeply understand the complexity of the issue, a systemic approach was used. A Likert-type questionnaire with a 5-points scale was developed to survey 456 rural youth aged 15 to 35 randomly selected using the Bernoulli Urn technique. SPSS software was used for descriptive and inferential statistical analysis. The Mann-Whitney and Kruskal-Wallis tests were used to compare the perceptions scores of the different groups analyzed. The study revealed that 53.5% of young people have a negative attitude towards agribusiness, 29.8% display a neutral attitude and only 16.7% of them show a positive attitude. 76.3% confirmed that they can only engage in agribusiness when they have no other job. 77.6% declared that agribusiness cannot enable them to meet all their basic needs. The study revealed a statistically significant difference in personal and societal perceptions scores between different age groups, between men and women, as well as between different youth education level groups. A statistically significant difference in the economic perceptions scores was observed only between the different survey areas. The study recommends a new dynamic of

awareness-raising in favor of agribusiness profession, involving education system, media, and development actors.

RESUMEN

Palabras clave:
actitudes, percepciones, juventud rural, agronegocios.

La demografía dinámica mundial con un número creciente de jóvenes tendrá efectos socioeconómicos variables en los países de bajos ingresos. La pobreza extrema de los jóvenes, especialmente en las zonas rurales, sigue siendo muy superior a la media mundial. Crear más y mejores puestos de trabajo para los jóvenes es, por tanto, una prioridad urgente del siglo. A pesar del papel impulsor reconocido de la agroindustria en el crecimiento económico, la creación de empleo y la reducción de la pobreza, hay evidencia de desconexión de los jóvenes hacia la agroindustria. El principal objetivo d'este estudio fue analizar las actitudes y percepciones de los jóvenes rurales hacia la agroindustria como profesión en Kivu del Sur, una zona de posconflicto. Para comprender profundamente la complejidad del tema se utilizó un enfoque sistémico. Se elaboró un cuestionario tipo Likert con una escala de 5 puntos para encuestar a 456 jóvenes rurales de 15 a 35 años seleccionados al azar mediante la técnica de la Urna de Bernoulli. Se utilizó el software SPSS para el análisis estadístico descriptivo e inferencial. Se utilizaron las pruebas de Mann-Whitney y Kruskal-Wallis para comparar las puntuaciones de percepción de los diferentes grupos analizados. El estudio reveló que el 53,5% de los jóvenes tiene una actitud negativa hacia la agroindustria, el 29,8% muestra una actitud neutral y sólo el 16,7% de ellos muestra una actitud positiva. El 76,3% afirmó que solo pueden dedicarse a la agroindustria cuando no tienen otro trabajo. El 77,6% declaró que la agroindustria no les permite cubrir todas sus necesidades básicas. El estudio reveló una diferencia estadísticamente significativa en las puntuaciones de las percepciones personales y sociales entre diferentes grupos de edad, entre hombres y mujeres, así como entre diferentes grupos de nivel de educación juvenil. Se observó una diferencia estadísticamente significativa en los puntajes de las percepciones económicas solo entre las diferentes áreas de la encuesta. El estudio recomienda una nueva dinámica de sensibilización a favor de la profesión de agronegocios, que involucre al sistema educativo, los medios de comunicación y los actores del desarrollo.

Introduction

The world is currently upset by a socio-economic dynamic marked by the high demographic growth. The world's population is expected to increase by 2.2 billion people over the next 30 years, from the current 8 billion to 9.7 billion in 2050 and peaking at 10.4 billion in 2080. The United Nations Department of Economic and Social Affairs (UNDESA, 2022, 2019) and the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ, 2020) indicate that most of the increase in the world population will take place in Sub-Saharan Africa where the population is expected to double by 2050 . With this rapid population growth, food insecurity, youth unemployment and underemployment have become serious challenges in many developing countries as shown by the Food and Agriculture Organization of the United Nations (FAO, 2021).

In Sub-Saharan Africa, nearly 20% of young people aged 15-24 and 30 % of those aged 25-34 have no formal education (Filmer & Fox 2014 in GIZ, 2020) and will have therefore difficulties in integrating the labor market. The study conducted by the Organization for Economic Co-operation and Development (OECD, 2017) in 32 countries located in Africa, Asia, Europe, Latin America, and the Caribbean reveals that most young people (15 – 29 years old) entered the labor market with high career aspirations, resulting in a huge gap between the aspirations of young people and the labor market reality. It should be noted that young people living in rural African areas are particularly disproportionately affected by this situation due to their remoteness from basic social services and the violence caused by armed conflicts and wars. Agriculture therefore remains the main sector of employment in most countries of Sub-Saharan Africa. This sector can enable young rural people to find employment, generate income and build their careers (African Union Commission & OECD, 2018; Bossenbroek et al., 2015; FAO et al., 2014; United Nations Industrial Development Organization, 2011; GIZ, 2020; Yeboah & Jayne, 2018).

The Democratic Republic of Congo (DRC) is the largest country in Sub-Saharan Africa (2,345,000Km^2) and third in terms of demography with a population of nearly 100 million inhabitants. 80 % of Congolese are under 35 years old and 36 % of them are between 15 and 35 years old. DRC has a high rate of population growth of nearly 3 % per year as it's indicated by the International Fund for Agriculture Development (IFAD, 2020) as well as the DRC National Statistics Institute (INS, 2020). The country has a strong agricultural production potential capable to feed nearly 3 billion people annually with more than 80 million hectares of arable land, including 4 million irrigable hectares, natural pastures that can support up to 40 million head of cattle. The deplorable reality is that the DRC fails to meet the basic food needs of its population, of which 27 million people suffer from acute food insecurity. Also 72 % of rural households are living in extreme poverty (National Ministry of Agriculture 2020; FAO, 2022). Food imports are estimated at nearly $2 billion, while this money could be used to revive the agribusiness system and then local economy (Congolese Central Banque, 2019; African Development Bank, 2019). In addition to enormous challenges of development and poverty reduction in its multiple dimensions, the DRC is struggling to establish peace in its eastern region and more specifically in Kivu region where more than 122 illegal armed groups are operating (Vogel et al., 2021). Most of the South-Kivu territories have been facing armed conflicts for the past three decades. Many of Congolese young people, faced with extreme poverty, instead of taking advantage of the agribusiness potential and food market opportunities, accept to join illegal armed groups putting their lives in danger. Young people choose this dangerous path hoping to profit through looting actions and illegal exploitation of mineral

resources. Other young people take of rural exodus pathways hoping of finding a prosperous life in urban cities or migrate to other countries. It should also be noted that Kivu region has urbanized very quickly the last three decades due to the massive rural exodus, which has led to a growing food demand. Agricultural markets opportunities should be considered as a lever to revive agripreneurship. Testimonies collected in the study area unfortunately indicated an important disinterest of rural young people towards agribusiness. The problem is to know, what are the rural youth perceptions towards agribusiness in this post-conflict context with enormous agribusiness potential and market opportunities?

As part of this study, *perception* refers to the awareness of objects and events through the senses. A bout *agribusiness* we consider the fundamental definition provided by Davis (1955) who considered agribusiness as the total sum of all operations involved in production and distribution of food and fiber. Van Fleet (2016) indicated recently that agribusiness includes all organizations, large and small, profit-seeking that engage in production, distribution, marketing of food, fiber, forest products, or biofuel, including services providing (water collection, west management). We did not find a study addressing the attitudes and perception of rural youth towards agribusiness issue particularly in Congolese post-conflict areas. Furthermore, this study aims to complement other studies focused on the youth perceptions towards agriculture carried out in others developing countries. For example, the results of the study carried out by Vihari et al. (2020) in India revealed that the majority (63.33%) of rural youth had medium perception level, followed by the rest with high (20.0%) and low (16.0%) perception level 67%). Uttej et al. (2020) indicated that a third (34.2%) of all young people had a neutral attitude towards agriculture. This is followed by a moderately favorable (28.3%) and moderately unfavorable (18.4%) attitude towards agriculture, while only 10.8% showed a very favorable attitude and 8.3% of them had very unfavorable attitude. Sarju et al. (2015) found that 100% of young people engaged in agriculture perceived that farm income did not meet their basic needs and about 71.43% of them agreed to leave agriculture. Wachenheim and Rathge (2000) show that social and physical distance from the rural environment, an individual's emotions, memory, experience, knowledge, socioeconomic characteristics, attitudes, and temporal attributes are likely to influence youth perceptions towards agriculture as a professional career. Although agriculture as an occupation is fraught with misperceptions and a lack of information and awareness (Kruijssen, 2009). Moreover, Sanginga (2015) indicates that African young people perceive agriculture as an intensive labor, with difficult working conditions and high risks. Note also the study realized by Allen et al. (2016) in Nigeria, Rwanda and Tanzania which confirms that farming is widely perceived by young people as an unattractive and intensive labor traditional agricultural activity that generates little or no profit. Despite all that evidence, the study conducted by Sumberg et al. (2021) in selected African countries reveals that agriculture has a place in the imagined future of some rural youth.

Method

Research design

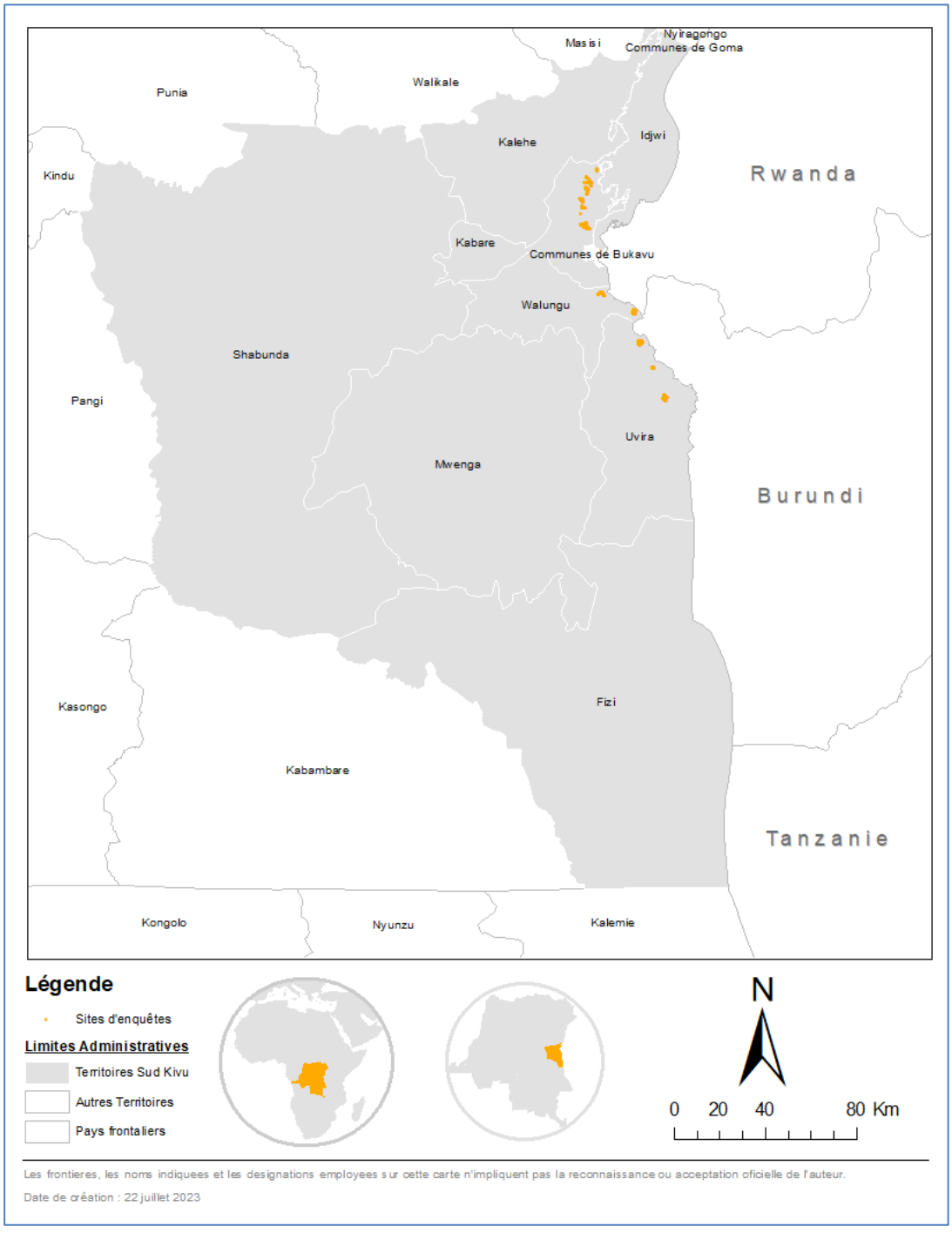
Agriculture with its role in economic development and the reduction of extreme poverty has occupied scientific debates for several years. Understanding the attitudes of actors operating in agricultural systems requires the mobilization of knowledge from several scientific fields because agricultural development is inseparable from other scientific

fields such as economy, social sciences, management sciences, psychology, decisions sciences, etc. The main objective of this research was to analyze the attitudes and perceptions of rural youth towards agribusiness as a profession in South-Kivu, a post conflict area. To properly analyze the complexity surrounding the problem addressed by this study, we used systemic approach . In the agricultural sector, systemic analysis is adopted as a comprehensive approach due to the complexity of farming through the prism of its interactions with its social, economic, ecological, and political environment (CIRAD, 1994; Donnadieur et al., 2003; Donnadieu & Karsky, 2002; Eloumi, 1994; Ferraton & Touzard, 2009; Le Moigne, 1990, 1995; Minani, 2014). The systemic approach is an important analysis tool for the agricultural systems because it makes it possible to understand the environment and the dynamics of farms, the practices, the constraints, and the actor's engagement level. Zipin et al. (2015) indicated that the individual aspirations of young people are produced through used logics, embodied dispositions manifesting themselves within the possibilities or limitations of given socio-structural positions such as gender, age, social class, family, caste, and ethnicity. Note that formal education itself, as currently practiced, often appears to be an important contributor to the construction of aspirations for a non-agricultural professional future (Katz, 2004). Understanding how rural youth interactions with agriculture and food systems change over time and across regions therefore requires a systemic view and a hypothetic-deductive method (Sumberg et al., 2012).

Population and sampling

We consider young people as all people aged 15 to 35 as it is defined by the Charter of the African Union (AU, 2006) and the legal texts in force in the Democratic Republic of Congo (INS, 2020). In view of the objective of this study and the nature of the information necessary to achieve it, convenience sampling and more specifically the quota method was used to select the individuals responding to the survey. This choice is justified by the insufficiency (or even the lack) of reliable official statistics necessary to constitute the sampling base as well as the very limited resources allocated to this study. Indeed, official information on the exact total number of rural youths in South-Kivu province is not available. Magnani (2001) shows the importance of quota sampling method to reduce the cost of collecting data on a population, especially when its size is not exactly known. The Canadian Statistical Agency (Statistics Canada, 2021) also encourages the use of the quota sampling method stating that it may be the only one appropriate choice in many cases where a suitable sampling frame does not exist for the population studied. Sampling of this study was carried out at different levels to determine the quota to be covered for each site. Indeed, after having selected the three targeted rural territories (Kabare, Walungu and Uvira), the areas deemed to have more agricultural potential were chosen in each territory with the support of local experts as well as our filed experience in South-Kivu province. A total of eight survey sites were chosen namely: Katana, Kavumu and Mudaka in Kabare territory, Nyangezi and Kamanyola in Walungu as well as Sange, Luberizi and Luvungi in Uvira (see the Figure 1).

Figure 1
Geographic map of the study area



Note. Taken from this research, elaborate from geographic coordinates collected during surveys carried out in 2022.

The quotas per survey site were estimated and planned before the field trip regarding to financial resources available, relevance of information to be collected, security situation and geographical access. When arriving in each locality targeted, the choice of individuals to interview took place according to a random process. Respondents were drawn randomly using the successive draws without replacement method, inspired by the *Bernoulli Urn* technique to give everyone the chance of being chosen as respondent and

thus reinforce the random characteristic of the sample. This technique is found in Bahati (2021) and is recommended by Chauvet (2015) as well as Bertsekas and Tsitsiklis (2002). The draw was applied in each of 8 survey sites. To achieve this, a list of 110 young people, almost double the planned quota, was drawn up for each site and after a draw without discount, 57 young women and men combined were selected. This gives a total of 456 young rural people aged 15 to 35 surveyed in the 8 survey sites. Identification of individual to be surveyed was carried out in each site with the support of local authorities, community leaders and local experts.

Field data collection

This survey was carried out from September to October 2022 to analyze the attitudes and perceptions of rural youth towards agribusiness as a profession in South-Kivu Province. Eight investigators experienced in conducting socio-economic and/or agricultural surveys familiar with the local context have been recruited and trained to carry out the surveys in the eight targeted survey sites.

Research instruments

A questionnaire addressed to young people aged 15 to 35 was developed using KoboToolbox platform (https://www.kobotoolbox.org) installed on the investigators' smartphones. The questionnaire was programmed based on the 5-point Likert scale therefore varying from 1 to 5: strongly disagree-1, disagree-2, neutral-3, agree-4 and strongly agree -5. Likert (1932) as well as Allahyari et al. (2016) demonstrate the importance of using this scale to fully understand people's attitudes and perceptions of a given phenomenon. Each young person who took part in the survey was therefore invited to indicate its level of agreement or disagreement based on declarations related to perceptions of agriculture as a profession.

Statistic data analysis

The qualitative and quantitative data from the survey conducted on 456 rural youth located in the 8 survey sites were exported from the KoboToolbox platform to Excel software to codify and process them. The descriptive statistical analysis (frequency, mean, median, standard deviation) and inferential statistical analysis (non-parametric statistical test: Kruskal-Wallis, Mann-Whitney) was carried out using IBM SPSS Statistics 20 software (Version 20.0 for Windows, 2013).

Results

The results presented in this section concern the profiling of rural youth surveyed, their attitudes towards agribusiness, a detailed analysis of perceptions as well as the factors influencing those perceptions.

Profiling of rural youth surveyed

The Table 1 indicate that the study concerned 456 rural young people belonging to 4 age groups, including 177 young people (38.8%) aged 15 to 19, 128 young people (28%) aged 20 to 24. The third group concerned 82 young people (18%) aged 24 to 25 and the last group composed by 69 young people (11.6%) aged 30 to 35. The average age was 22.41 with a standard deviation of 5.555 while the median age is 21.50.

Table 1
Rural youth surveyed age distribution

Youth age groups	Frequency	Percentage
15-19	177	38.8
20-24	128	28.1
25-29	82	18.0
30-35	69	11.6
Total	456	100.0
Mean	22.41	
Standard Deviation	5.555	
Median	21.50	

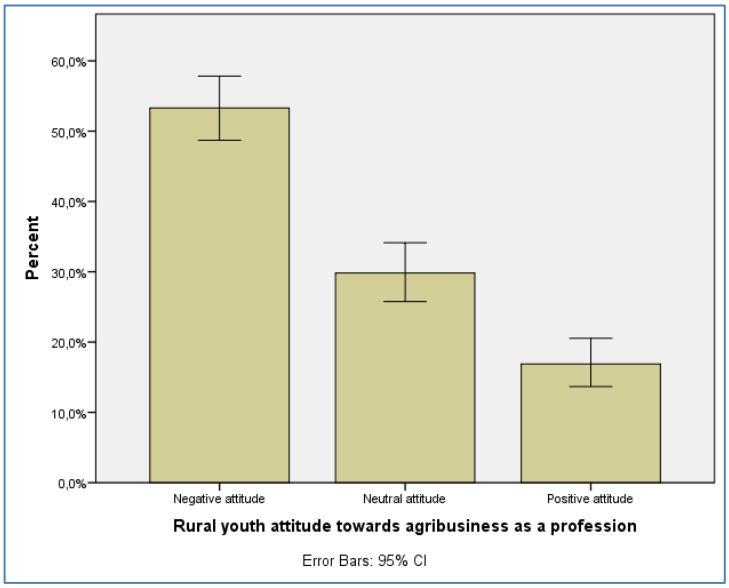
Note. Taken from this research, results of surveys carried out in 2022

Regarding other social characteristics, the results showed that among the 456 rural youths surveyed, 230 youths (50.4%) were women while 226 of them (49.6%) were men. The distribution of the education level reveals that 262 young people respondents (57.5%) have reached the secondary education, 125 young people (27.4%) have not gone beyond the primary level, 55 young people surveyed (12, 1%) were illiterate (did not go to school) and 14 young people among the respondents (3.1%) had university level. Regarding youth marital status, we note that more than half of them (55.5%) were single while 39.7% were married, 3.9% were divorced and only 0.4% were widowed.

Attitudes of rural youth towards agribusiness

The Figure 2 clearly indicates that out of 456 rural youth who responded to the survey, 244 of them (53.5%) display a negative attitude towards agribusiness, 136 young people (29.8%) display a neutral attitude, and only 76 young people (16.7%) show a positive attitude.

Figure 2
Attitude of rural youth towards agriculture as a profession



Note. Taken from this research, results of surveys carried out in 2022.

Detailed analysis of rural youth perceptions towards agribusiness

The detailed analysis of the rural youth perceptions towards agribusiness as a profession was carried out through statements grouped into three categories: economic, personal, and societal perceptions (see the Table 2).

Table 2

Detailed analysis of the rural youth perceptions towards agribusiness as a profession

N°	Declarations	Responses (N=456)										MS	SD
		Strongly Disagree (1)		Desagree (2)		Neutral (3)		Agree (4)		Strongly Agree (5)			
		F	%	F	%	F	%	F	%	F	%		
I	**Economic Perceptions**												
1	Agribusiness can meet all my basic needs	134	29.4	220	48.2	1	2.4	65	14.3	26	5.7	2.186	1.1703
2	I like to do agribusiness activities	34	7.5	232	50.9	8	6.1	131	28.7	31	6.8	2.765	1.1463
3	Opportunities are limited for young people in the agribusiness	6	1.3	83	18.2	1	2.4	204	44.7	152	33.3	3.906	1.0944
4	If I don't have a job, then I can resort to agriculture	1	0.2	70	15.4	7	8.1	284	62.3	64	14.0	3.746	0.8901
5	Agribusiness and related sectors are hard work	-	-	87	19.1	4	5.3	300	65.8	45	9.9	3.664	0.8965
II	**Personal Perceptions**												
6	The engagement of young people like you can change the reputation of agribusiness	7	1.5	130	28.5	74	38.2	133	29.2	12	2.6	3.03	0.863
7	People will not give me respect if I engage in agribusiness	5	1.1	102	22.4	0	4.4	282	61.8	47	10.3	3.579	0.9824
8	With my education level I can't engage in agribusiness	116	25.4	114	25.0	4	3.1	159	34.9	53	11.6	3.579	0.9824
9	With agribusiness I can't achieve my dreams	2	0.4	90	19.7	1	2.4	305	66.9	48	10.5	3.673	0.9238
10	Personally, I have no interest in agribusiness	2	0.4	50	11.0	3	4.8	184	40.4	198	43.4	4.154	0.9690
III	**Societal Perceptions**												
11	Young people from this village do not want to engage in agribusiness	-	-	45	9.9	7	8.1	268	58.8	106	23.2	3.954	0.8413
12	My family does not encourage me to engage in agribusiness	4	0.9	47	10.3	5	7.7	215	47.1	155	34.0	4.031	0.9534
13	Agribusiness is respectful than the administrative work	198	43.4	213	46.7	3	0.7	33	7.2	9	2.0	1.776	0.9272
14	The people from this village engage in agribusiness for lack of other options	6	1.3	41	9.0	1	2.4	127	27.9	271	59.4	4.154	0.9690
15	Agriculture is a profession for the elderly people	20	4.4	93	20.4	3	0.7	225	49.3	115	25.2	3.706	1.1773

Note. F: Frequency, MS: Mean Score, SD: Standard Deviation

Perceptions related to economic aspects

Agribusiness can meet all my basic needs: The Table 2 reveals clearly that 48.2% of rural youth disagree with this declaration, followed by those who strongly disagree (29.4%) and those who agree (14, 3%), strongly agree (5.7%), few rural young people display a neutral position (2.4%). The median score of perceptions obtained on a 5 points Likert scale for this declaration is 2 with a mean equal to 2.186 and a standard deviation of 2.186.

I like to do agribusiness activities: The Table 2 reveals clearly that 50.9% of rural youth disagree with this declaration followed by those who agree (28.7%), rural youth who strongly disagree (7.5%), strongly agree (6.8%) and neutral (6.1%). The median score of perceptions obtained on a 5 points Likert scale for this declaration is 2 with a mean equal to 2.765 and a standard deviation of 2.265.

Opportunities are limited for young people in the agribusiness sector: The Table 2 reveals clearly that 44.7% of rural youth agree with this declaration, followed by those who strongly agree (33.3%), then rural youth who disagree (18.2%), neutral (2.4%) and only a small number of them are strongly disagree (1.3%). The median score of perceptions obtained on the 5 points Likert scale for this declaration is 4 with a mean equal to 3.906 and a standard deviation of 1.0944.

If I don't have a job then I will resort to agribusiness: The Table 2 reveals clearly that 62.3% of rural youth agree with this declaration, followed by those who disagree (15.4%), then rural youth who strongly agree (14.0%), neutral (8.1%) and only a small number strongly disagree (0.2%). The median score of perceptions obtained on the 5 points Likert scale for this declaration is 4 with a mean equal to 3.746 and a standard deviation of 0.8965.

Agribusiness and related sectors are hard work: The Table 2 reveals clearly that 65.8% of rural youth agree with this declaration, followed by those who disagree (19.1%), then those who strongly agree (9.9%), neutral (5.3%). The median score of perceptions obtained on a 5 points Likert scale for this declaration is 4 with a mean equal to 3.664 and a standard deviation of 0.8965.

Perceptions related to personal aspects.

The engagement of young people like you can change the reputation of agribusiness: The Table 2 reveals clearly that 38.2% of rural youth are neutral with this declaration, followed by those who agree (29.2%), then rural youth who disagree (28.5%), strongly agree (2.6%) and those who strongly disagree (1.5%). The median score of perceptions obtained on a 5 points Likert scale for this declaration is 3 with a mean equal to 3.03 and a standard deviation of 0.865.

People will not give me respect if I engage in agribusiness: The Table 2 reveals clearly that 61.8% of rural youth agree with this declaration, followed by those who disagree (22.4%), then rural youth who strongly agree (10.3%), neutral (4.4%), very few young people strongly disagree with this statement (1.1%). The median score of perceptions obtained on 5 points Likert scale for this declaration is 4 with a mean equal to 3.579 and a standard deviation of 0.8965.

With my education level I cannot engage in agribusiness: The Table 2 reveals clearly that 34.9% of rural youth agree with this declaration, followed by those who strongly disagree (25.4%), then those who disagree (25.0%), strongly agree (11.6%), and neutral (3.1%). The median score of perceptions obtained on a 5 points Likert scale for this declaration is 2 with a mean equal to 3.579 and a standard deviation of 0.9824.

With agribusiness I can't achieve my dreams: The Table 2 reveals clearly that 66.9% of rural youth agree with this declaration, followed by those who disagree (19.7%), strongly agree (10.5%), neutral (2.4%) and very few strongly disagree (0.4%). The median score of perceptions obtained on a 5 points Likert scale for this declaration is 4 with a mean equal to 3.673 and a standard deviation of 0.9238.

Personally, I have no interest in agribusiness: The Table 2 reveals clearly that 43.4% of rural youth strongly agree with this declaration, followed by 40.4% who agree, disagree (11.0%), neutral (4 .8%) and very few strongly disagree (0.4%). The median score of perceptions obtained on a 5 points Likert scale for this declaration is 4 with a mean equal to 4.154 and a standard deviation of 0.9690.

Perceptions related to societal aspects

Young people from this village do not want to engage in agribusiness: The Table 2 reveals clearly that 58.8% of rural youth agree with this declaration, followed by 23.2% who strongly agree, disagree (9.9%), neutral (8.1%). The median score of perceptions obtained on a 5 points Likert scale for this declaration is 4 with a mean equal to 3.954 and a standard deviation of 0.8413.

My family does not encourage me to engage in agribusiness: The Table 2 reveals clearly that 47.1% of rural youth agree with this declaration, followed by 34.0% who strongly agree, then those who disagree (10.3%), neutral (7 .7%) and only 0.9% strongly disagree. The median score of perceptions obtained on the 5 points Likert scale for this declaration is 4 with a mean equal to 4.031 and a standard deviation of 0.9534.

Agribusiness is respectful than the administrative work: The Table 2 reveals clearly that 46.7% of rural youth disagree with this declaration, followed by 43.4% who strongly disagree, then those who agree (7.2%), strongly agree (2.0%) and neutral (0.7%). The median score obtained on a 5 points Likert scale for this declaration is 2 with a mean equal to 1.776 and a standard deviation of 0.9272.

People from this village engage in agribusiness for lack of other options: The Table 2 reveals clearly that 59.4% of rural youth strongly agree with this declaration, followed by 27.9% who agree, disagree (9.0%), neutral (2.4%) and only 1.3% strongly disagree. The median score of perceptions obtained on a 5 points Likert scale for this declaration is 5 with a mean equal to 4.154 and a standard deviation of 0.9690.

Agribusiness is a profession for the elderly: The Table 2 reveals clearly that 49.3% of rural youth agree with this declaration, followed by 25.2% who strongly agree, disagree (20.4%), strongly disagree (4.4%) and neutral (0.7%). The median score of perception obtained on a 5 points Likert scale for this declaration is 4 with a mean equal to 3.076 and a standard deviation of 1.1773.

Analysis of factors influencing rural youth perceptions towards agribusiness

Rural youth do not constitute a homogeneous group but diverse sub-groups according to some factors such as gender, age, education level, health status, ethnic origin, residential status, marital status, living environment, etc. The study revealed that rural youth perceptions towards agribusiness as a profession are due to a very complex combination of factors.

Age: A Kruskal-Wallis's test revealed that the personal perceptions scores were statistically different between the four different age groups (Gp1, n=177: 15–19 years old, Gp2, n=128: 20–24 years old, Gp3, n = 82: 25-29 years old; Gp4, n=69: 30-35 years old), $\chi 2$ (3, n = 456) = 11.876, p = 0.008. This difference was also observed for societal perceptions scores $\chi 2$ (3, n = 456) = 8.888, p = 0.031. Otherwise, no statistically significant difference was revealed between the different age groups concerning economic

perceptions scores, $\chi 2$ (3, n = 456) = 2.759, p = 0.430. Note that all the groups recorded the same median score for societal perceptions (Med=3.6). Concerning personal perceptions, the first two groups (15-19 years old and 20-24 years old) recorded the highest score (Med=3.6) while the oldest group (30-35 years old) showed a lower score (Med=3.2) and the 25–29 years old group recorded an average median score (Med=3.4).

Gender: a Mann-Whitney's test revealed that the personal perceptions scores of young women (Med=3.4, n=230) were significantly different compared to the scores of young men (Med= 3.4, n=226), U=22184, z=-2.726; with a small size effect, r=0.13. Otherwise, there is no significant difference between the economic perceptions scores of young women (Med= 3.20, n=230) compared to the scores of young men (Med=3.6, n=226), U=25934, z=-0.041, p=0.968 with a very small size effect, r= 0.002. This same tendency is observed for societal perceptions scores of women (Med=3.20, n=230) compared to those of men (Med=3.60, n=226), U=24122.50, z =-1.343, p=0.179 with an effect size r=0.63.

Education level: a Kruskal-Wallis's test revealed that the personal perceptions scores where statistically different between the four education level groups analyzed (Gp1, n = 55: illiterate, Gp2, n = 125: primary, Gp3, n = 262: secondary; Gp4, n=14: university), $\chi 2$ (3, n=456) =129.990, p=0.000. This difference is also observed for societal perceptions scores, $\chi 2$ (3, n = 456) = 7.905, p = 0.048. The primary and secondary education groups recorded the highest median score for societal perceptions (Med=3.6) compared to the illiterate and university level groups (Med=3.4). For personal perceptions the university group recorded the highest median score (Med=4.0) followed by the secondary group (Med=3.6). Illiterate and primary groups recorded a score low median (Med=3.2) compared to the other groups. Otherwise, the same test reveals not statistically different between the four education level groups regarding economic perceptions scores, $\chi 2$ (3, n = 456) = 4.217, p = 0.239.

Area of origin : a Kruskal-Wallis's test revealed that economic perceptions scores where significantly different between young people from 8 different survey sites (Katana, Kavumu, Mudaka, Nyangezi, Kamanyola, Luvungi, Luberizi and Sange), $\chi 2$ (7, n = 456) = 12.725, p = 0.04, the same difference was observed for personal perceptions scores, $\chi 2$ (7, n = 456) = 46.796, p = 0.000 as well as for societal perceptions scores, $\chi 2$ (7, n = 456) = 47.533, p = 0.000. For economic perceptions the highest median score was recorded in the groups from Nyangezi and Luberizi (Med=3.4), the other groups recorded the same score (Med= 3.2). The group from Kavumu recorded the highest score (Med=3.8). Finally, the group from Kavumu and Luberizi recorded the highest median score about societal perceptions (Med=3.8).

Discussion and conclusions

From the results presented in the previous section, it can be deduced that in South-Kivu province more than half of rural youth (53.5%), have a negative attitude towards agribusiness as a profession, 29.8% of youth have a neutral attitude and only 16.7% of them are positive towards agribusiness. These results are not far from those found by Uttej et al. (2020) in India although the context is different. Uttej and co-authors found that a third (34.2%) of all young people had a neutral attitude towards agriculture, followed by those who were moderately favorable (28.3%) and moderately unfavorable attitude (18.4%), while only 10.8% where very favorable and 8.3% where with unfavorable attitude. The lack of interest in agribusiness is due to the negative image society have towards agriculture and related sectors around developing countries in

general. In South Kivu, the negative perception towards agribusiness is also influenced artisanal mining considered by young people as more profitable. Testimonies collected during field surveys indicated that agribusiness promotion is also limited by a lack of awareness. Note also that current education system tends to prepare youth for non-agricultural careers. Agribusiness is therefore considered in Sud-Kivu as a career for poorest people who have failed in school. Armed conflicts which have almost destroyed the socio-economic fabric, making some rural areas hostile while reducing the capacity of the government to stimulate a new economic dynamic.

Indeed, 77.6% of young rural people surveyed agreed/strongly agreed that agribusiness cannot enable them to meet all their basic needs. Sarju et al. (2015) revealed almost the same trends in one of India's districts. The author indicated that 100% of young people engaged in agriculture perceived that agricultural income did not allow them to meet their basic needs, 71.43% of them agreed to leave agriculture. These perceptions linked to the negative image attributed to the agricultural sector can justify the number of young people (76.3%) who agreed with the declaration according that they can only engage in agriculture when they have no other job. These evidence from South-Kivu are close to the assertions from Sanginga (2015) which indicated that African young people perceive agriculture as a high-intensity work, with difficult working conditions and high risks. Note also the study carried out by Allen et al. (2016) in Nigeria, Rwanda and Tanzania which confirm that agriculture is widely perceived by young people as an unattractive, traditional labor-intensive activity that generates little or no profit.

This study analyzed the influence of factors on rural youth perceptions towards agribusiness in South-Kivu. It's therefore especially gender, age, education level and area of origin. The analysis focused on economic, personal, and societal perceptions aspects. It appears that three out of four factors analyzed (age, gender, education level), significantly influenced the rural youth personal perceptions as well as their societal perceptions. The study revealed also that only the area of origin (living environment) has significantly influenced the economic rural youth perceptions towards agribusiness. Regarding the median value of the economic perceptions score, the highest score being recorded in the group of Nyangezi and Luberizi. These results are similar to those reported by Leavy and Hossain (2014) through a study carried out in 23 urban and rural areas located in 10 countries, including 4 Africa courtiers (Burkina Faso, Ethiopia, Kenya and Zambia). The authors concluded that farming is not a preferred option for the younger generation in rural areas. They found also that high youth educational level was strongly correlated with very high career aspirations, both from young people, from their parents and as well as from society. The influence of youth perceptions due to the education level is also observed by Katz (2004) who indicated that agriculture is classified as a profession only for those who had not successful at school. Other studies such as Barratt et al. (2012) also Sumberg and Okali (2013) concluded that most young people do not consider agriculture as a professional career but rather as backbreaking work generating low productivity and offering less income and less social consideration.

Rural youth engagement in agribusiness remains a locomotive pillar on which the world and more particularly the Democratic Republic of Congo must rely to boost the local economy, reduce extreme poverty, and fight against youth employment crisis as well as food insecurity. Substantive work must be carried out to guarantee the positive image of young people because the agricultural generation gap revealed by this study may compromise food security and local economy. A new dynamic of awareness-raising in favor of agribusiness profession is therefore needed, involving government, education system, media, development actors and other social structures.

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EFFORT IN PROJECT MANAGEMENT APPLIED TO ARTIFICIAL INTELLIGENCE PROJECT

ESFUERZO EN LA GESTIÓN DE PROYECTOS APLICADA A PROYECTOS DE INTELIGENCIA ARTIFICIAL

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ABSTRACT

In the last five years, advancements in computing power have brought about a surge in artificial intelligence (AI). Directly or indirectly, a significant number of systems have started incorporating AI algorithms or implementations into their functionality to perform various tasks. These implementations range from machine learning models to natural language processing and image processing, among many others. The development of a computer program requires technical skills, and it also necessitates the application of a project management model capable of incorporating and adapting to the new technologies integrated into the development process. This study examines whether the inclusion of a new AI technology as a functional requirement in the development of a product impacts the project management effort by measuring the hours devoted to this task. The research aims to answer the following research question: i) ¿Is there any difference in the effort and hours dedicated to project management in software development projects that include some form of artificial intelligence technology as part of their functionality? To address this question, a non-experimental quantitative documentary research approach is employed, using descriptive statistics as a quantification tool. The study encompasses the entire analyzed population, and the results highlight that the effort in management tasks does not show significant differences.

Palabras clave:
gestión de proyectos, esfuerzo de gestión, inteligencia artificial, desarrollo de software, tecnología.

RESUMEN

En los últimos cinco años, el avance en el poder de cómputo trajo consigo un auge en la inteligencia artificial (IA). De forma directa o indirecta, una gran cantidad de sistemas comenzaron a incluir dentro de su funcionalidad, algoritmos o implementaciones de IA para realizar diversas tareas. Estas implementaciones van desde

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modelos de machine learning, procesamiento de lenguaje natural o de imágenes entre muchos otros. La construcción de un programa informático requiere de habilidades técnicas, así como también, es necesaria la aplicación de un modelo de gestión de proyectos que sea capaz de incorporar y adaptarse a las nuevas tecnologías que se incorporan dentro del proceso de desarrollo. En este trabajo, se analiza si la incorporación de una nueva tecnología de IA como requerimiento funcional de desarrollo de un producto, impacta en el esfuerzo de gestión de proyecto mediante la medición de las horas invertidas a dicha tarea. En esta investigación se responde la siguiente pregunta de investigación: i) ¿Existe alguna diferencia en el esfuerzo y dedicación de horas de gestión en los proyectos de desarrollo de software que incluyen como parte de su funcionalidad alguna tecnología de inteligencia artificial? Para ello, se efectúa una investigación documental con enfoque cuantitativo no experimental haciendo uso de la estadística descriptiva como herramienta de cuantificación. El estudio incluye el 100% de la población analizada y dentro de los resultados se destaca que el esfuerzo en tareas de gestión no presenta mayores diferencias.

Introduction

Throughout this research, we will analyze the degree projects (or Degree Thesis) for the university careers of Engineering and Bachelor in Computer Science of the Faculty of Engineering of Universidad de la Empresa (UDE), focusing the study on the effort dedicated by students in project management activities, measured in hours.

According to the Project Management Institute (PMI) a project is "A temporary effort undertaken to create a unique product, service or result. The temporal nature of projects indicates a beginning and an end to the project work or a phase of the project work. Projects can be stand-alone or part of a program or portfolio." (Project Management Institute, 2021, p.31).

The university degree theses analyzed in this research work strictly comply with the definition presented above, since there is a defined time frame whose start and end dates are established in the preliminary project that formally initiates the project and the product to be built is unique.

The students who carry out these university theses (from now on degree projects) must select and apply some project management methodology in a mandatory way, being this obligation a fundamental part of the project and a necessary condition to obtain the final approval. In this scenario, the student(s) officiating as project manager(s) must apply all possible and available tools in order to perform an efficient and correct project management during the entire project life time leading to the successful completion of the project.

From a theoretical point of view, project management is a discipline that integrates a great variety of concepts, which when applied in a coordinated manner and with a common objective, allows leading or managing a project to achieve the defined objectives. Students doing the degree project have received a wide variety of training courses and a wide variety of management tools and techniques throughout their college career. All this acquired knowledge must be applied throughout the project in order to maximize the probability of success and successfully conclude the project.

One of the major decisions that students must make is the choice of the management methodology to be applied throughout the project. Throughout their careers they have been confronted with different management methodologies and many of them have been analyzed in greater depth due to their inclusion in the study plan. However, they have the knowledge to learn and apply any existing methodology.

Among the management methodologies are those referred to as traditional methodologies, where we can highlight the project management methodology promoted by the Project Management Institute (PMI), the ISO 21502 for project management and direction promoted by the International Organization for Standardization (ISO) and the competency-based methodology proposed by the International Project Management Association (IPMA) called ICB Competence Baseline, among many others.

The body of knowledge of the PMBOK in its 7th edition, leaves aside the concept of knowledge areas and replaces them with performance domains. The performance domains consist of the set of activities fundamental to the achievement of the planned objectives; the domains as a whole represent the interactive, interrelated and interdependent capabilities to achieve the expected results. In addition, the seventh edition of the PMBOK shifts the focus from a process-based methodology to a principles-based methodology. The new approach defines 12 management principles that focus on and aim to guide the style of work and management of a project (Project Management Institute, 2021).

The ISO 21502 standard for project management specifies high-level guidelines that emerge from the good practices applied and results obtained in different projects. The proposed guidelines are composed of a set of processes and methods that must be executed in a coordinated manner and as part of a complete system, considering the project's own characteristics. According to the ISO organization, this standard can be applied to any public or private organization of any size (Organización Internacional de Normalización, 2022).

The competency-based project management (ICB Competence Baseline) proposed by IPMA proposes that project management should be performed by individuals with three specific competencies, each of which focuses on a specific dimension. The competencies proposed by IPMA are: Perspective, focused on evaluating the context where the project is carried out to determine the execution strategy, governance, processes, culture, management of powers and interests, among others; People, focused on the human part of the team to manage internal conflicts, promote teamwork and communication, self-criticism and reflection, leadership, negotiation, among others; and Practice, where all activities related to time management, activities, finances, quality, risks and opportunities, among others, are highlighted (International Project Management Association, 2018).

On the other hand, there is a set of methodologies called "agile methodologies" whose objective is to focus on the product over the process. There is a misconception that these methodologies avoid "heavy" processes such as documentation in favor of product-focused tasks. It is important to note that in these methodologies the effort of management tasks is reduced and resources are focused on the production of the product. Management activities or activities transversal to the product are minimized to what is necessary to support the product. Within these methodologies we can highlight SCRUM, Kanban Scrumban.

The SCRUM methodology was created by Ken Schwaber in 1995, whose main objective is the software development process in an agile and continuous way. It prioritizes short iterations, where each iteration concludes with a piece of functional software, which is quickly validated by the customer represented in the figure of the Product Owner. Short cycles favor the incorporation of changes that can be included in the development process quickly, minimizing the impact on the process. The methodology is described in the SKBOK (Satpathy, 2022).

The Kanban method was created in 2007 and its mission is to improve, manage and define services that deliver intangible work, such as software development. To achieve this, it uses a dashboard to visualize the intangible work where the right amount of work required and the delivery capacity is presented, thus limiting the amount of work in progress. As a general rule, it uses the concept of carry-over, where a new job can start if and only if another job is completed. This minimizes "waste" or, in other words, work started but not completed or partially completed (Carmichael & Anderson, 2016).

Scrumban is an agile methodology whose origin dates back to 2008 and as its name suggests, it is a hybrid composition between Scrum and Kanban (Ladas, 2008). According to him Salvay (2017), it is particularly useful for maintenance projects where the adoption of this methodology allows the use of Kanban concepts that cannot be used when applying the SCRUM methodology or vice versa.

Authors such as Pressman (2020) y Sommerville (2016)define software project management as an additional activity or discipline that is included within the activities of software engineering.

There is a constant evolution and adaptation in project management methodologies to accommodate the changes that projects face every day, where we can

name the contexts where projects are carried out, such as the place where they are implemented, the external forces that exert different pressures on the project, the human or technical resources, as well as the new and different technologies that emerge at an increasingly accelerated pace.

A very particular case of this evolution occurs with the inclusion of new technologies, software projects must not only adapt to technological changes such as new versions of programming languages, changes in security or in the base systems, but must also be able to incorporate and adapt to the disruptive technologies of the moment.

In the past, technologies such as Bluetooth or IoT marked an era where many companies of different types and sizes began to include these technologies as part of their development solutions, and therefore project management had to adapt quickly to manage projects with cutting-edge technologies where an additional factor of uncertainty and risk was added to the existing ones.

The progress in the development and evolution of the various branches of artificial intelligence in recent years has shaken all existing disciplines and professions. Some of the concerns raised by artificial intelligence include the disappearance of some professions, as well as the creation of others. Project management is no stranger to these advances and there are several studies that identify or relate how this technology can collaborate with this discipline, enhancing it and facilitating its performance.

In the bibliographic research carried out, a lack of research on the subject of this work was observed, thus limiting the understanding of how this new technology impacts the management effort in development projects that decide to implement and incorporate artificial intelligence technologies as part of the product, in any of its branches, either as part of the core of the software to be built or as an added value of it. It is in this context that this study presents a first approach to the subject.

Software development projects that include the development of some type of artificial intelligence must include new profiles such as: data engineer/scientist, data analyst, machine learning engineer, among others. Along with these new roles, new activities arise where the activities related to preparing the data to be processed by the artificial intelligence algorithms, the modeling and optimization of the machine learning algorithms and the infrastructure where these algorithms are to be executed are highlighted (Arias, 2023).

Different authors such as Pressman (2020) y Sommerville (2016) agree that project management consists of a series of activities that, according to Pressman, include: Human Resources Management, Measurement (Product and Process Metrics), Project Estimation, Planning (Scheduling), Risk Management, Maintenance and Evolution.

The inclusion of cutting-edge and innovative technology should not be taken lightly or underestimated, as it impacts every one of these activities and every one of the decisions a manager must make.

By analyzing each of these activities, we can understand to what degree and how each activity is affected by the new technology included in the development project.

Human resource management from the project manager's perspective consists of the manager's ability to select the right human resources for the specified task, as well as managing the interactions and supporting the people in whatever they require (Pressman, 2020).

In this scenario, the inclusion of a new technology will have an impact not only on the management of the project from the point of view of the choice of the most suitable human resources or collaborators to carry out the task, but also, the time required for training and the minimum necessary mastery of the technology in question must be considered. When using a new technology, it is important to manage the emotions and

mood resulting from possible setbacks or difficulties in the learning curve and adoption of these new technologies, which is why managing this type of situation will be critical when managing the project.

Project measurement consists of choosing the right metrics to be able to measure and act proactively in the different situations faced by the project manager. Project metrics are divided into process metrics and product metrics; while the former are likely to be maintained independently of the technology implemented, product metrics are closely linked to the technologies used and therefore monitoring these metrics may require additional effort in project management (Pressman, 2020).

Project estimation is one of the most complex tasks a project manager can face. This task is not carried out by the manager individually and must be supported by different people, with a mastery of the technology to be used, who are an integral part of the project team together with the use of different tools that allow the most accurate estimate possible (Pressman, 2020).

As can be seen, the use of new technologies adds several additional components to the project, including training and the time required to minimally master the new technologies. As a result of the above, and due to the fact that all projects exert different pressures on the teams assigned to them, new and different uncertainties associated with these technologies and new scenarios are generated, which have an impact on the lack of technical knowledge at the time of making the necessary estimates to carry out the project.

Planning is an activity that is strongly related to estimation, since estimation is a fundamental input for a project manager to plan the project. Additionally, planning requires the ability to divide complex tasks into smaller and simpler tasks, to achieve the interrelation between the different tasks, to include the amount of available resources and their allocation so that as a whole the time needed to complete the project can be determined, giving rise to the base schedule (Pressman, 2020).

The planning of a project is directly affected by a new technology, mainly in the ability to subdivide tasks, since working with a new technology can be more complex, and in the allocation of human resources to these tasks. It may also be indirectly affected by estimates, as these were influenced by new technologies and will therefore affect planning and timing, as well as the allocation of resources to tasks. It can be seen that, to a greater or lesser extent, new technologies affect the manager in terms of planning and, ultimately, how it should be managed.

Risk management, according to Pressman (2020), consists of identifying any event that may positively or negatively affect the development and objectives of the project. The project manager must not only be able to identify risks, but must also be able to classify them into general, technical and human risks, among others; plan the follow-up and actions to be implemented by designing mitigation and contingency plans; perform the analysis and subsequent writing of lessons learned and reporting (Pressman, 2020).

A project that includes the use of new technologies presents additional risks inherent to new technologies. In this scenario the manager faces new challenges, where there may be no similar projects that can be used as sources of inspiration, and the manager's abilities to anticipate, predict and identify new risks become critical in meeting objectives.

The main objective of the project manager is to administer and/or manage the project within the stipulated time, however, he/she must also be able to determine or provide additional information on the steps to be performed once the project is completed and the product delivered; this phase is referred to as "maintenance and evolution". Although this phase is subsequent to the completion of the project, it should be considered

and included as part of the activities that the project manager must plan and determine to ensure the continuity of the product delivered to the customer (Pressman, 2020).

In the degree projects, maintenance and evolution are outside the students' responsibilities, since they should only focus on the degree project within the stipulated timeframe. Any subsequent activities are outside the scope of the project and within the scope of an agreement between the student and the company sponsoring the project.

The theoretical concepts detailed above allow students to understand each of them from a general perspective, but sometimes the practice is very different from the theory. Students require concrete examples of how to apply or take these methodologies from a theoretical perspective to a practical and concrete example. That is why authors such as Lledó (2016) y Alaimo & Salías (2013) provide a realistic approach that allows students to visualize the implementation of these methodologies in concrete situations.

Throughout this research work, we will analyze the effort dedicated by students in their university degree project in those activities focused on project management in projects that include some artificial intelligence or machine learning technology, as part of its functionality and thus, compare the results obtained with software development projects without these technologies. Based on the data analyzed, the following two research questions are posed, which are highly interrelated.

- Is there a difference in the effort and dedication of management hours in software development projects that include artificial intelligence technology as part of their functionality?
- how much management effort do projects involving this type of technology require?

Method

Among the different types or strategies of research are the quantitative and qualitative approaches. The quantitative approach presents a set of characteristics that allow a clear and specific definition of a problem, the formulation of objectives and hypotheses, and the use of tools that allow the precise and objective measurement of the event to be investigated. On the other hand, the qualitative approach focuses on aspects that cannot be quantified, focusing on aspects of behavior, patterns, processes or meanings, such as, for example, feelings, thoughts, among others... (Lerma González, 2009). According to the above, the quantitative approach was used in this research work because it is the one that best suits the objectives set out.

The study population participating and evaluated in this work is made up of the total number of degree projects available, and it is because of this that we will not work with a statistical sample, but, as previously mentioned, with the population as a whole. Working with 100% of the set of projects is possible because the number of projects is limited and manageable. In accordance with the above, descriptive statistics is the ideal tool to be used throughout this research work. By using descriptive statistics, the behavior of a set of individuals can be described clearly and accurately. The use of descriptive statistics is chosen over inferential statistics because the set of total projects is reduced and manageable, thus avoiding the need to make inferences or validations through techniques such as the p-value or null hypothesis.

The first group consists of those development projects that implement some artificial intelligence technology, while the second group is composed of traditional software projects where no artificial intelligence functionality is implemented. The variable of relevance for this study consists of the effort in management activities without

any manipulation on it, thus the work will allow comparisons to be made in search of similarities or differences.

On the basis of the above, authors such as Sampieri Hernandez et al., (2014) y Ñaupas et al., (2018) classify this research work as a quantitative, descriptive, univariate and non-experimental study.

Data acquisition process

Data acquisition was performed following a sequential set of steps, which are listed below:

1. Data collection in the library.

The first step consisted of collecting all the degree projects, for the careers that make up this study, that are available in the university library, either in physical or digital format.

2. Initial data cleansing or debugging.

Based on the previous step, the bibliographic review of each project was preceded by an initial filtering and filtering based on the following criteria:

a. Period to be used
b. Discard projects that do not include development

3. Collection and recording of project management (PM) effort and activities.

With the information recorded by the students, we proceeded to record the effort in hours for the project management task and then calculate what percentage it represents in the total hours. This record was made using the total hours reported by the students, the sum of hours for each iteration or the percentage calculated by the students.

4. Review and adjustment of the GP value.

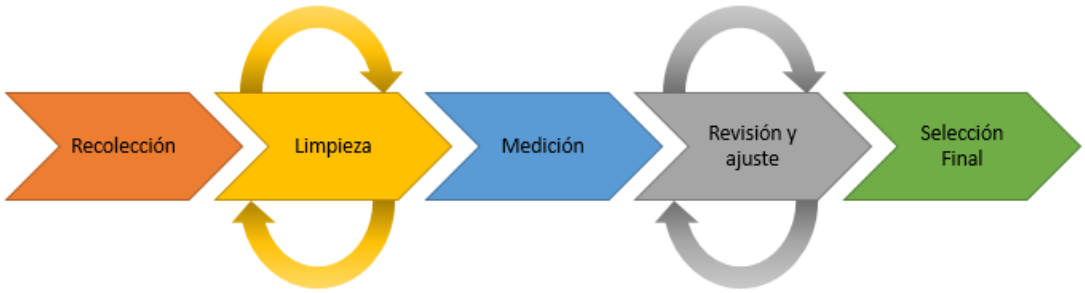
An analysis was made of the documents submitted by the students and in those cases where the project presented greater detail in the information provided by the students, the values recorded were verified and, if any inaccuracy was detected in the record, the necessary corrections were made.

5. Final selection of projects.

The last step consisted of discarding and consequently selecting those projects that will be part of this work. Projects were discarded if the documentation analyzed did not show evidence of registration and/or the variable of interest (GP effort) could not be reconstructed.

The process used for data acquisition is presented below.

Figure 1
Data acquisition process



Participants

The study covers the final academic degree projects of the Faculty of Engineering of the Universidad de la Empresa for the undergraduate degrees of Bachelor's Degree in Computer Science and Computer Engineering recognized by the Ministry of Education and Culture of Uruguay (MEC).

The initial number of projects within the selected study period and whose final product is either a software development or a software prototype consists of 113 projects.

The initial data set was fragmented into two sets, the first set contains the traditional software development or prototype projects, this set is composed of a total of 95 elements of which 77 of them have the study variable, while 18, lacking this variable, will not be considered throughout this work.

The second dataset contains 18 projects that directly or indirectly use some artificial intelligence technology; of these 18 projects, 13 contain the study variable, while 5 are discarded for lacking it.

Table 1 shows the details of the data presented above for each data set.

Table 1
Number of projects analyzed

Number of Projects	Methodology	Valid	No data
95	App development projects.	77	18
18	AI related projects	13	5
113		90	23

Data design and analysis

The projects that are part of this work are in the period from 2012 to 2022. The minimum duration of the undergraduate projects is a total of 6 months with an automatic extension of up to 50% of the initial duration, giving a maximum total duration of 9 calendar months without penalty in the grade obtained. After this deadline, students may apply for an additional extension of up to 5 months, where the tutor authorizes this extension based on different criteria or situations that have arisen throughout the project. In this scenario, students are penalized in the final grade by the tribunal, since the project has a total duration of 14 months.

The University has a mechanism that enables and authorizes the continuation of the project if the term is extended and exceeds 14 months. This mechanism allows the University to contemplate extreme and serious cases where there is a health problem or a very particular situation and a formal process must be fulfilled with evidence that supports the problem occurred and it is the University's responsibility to authorize the

continuation of the project outside these deadlines, up to a maximum of 4 months, however, none of the 113 projects analyzed have been in this situation.

The data analysis was performed using the bibliographic information provided as part of the project and accessible through the university library. As mentioned above, the review process included a detailed and in-depth analysis of the documents submitted and the verification of the time records for each of the projects. In case of discrepancies between the data reported by the students and the verification performed, the pertinent correction and adjustment is made.

Results

Tasks performed as part of project management

For the students, the undergraduate projects proposed by the Faculty of Engineering of the Universidad de la Empresa are simulations of projects that they will face in their professional activity, which is why all projects are sponsored by a real client. All projects must comply and be managed as a real project, so all the activities of a software project must be performed, including those management activities that must be executed by the Project Manager.

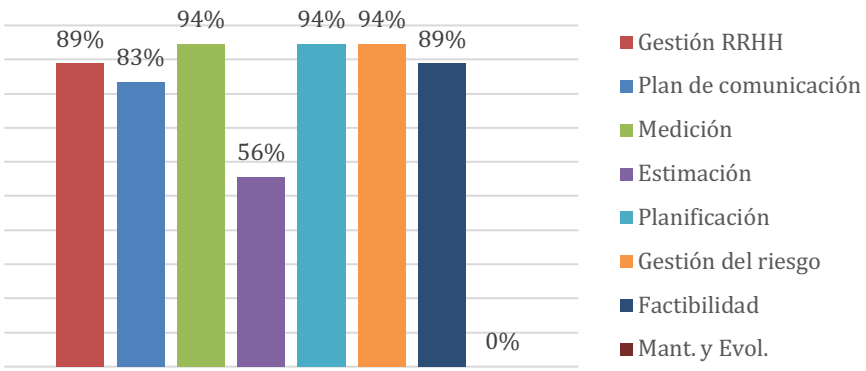
Pressman (2020) describes project management, or project administration, as a discipline within software engineering, and groups management activities into the following six categories: Human Resources Management, Measurement (Product and Process Metrics), Project Estimation, Planning (Scheduling), Risk Management, Maintenance and Evolution.

Project management requires that activities be carried out in a recurrent and planned manner, although no activity is considered more important than another, since all of them are focused on achieving the project's objectives, in what refers to a project in the context analyzed, we can say that some of these activities can be carried out in a cursory or very limited manner, such is the case of "Human Resources Management".

Figure 2 shows the percentage of projects that carry out each of the activities. According to the values observed, it can be seen that with the exception of the "Estimation" and "Maintenance and Evolution" activities, the rest of the activities are carried out by more than 80% of the projects analyzed.

Figure 2

Project management activities in AI projects



Regarding "Estimation", it is important to note that students make an initial estimate prior to the formal start of the project, in what is called the delivery of the

preliminary project. The pre-project is an official document that stipulates in writing the scope of the project, the start date, the tasks to be performed, the functional and non-functional requirements and the methodology to be used.

With regard to the refinement of estimates during project development, it is observed that only half of the projects make new estimates or adjustments to the initial estimates, whether these are estimates of scope and effort required to successfully complete the project, using and taking advantage of the information gathered and obtained throughout the execution of the project.

It is difficult to explain or understand the reason for this low percentage, because from the information analyzed, there is no information that can explain it, however, some possible explanations may be in the direction of the absence of similar projects, lack of knowledge to estimate projects that include artificial intelligence or that the project should be carried out regardless of the estimate made, so it can be seen, erroneously, as an activity that will not produce a positive/negative impact on the project.

University degree projects have a finite scope with an established end date, where within the scope, no maintenance or any linkage after the end date is included. This is reflected in the percentages shown in Figure 2, where it can be seen that no project performs Maintenance and Evolution tasks. Having said this, it is important to note that the projects do include a section where they must clearly express the future work that can be carried out and in some way delimit where the systems can evolve.

In analyzing the recording of project management effort we came across two errors that are commonly made by students when accounting for hours on this particular type of task. Both errors consist of confusing or counting project and/or documentation management hours as if they were the same activity. It is very difficult to understand the causes of this confusion using only the documentation presented by the students, so when analyzing these hours, we must be cautious and, as far as possible, review and compare the spreadsheets (if they exist) to validate the correct allocation of hours.

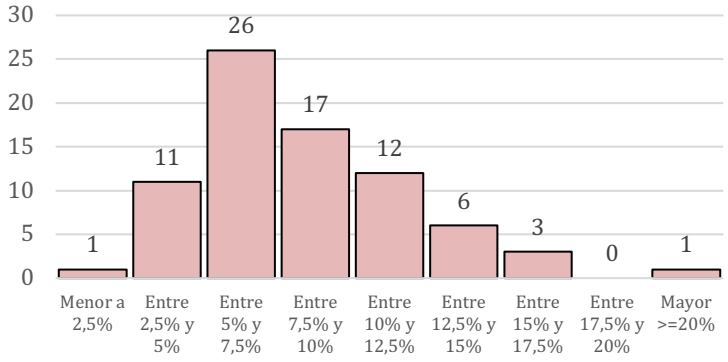
According to the above mentioned, and based on my experience as a tutor and corrector of undergraduate projects, in projects where the project management effort is less than 5% generally many management hours are counted as documentation and when the management hours are very high the opposite happens. While this is not true in all cases, and there may be exceptions or nuances, it is a common mistake that has been seen in some projects.

Project management hours effort survey

The management of software development projects that do not include any type of artificial intelligence or machine learning technology presents a Gaussian curve with a slight slope to the left (See Figure 3).

Figure 3

Histogram of the effort in software development projects (Without AI)



As can be seen from the data analyzed and presented in Figure 3, 93.4% of the university degree projects for the Bachelor's and Computer Engineering degrees at the Universidad de la Empresa are in the range of 2.5% to 15%, and within this range, 56% correspond to projects whose management is between 5% and 10%. As stated above, projects with values below 5% may contain an under-recording of hours and an incorrect allocation, so that, in principle, it can be discarded as part of the range of valid effort.

Jones (2005) indicates that project management in development projects is around 10% of total project hours. A specific study of the effort registered in undergraduate projects for computer science majors carried out by Rojas Sánchez & Uc Ríos (2022)confirm what was presented by Jones (2005)and state that the mean value of effort in project management activities in the context of the academic degree projects evaluated is 9.1%. In addition, they claim that the effort in management tasks is in a range between 5% and 15% with an average of 9.8%.

When contrasting the results obtained in this research work, we can see that although the values reported by the students are not centered on the 10%, they are very close to it.

The project management effort that includes some type of artificial intelligence or machine learning technology presents a behavior with some observable differences, mainly in that the curve drawn in the graph does not present the shape of a Gaussian curve. However, in general terms, it respects the ranges presented above and, as can be seen in Figure 4, 92.3% that applied some degree of IA within the project dedicated a management effort in the range of 5% to 15% (there are no projects with an effort of less than 5%) and within this range 53% are in the range of between 5% and 10%.

Figure 4

Histogram of the effort in software development projects (With AI)

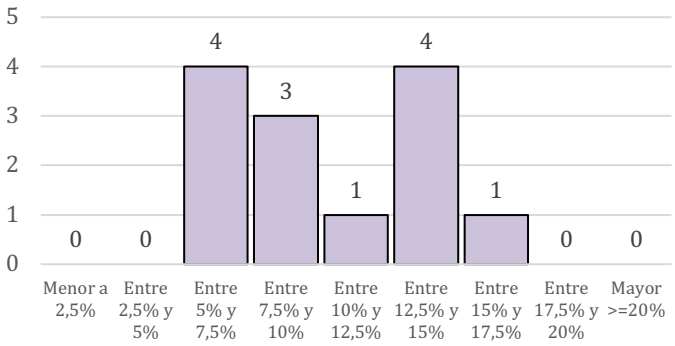


Table 2 shows the summary of the statistical values obtained throughout this research work as opposed to those presented in the research conducted by Rojas Sánchez, M. & Uc Ríos, C. (2022). As can be seen, the IA/ML projects do not present major differences with the values obtained for conventional development projects or with the values presented by Ríos, C. and Rojas, M. (2022). With regard to statistical values such as average, mean and bounded mean, they show a difference of around 2% with respect to traditional projects and around 1% for the values presented by Ríos and Rojas, while the standard deviation and variance indicate that there is little dispersion in the IA projects.

Table 2

Management hours statistics by type of software project

	Software Traditional	**Software IA/ML**	**Rojas and Rios (2022)**
Range	5%-12,5%	5%-15%	5%-15%
Average	8,3%	10,3%	9,8%
Average (10%)	7,5%	10,0%	9,1%
Median	8,1%	10,3%	8,5%
Minimum	1,0%	5,9%	1,0%
Maximum	21,1%	17,1%	45,7%
Standard deviation (o^2)	3,6%	3,7%	5,9%
Variance (o)	0,1%	0,1%	0,4%

Note. Source: Own elaboration with data from Ríos and Rojas (2022)

Discussion and conclusions

The origins and triggers that initiate this research work arise with the objective of answering the following two questions:

- Is there a difference in the effort and dedication of management hours in software development projects that include artificial intelligence technology as part of their functionality?
- How much management effort do projects involving this type of technology require?

These questions are generated by the massive implementation and development of information systems that use or implement, to a greater or lesser extent, artificial intelligence or machine learning algorithms.

Artificial intelligence technologies have opened up new opportunities and have been widely disseminated due to the benefits and advantages they provide to users and the potential improvements they offer when used in everyday problems.

Throughout this research work, we have measured the impact of including these technologies in software development projects and in particular, how the inclusion of these technologies can affect the effort dedicated to project management tasks.

The students who carry out the academic degree project are faced with new activities and tasks that resemble real projects, where they must make decisions as project managers that impact positively or negatively on the development of the project.

As could be observed, all the project management activities proposed by Pressman (2020) were performed in almost all the projects, with the exception of the estimation activity, which was only performed by half of the IA projects studied. That said, there is no difference between the tasks performed by students in traditional development projects compared to projects that include artificial intelligence in some of its variants.

It is difficult to discern and explain why traditional development projects and projects implementing artificial intelligence technologies perform exactly the same project management tasks (presented above), however, we can venture a hypothesis that should be tested with a specific study to verify its validity. The undergraduate projects in the academic context analyzed are framed within an inflexible context where the tasks that must be performed and evidenced in order to approve the project are to a greater or lesser extent pre-established. Although there is a margin for adaptation, this margin is not very large and tends to be small. In addition, students take projects from previous years as examples, so they base their documentation and tasks on projects that have already been evaluated and approved, because aligning themselves with successful projects maximizes their chances of success.

However, this leads to a lack of innovation in terms of process adaptation and, consequently, a lack of risk-taking to bring about improvements or to create new implementations and/or adaptations that are better suited to the projects they develop.

From the measurement and analysis carried out, it can be seen that IA projects do not behave differently from traditional projects. All statistical measures, as well as the ranges found, are very close to or equal to the rest of the types of projects studied.

In response to the questions posed, based on the data analyzed and presented, there is no evidence indicating the existence of any considerable or detectable impact that positively or negatively influences the effort and dedication of hours dedicated to project management tasks for the projects under study.

The hours dedicated to project management tasks for these projects were in the range between 5% and 15%, with minimal differences with respect to the hours and effort dedicated to similar tasks in traditional development projects, in line with the results proposed by Rojas Sánchez & Uc Ríos (2022) and, to a greater and lesser extent, very close to those presented by Jones (2005).

Based on the foregoing and in conclusion, the answers to the research questions posed at the beginning of this paper are presented below. The initial question originating this paper was: is there any impact on the effort and dedication of hours in project management, in the projects that include as part of its functionality some artificial intelligence technology, has the answer that there is NO impact in terms of effort and dedication of management hours.

Regarding the second silver question: How much management effort is required for projects that include this type of technology, the answer to this question is that the project management effort is in the range of 5% and 15% with a median of 10% and an average of 10.3%.

Reflections and limitations

Among the limitations detected in this research work, those directly related to the available data stand out. The following is a list of the present and future limitations detected:

1. One of the most important limitations that was present from the beginning of this work was the number of projects. This research has a number of projects of less than 120 elements and the number of projects that can be categorized within the projects subject to study turns out to be in the order of 15%. Although this favors the use of descriptive statistics and makes it possible to describe the behavior of this type of project as opposed to traditional projects, the total number of projects is small. For this reason, it is important to emphasize that this work is exploratory and a starting point to lay the foundations and direction for further work that may include a larger number of projects from other universities and other countries.
2. The recording of effort measured in hours was performed exclusively by the students. It is important to note that there are always small errors in effort recording, but experienced project managers are able to minimize or even detect and minimize these errors. The students, lacking experience in project management and in view of the imperative need to carry out and complete the project, do not apply any methodology to minimize possible errors in the registry, so a certain margin of error in this registry is to be expected. In order to minimize these errors, in cases where there was additional information regarding the recording of effort, the values recorded were validated, verified and adjusted if inconsistencies and/or anomalies were detected.
3. The diversity by type of project is a minor limitation that, although it did not have a direct impact on the object of study of this work, it does present challenges and challenges for the future in possible lines of research that may derive or originate from this work.

Continuity proposals

Research work in academic contexts is a research opportunity that is seldom taken advantage of. Having the information of the entire process executed throughout the project presents endless possibilities and lines of research that can be the starting point for different lines or future work.

This paper analyzes the impact of a new technology, such as artificial intelligence, from a development point of view and whether this inclusion impacts project management.

Among the possible proposals for continuity, it is proposed to evaluate the impact of this new technology on specific project management activities, such as risk management. When including a new technology, it is expected that specific risks will arise, as well as mitigation and contingency plans associated with these new technologies. Students are trained and will be able to cope with these new scenarios, is a question that seems to be interesting to answer.

Another possible line of research is a direct extension of this work, which consists of measuring the hours spent on software development tasks, as well as the hours spent

on documentation tasks. While development hours may indicate that this type of activity may be more or less from a technical expertise standpoint, development hours are a critical component of providing quality and compliance to the end user. While the manager is not the role that performs these activities, it is something that is under his control and therefore he is partly responsible for these activities.

Finally, the information obtained in this work is intended to be the starting point for future specific research work, which will investigate the impact of new technologies on academic degree projects, and how they affect the dynamics and activities that are performed by students when faced with new or disruptive technologies.

Companies that within their processes perform measurements similar to those performed in this project will be able to compare their results with those obtained in the academic field and thus evaluate and have a reference value as a point of comparison.

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COACHING AND EMPOWERMENT IN THE AUTOMOTIVE SECTOR OF GUAYAQUIL, ECUADOR

COACHING Y EL EMPOWERMENT EN EL SECTOR AUTOMOTRIZ DE GUAYAQUIL, ECUADOR

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ABSTRACT

The investigative study aims to determine the relationship between coaching and empowerment to achieve high performance in the automotive sector of Guayaquil, Ecuador. Within the study, Barrett's theory (2017) is part of the model of the seven levels of consciousness: survival, relationships, self-esteem, transformation, internal cohesion, making a difference and service, this represents a powerful potential in the human being in the companies that direct leaders to improve the organizational culture and promote business success to meet goals. The study methodology is quantitative, non-experimental, cross-sectional, basic, with a descriptive-correlational approach. The study population is 30 workers from two companies in the automotive sector, where a census study was carried out through a questionnaire to find out how coaching and empowerment are related in the automotive sector. In the results, a significant relationship between coaching and empowerment was obtained, the null hypothesis (Ho) was rejected and the alternative hypothesis (Ha) was accepted, the association is significant at 0.000, with a strong positive Spearman correlation coefficient of = .637 to; Through this, the implementation of strategies with coaching sessions generates a high benefit within the business environment and promotes high performance in the management of human talent of the company's workers.

RESUMEN

El estudio investigativo tiene como objetivo determinar la relación del coaching y el empowerment para alcanzar un alto rendimiento en el sector automotriz de Guayaquil, Ecuador. Dentro del estudio forma parte la teoría de Barrett (2017) acerca del modelo de los

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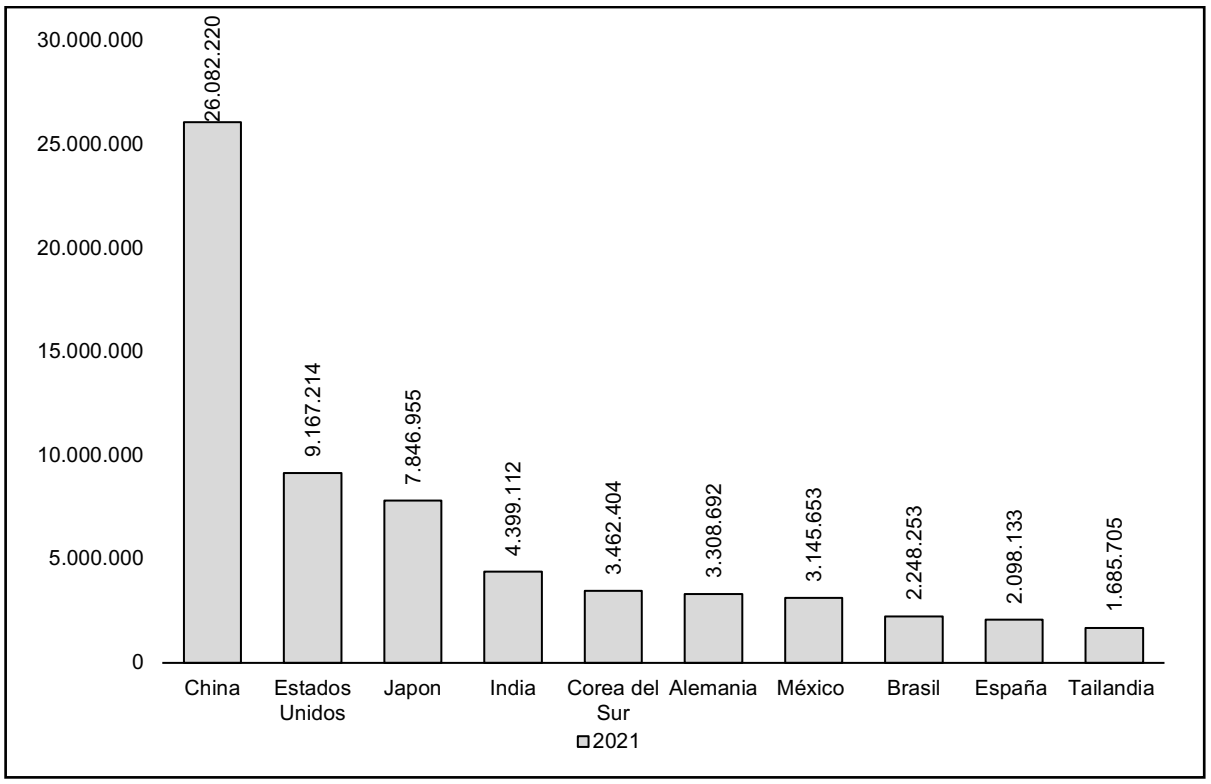
Palabras clave:
coaching, empowerment, liderazgo, clima organizacional e inteligencia emocional.

siete niveles de conciencia: supervivencia, relaciones, autoestima, transformación, cohesión interna, marca una diferencia y servicio, esto representa un potencial poderoso en el ser humano en las empresas que dirigen lideres para mejorar la cultura organizativa y promueve el éxito empresarial para cumplir las metas. La metodología del estudio es de enfoque cuantitativo, no experimental, transversal, básico, con un nivel descriptivo-correlacional. La población del estudio es de 30 trabajadores de dos empresas del sector automotriz, donde se realizó un estudio censal por medio de un cuestionario de preguntas para conocer cómo se relaciona el coaching y el empowerment en el sector automotriz. En los resultados se obtuvo una relación significativa del coaching y el empowerment, se rechazó la hipótesis nula (Ho) y se aceptó la hipótesis alternativa (Ha), la asociación es significativa en 0,000, con un coeficiente de correlación de Spearman positiva fuerte de = ,637 a; a través de esto, la implementación de estrategias con sesiones de coaching genera un alto beneficio dentro del entorno empresarial y promueve un alto rendimiento en la gestión de talento humano de los trabajadores de la empresa.

Introduction

The automotive industry in recent years has become one of the most competitive sectors in the world, being one of the main ones in keeping the economy at a high level in countries with a high impact of technological innovation that excels in competition with other markets. According to data from the Mexican Automotive Industry Association (AMIA, 2022a), Mexico's automotive industry is the leading generator of foreign exchange, the fifth largest exporter of light vehicles, automotive products account for 32% of manufactured exports, it is the seventh largest vehicle manufacturer in the world and the first in Latin America, the fourth largest exporter of auto parts in the world and the leading supplier to the United States. In 2021, it generated 930,758 jobs, an 18.3% share of the manufacturing Gross Domestic Product (GDP). The automotive sector has a foreign direct investment (FDI) share of 17% and the receipt of FDI generates foreign exchange and innovation.

Figure 1
World vehicle production 2021



Note. Adapted from the Mexican Automotive Industry Association (AMIA, 2022b).

World vehicle production accounts for 80,154,988 (3.1%) units per year; with the top ten vehicle producers per year ranking as follows: Figure 1 shows in first place, China with 26,082,220 (32.5%) units, second place United States with 9,167,214 (11.4%) units, followed by Japan with 7,846,955 (9.8%) units, India has 4,399,112 (5.5%) units, South Korea with 3,462,404 (4.3%) units, Germany with 3,308,692 (4.1%) units, in seventh place Mexico with 3.145.653 (3.9%) units, Brazil with 2,248,253 (2.8%) units, Spain with 2,098,133 (2.6%) units and Thailand with 1,685,705 (2.1%) units of vehicle production in the world and is one of the most important sectors in the economy of the countries to achieve a high impact due to the profitability it generates in the world (AMIA, 2022b).

In Iparraguirre's report (2022), Argentina's automotive sector performs well despite low imported inputs, global logistics problems and union conflicts. Measures were taken to overcome the problems, there was a 15% increase, the implementation of the investment promotion law for the automotive industry gave an incentive to the exporter, fostering international insertion, generating employment, strengthening the sector and the value chain. Vehicle and auto parts production increased 28% year-over-year. The foreign currency deficit of the sector due to the shortage of auto parts affected the economy of the automotive companies, endangering the value chain and production in the terminals; despite the complex situation in Argentina, they achieved a contribution to the automotive sector of 60.4% for the growth of the industry.

The Association of Automotive Companies of Ecuador (AEADE, 2022) records 12,439 units sold, this represents sales growth of 9% compared to 2021, the market with the highest number of vehicle sales in the country is Pichincha, Guayaquil and Azuay, whose import of vehicles in 2022 was 10,701 and there are no exports because the country does not have the budget, technological equipment, trained personnel or innovation to invest in the manufacture of vehicles for export. According to data obtained by the Central Bank of Ecuador (BCE), the number of employees in the automotive sector in 2022 was 62,268. The brands with the highest sales of light vehicles in the country are Kia (19.7%), Chevrolet (17.5%), Toyota (9.6%), Hyundai (6.6%) and Chery (5.6%); also in commercial vehicles are Hino (15.9%), JAC (12.3%), Shineray (8.9%), Sinotruk (8.6%) and Chevrolet (8.1%); this shows that vehicle sales play an important role in the national economy, promoting the generation of employment, income and liquidity of Ecuadorians, access to financing, investments and productive reactivation that influence decisions to purchase a vehicle.

In the article by Rodríguez Barrero et al. (2020) the objective was to describe coaching as a tool that facilitates the achievement of business objectives of financial institutions in Colombia. The aim is to develop the potential of workers to achieve leadership and empowerment that improves people's lifestyles. The methodology is a qualitative, exploratory-descriptive study. The study population comprises two financial institutions in Colombia, through a case study. The company's weaknesses are due to poor assertive communication, low competitive development and synergy in the management areas, process efficiency needs, limitations in the achievement of objectives and strategies to strengthen the company's values. For this reason, the application of coaching in companies represents a necessary tool that allows the transformation and training of workers for the ideal performance of the work team and to achieve job satisfaction in order to help in decision making to increase productivity and the maximum potential of workers.

In the study by Peña Vinces (2021), the objective was to analyze the incidence of empowerment in human talent management in human resources consulting firms in Peru. With the application of empowerment management strategies, the recruitment and selection process can be improved to enhance teamwork, develop skills and competencies to maximize productivity and profitability of companies. The methodology is quantitative, quasi-experimental cross-sectional type, with Likert scale, the population is 80 workers to collect data through a questionnaire and see how empowerment affects human talent management. The results have a Pearson Chi-square = 9.676^{a} and the critical point with an inverted Chi-square of 9.48772904, has an asymptotic significance of .046 less than 0.05, the null hypothesis is rejected and the alternative is accepted; it is affirmed that there is a significant incidence of empowerment and human talent management in human resources consulting companies. With the application of administrative strategies, empowerment favors positively in the company in the management of human talent to

generate incentives in the personnel and achieve a high economic and business performance.

García Guiliany et al. (2021) in their article on companies in Venezuela and Colombia, 36% of the workers indicate that the company does not comply with management strategies to achieve goals and adequate planning in the established time; while 21% are aware of and agree with the strategies implemented. For 31% of the workers, including management strategies allows companies to stay in the market and increase their client portfolio in order to achieve economic growth. 77% of the workers agree that empowerment represents a management tool that helps managers, supervisors and workers to design a management plan that promotes high business performance and strengthens human talent.

In Altamirano Salazar's (2022) study, the general objective was to determine the relationship between business coaching and empowerment in the workers of the Hostal San Eduardo-Peru. Due to the problems caused by stress, the managers' interest was to look for strategies to improve the physical and psychological well-being of the workers. The research was basic, correlational, non-experimental design of quantitative approach, with a survey whose instrument was a questionnaire made to a population of 16 workers of the hostel, this represents a census study because it is small. The results show that 81.25% of the workers perceive a medium level of business coaching and 18.75% are at a high level, while 31.25% of the workers perceive a low level of empowerment and 56.25% are at a medium level. Business coaching is positively related to empowerment with a p= 0.000 less than 0.05, the null hypothesis is rejected and the alternative is accepted, it has a strong positive Pearson correlation of = ,856 [a] which shows the relationship of the study variables. With this, it is necessary to strengthen the relationship between business coaching and empowerment through an annual strategic plan that allows the self-management of the company, maintaining the organization and promoting business empowerment in the workers.

Quiroz Yerren (2021) in his study proposes a coaching program from a prospective approach to improve the organizational climate in the general surgery service of the Lambayeque-Peru Regional Hospital. The methodology is a mixed approach, non-experimental, transectional, exploratory, descriptive-propositive design. A questionnaire was sent to 70 workers of the Lambayeque Regional Hospital, whose data were processed to obtain information on the study problem. The results showed an unfavorable perception level for motivation (78.5%), leadership (72.9%), decision making (71.4%), conflict and cooperation (68.6%), innovation (60%), due to the inadequate organizational climate, the phases that are detrimental to the execution of activities within the institution were evaluated; therefore, it is necessary to implement coaching, leadership, motivation and teamwork programs to ensure the welfare of workers, promote the development of skills and abilities in order to provide a guaranteed service and improve the organizational climate.

Companies in the automotive sector have a poor working environment due to inadequate communication, low motivation, low performance and few trained personnel to lead the team, this should be analyzed by management to seek control mechanisms through strategies that provide coaching sessions to achieve empowerment and increase sales with a good performance of staff and obtain technological resources that generate a positive impact on the performance of the automotive sector. It is important to assume the role of leader with strategies aimed at effective communication and emotional management of workers to organize the work team within the company, achieve high economic performance, optimize resources and achieve goals that promote good competitive development in the automotive sector. Coaching and the relationship with

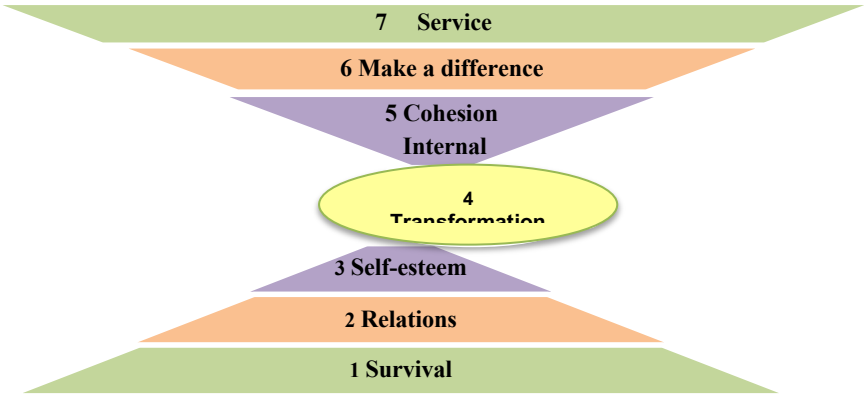
empowerment represents a high level of business in the automotive market to achieve competitiveness, team management practice, business leadership that gives workers the power to make decisions and collaborate with ideas in order to achieve economic growth and skills development in the company.

The general objective of the study is to determine the relationship between coaching and empowerment to achieve high business performance in the automotive sector in Guayaquil, Ecuador. The specific objectives are: To analyze the relationship between coaching and organizational climate in the automotive sector in Guayaquil, Ecuador and to evaluate the relationship between coaching and emotional intelligence in the automotive sector in Guayaquil, Ecuador. The general hypothesis: There is a significant relationship between coaching and empowerment in the automotive sector in Guayaquil, Ecuador. Specific hypothesis 1, there is a positive relationship between coaching and organizational climate in the automotive sector of Guayaquil, Ecuador and specific hypothesis 2, there is a high relationship between coaching and emotional intelligence in the automotive sector of Guayaquil, Ecuador.

In the automotive sector companies do not have the necessary tools to achieve optimal performance of workers due to the few incentives that exist and the poor working environment, this should be evaluated by the managers of the companies to seek skills and competencies that promote a high relationship with the purpose of improving business development to achieve efficiency and high performance of workers; therefore, it is necessary to make an analysis of the internal problems of the company, as they carry the daily planning of activities, if there is communication in the workers, in order to implement coaching techniques within the work team to achieve optimal job performance and market competitiveness.

Part of the study is Barrett's (2017) theory of the seven levels of consciousness model shown in Figure 2: survival, relationships, self-esteem, transformation, internal cohesion, making a difference, and service. This model represents a powerful human potential in companies managed by leaders to improve the organizational culture and promote business success from the perspective of human needs and their development with the environment to meet their goals. Concepts associated with consciousness detailed in Vedic philosophy, soul consciousness, cosmic consciousness, God consciousness, unity consciousness are integrated into the model of the seven levels of consciousness. This is part of people's daily lives and recognizes that a person is more than an ego or physical, where values, soul purpose and energetic reality are identified. Since cosmic consciousness identifies with the soul at all times, where the state of mind and philosophy function without fear, they are able to live their own life to the fullest without depending on the approval of others. In God consciousness there is a level of soul connection with other people where consciousness is an individualized aspect of the same individual energy field. The seventh state of unity consciousness represents the highest state of consciousness that the human being can reach, there is no separation of the knower and the known objective. As time passes and the physical and emotional needs, new beliefs are experienced letting go of fear, freeing the soul to achieve a high potential state of consciousness that promotes positive feelings that release stress and gain energy that favors the mood of people to achieve full personal satisfaction.

Figure 2
Model of the seven levels of consciousness



Note. Barrett (2017)

The theory based on the model of the seven states of consciousness is important within the research study, since the states of consciousness help identify the personal empowerment of workers in the company and solve internal conflicts through assertive communication, teamwork to achieve high performance, fulfillment of goals, create a suitable work environment with efficiency that promote motivation and incentives by managers and achieve business success in the automotive sector.

This study is of great relevance because it allows to determine the relationship between coaching and empowerment to achieve high business performance in the automotive sector of Guayaquil, Ecuador; factors that affect the state of the workers of the companies have been known, with this purpose the research work was implemented as a contribution to internal improvement from the approach of new strategies with coaching techniques and personal empowerment that allow achieving goals and improving the organizational climate. With respect to the practical contribution, its purpose is to provide a management plan that includes coaching techniques, leadership, teamwork, soft skills, personal development and work motivation that allow workers to achieve empowerment with commitment as a labor management strategy to achieve productivity and competitiveness in the automotive sector.

Method

The methodology of the study is quantitative, non-experimental, cross-sectional, basic, descriptive-correlational. This study aims to identify the shortcomings presented within the work environment by workers in any situation that affects the work environment within the company to provide strategies and an action plan for the improvement of business performance in the automotive sector.

Variable 1. Coaching: According to the International Coach Federation (ICF, 2020), it is the ongoing professional relationship with clients to obtain favorable results in the individual's life, profession and business, deepens knowledge, increases performance and improves quality of life. Coaching sessions create interaction on the part of the coach and motivate the client to act and leave paradigms of the past and focus on taking action for the achievement of goals and personal success.

Variable 2. Empowerment: It is a strategic tool that improves leadership, strengthens teamwork, this is based on the power to delegate authorities and responsibility of the levels of the organization, motivation to create an environment

where good performance is recognized and encouraged, the development that leads to constant training and leadership that allows decision making to achieve effective teamwork that promotes the participation of human talent (Riquelme, 2023).

The population of the research study is 30 workers of two companies in the automotive sector, a census study is conducted, since the population is small and is taken directly for analysis and data collection, in order to achieve a positive solution within the research study. The variables of the study are Coaching and Empowerment, with this identified the internal shortcomings of the company to implement solution strategies that help business growth and personal development of workers within the automotive sector. The inclusion criteria for the companies in the automotive sector are: men and women working in the automotive sector companies in Guayaquil and the exclusion criteria include workers in other companies, people under 18 years of age and clients who did not participate in the research to obtain the necessary data for the study.

Surveys were made to 30 workers of the automotive sector based on the Likert scale with frequency levels to access the information that allow the researcher to make decisions and collect the data of the study, in order to know the shortcomings and the managerial behavior that the companies manage on the part of the workers in relation to the objective and to see the veracity of the hypothesis raised. The instrument was a 17-question questionnaire to study the variables coaching and empowerment and to obtain the results with the data acquired by the workers surveyed. The validation of the questionnaire was carried out by expert judges in the variables of the study in order to make known the feasibility and provide ideas that contribute with the necessary data for the research. The measurement of the questionnaire is by means of scales Totally disagree, disagree, undecided, agree and totally agree, the information is entered into a database in Excel and then to the statistical program "Stadistical Package for Social Sciences SPSS V.25" to obtain the data in the research.

Through the Cronbach's Alpha reliability test, the reliability of the questionnaire is known with a pilot test of 10 workers of the companies of the automotive sector of Guayaquil-Ecuador with the veracity of the study. Cronbach's alpha has a value of 0.80, which is ideal for the measurement of variables focused on the research study. This study was conducted with the authorization of the companies whose information is collected in an average of 10 minutes without affecting the work of workers to continue their workday.

For the data analysis, a database was created to enter the information acquired in the survey and to show the reliability in the Excel statistical program Cronbach's Alpha with the support of theories that promote the veracity of the hypothesis proposed. Information was obtained based on the objectives of the variables to access the results through correlations and to see the significance of the hypothesis with the Spearman correlation coefficient in the SPSS program to know the internal situation of the companies of the automotive sector of Guayaquil-Ecuador and to provide a management plan that promotes optimal leadership and high business performance.

Results

In Table 1, 60% of the workers agree that empowerment is good when coaching is at a medium level; while 25% are undecided that empowerment is regular when coaching is at a low level, this identifies the good relationship of coaching and empowerment, provided that managers take the necessary measures to achieve stability in the work environment and make an adequate human talent management by reducing the

shortcomings presented through strategies in coaching sessions to achieve a high impact on the development of skills and profitability of the company.

Table 1
Coaching and Empowerment Analysis

			EMPOWERMENT				
			Disagree	Undecided	Agreed	Totally agree	Total
COACHING	Disagree	Count	3	1	0	0	4
		% within Coaching	75,0%	25,0%	0,0%	0,0%	100,0%
	Undecided	Count	1	11	4	0	16
		% within Coaching	6,3%	68,8%	25,0%	0,0%	100,0%
	Agreed	Count	0	3	6	1	10
		% within Coaching	0,0%	30,0%	60,0%	10,0%	100,0%
Total		Count	4	15	10	1	30
		% within Coaching	13,3%	50,0%	33,3%	3,3%	100,0%

In Table 2, 100% of the workers agree that the organizational climate is good when coaching is at a medium level; a considerable group also disagrees that the organizational climate is bad when coaching is at a low level, this shows the good relationship between coaching and organizational climate when workers maintain effective communication in the work team to achieve group harmony, encouraging motivation and promoting the initiative to give ideas to be taken into account by managers when making decisions that favor the personal and professional welfare of the members that make up the company.

Table 2
Coaching and Organizational Climate Analysis

			ORGANIZATIONAL ENVIRONMENT			
			Disagree	Undecided	Agreed	Total
COACHING	Disagree	Count	4	0	0	4
		% within Coaching	100,0%	0,0%	0,0%	100,0%
	Undecided	Count	0	16	0	16
		% within Coaching	0,0%	100,0%	0,0%	100,0%
	Agreed	Count	0	0	10	10
		% within Coaching	0,0%	0,0%	100,0%	100,0%
Total		Count	4	16	10	30
		% within Coaching	13,3%	53,3%	33,3%	100,0%

In table 3, 68.8% of the workers are undecided that emotional intelligence is regular when coaching has a low level; while, 60% agree with the good relationship of emotional intelligence when coaching is at a medium level; this shows that, the relationship of the variables remains good when workers know how to manage emotions and use techniques that release stress and promote calmness to reflect before an event without affecting personal well-being and maintain a healthy work environment that improves the communication of the work team, generates the satisfaction of needs and high work performance.

Table 3
Coaching and Emotional Intelligence Analysis

			EMOTIONAL INTELLIGENCE				
			Disagree	Undecided	Agreed	Totally in agreement	Total
COACHING	Disagree	Count	3	1	0	0	4
		% within Coaching	75,0%	25,0%	0,0%	0,0%	100,0%
	Undecided	Count	1	11	4	0	16
		% within Coaching	6,3%	68,8%	25,0%	0,0%	100,0%
	Agreed	Count	0	3	6	1	10
		% within Coaching	0,0%	30,0%	60,0%	10,0%	100,0%
Total		Count	4	15	10	1	30
		% within Coaching	13,3%	50,0%	33,3%	3,3%	100,0%

Ho. There is no significant relationship between coaching and empowerment in the automotive sector in Guayaquil, Ecuador.

Ha. There is a significant relationship between coaching and empowerment in the automotive sector in Guayaquil, Ecuador.

Table 4 shows that there is a significant relationship between coaching and empowerment with a value p= ,000 less than p= 0.01, the null hypothesis (Ho) is rejected and the alternative hypothesis (Ha) is accepted, so there is a significant relationship of 0.01 in the study variables, with a strong positive Spearman correlation coefficient = ,637 [a], which determines that the variables are associated with each other in the study conducted in the automotive sector of Guayaquil, Ecuador.

Table 4
Correlation coefficient Coaching and Empowerment

			Coaching	Empowerment
Spearman's Rho	Coaching	Correlation coefficient	1,000	,637**
		Sig. (bilateral)	.	,000
		N	30	30
	Empowerment	Correlation coefficient	,637**	1,000
		Sig. (bilateral)	,000	.
		N	30	30

Note. **. The correlation is significant at the 0.01 level (bilateral).

Ho. There is no positive relationship between coaching and organizational climate in the automotive sector in Guayaquil, Ecuador.

Ha. There is a positive relationship between coaching and organizational climate in the automotive sector in Guayaquil, Ecuador.

Table 5 shows that there is a positive relationship between coaching and organizational climate with a value p= ,000 less than p= 0.01, the null hypothesis (Ho) is rejected and the alternative hypothesis (Ha) is accepted, therefore there is a significant

association of 0.01 in the study variables, with a perfect positive Spearman correlation coefficient = 1.000 [a], which determines that the variables are perfectly associated between them, achieving a good contribution in the automotive sector of Guayaquil, Ecuador.

Table 5

Correlation coefficient Coaching and Organizational Climate

			Coaching	Organizational climate
Spearman's Rho	Coaching	Correlation coefficient	1,000	1,000**
		Sig. (bilateral)	.	.
		N	30	30
	Organizational climate	Correlation coefficient	1,000**	1,000
		Sig. (bilateral)	.	.
		N	30	30

Note.**. The correlation is significant at the 0.01 level (bilateral).

Ho. There is not a high relationship between coaching and emotional intelligence in the automotive sector in Guayaquil, Ecuador.

Ha. There is a high correlation between coaching and emotional intelligence in the automotive sector in Guayaquil, Ecuador.

Table 6 shows that there is a high relationship between coaching and emotional intelligence with a value p= ,000 less than p= 0.01, the null hypothesis (Ho) is rejected and the alternative hypothesis (Ha) is accepted, therefore there is a significant relationship of 0.01 in the study variables, with a strong positive Spearman correlation coefficient = ,637 [a], which determines that the study variables are associated with each other to a high degree within the automotive sector of Guayaquil, Ecuador.

Table 6

Correlation coefficient Coaching and Emotional Intelligence

			Coaching	Emotional intelligence
Spearman's Rho	Coaching	Correlation coefficient	1,000	,637**
		Sig. (bilateral)	.	,000
		N	30	30
	Emotional intelligence	Correlation coefficient	,637**	1,000
		Sig. (bilateral)	,000	.
		N	30	30

Note. **. The correlation is significant at the 0.01 level (bilateral).

Discussion and conclusions

The research study analyzed coaching and empowerment in the automotive sector in Guayaquil, Ecuador, where information was collected to obtain relevant data on the variables and identify the shortcomings that exist within the companies in order to demonstrate the veracity of the study compared to studies conducted in other periods before the current study.

In the general objective: To determine the relationship between coaching and empowerment to achieve high business performance in the automotive sector in Guayaquil, Ecuador. With the statistical analysis it is visualized that, the variables are associated between them; therefore, in table 4 gives as a result of the strong positive Spearman correlation coefficient = ,637 [a], with a value p= ,000, this demonstrates the significant relationship of coaching and empowerment in the automotive sector. This comes with input from Barrett's (2017) theory about the seven levels of consciousness model: survival, relationships, self-esteem, transformation, internal cohesion, making a difference, and service. This model represents a powerful human potential in companies managed by leaders to improve the organizational culture and promote business success from the perspective of human needs and their development with the environment to meet their goals. It has a positive contribution in the business environment and allows the association of variables compared to other periods with a high range of veracity, therefore the theory of Barret (2017), provides the necessary tools to proceed to a suitable human talent management plan in order to promote the economic and financial stability of the automotive sector. García Guiliany et al. (2021) in his article the objective was to analyze coaching and empowerment to strengthen the human talent of companies in Venezuela and Colombia, with the purpose of providing business management tools and techniques to support competitive growth to increase the productivity of operations that contribute to the resolution of internal conflicts as a contribution to the achievement of economic performance and goals of the company. 33.33% of the workers identify with the organization in the application of methods with effectiveness and promote appropriate communication, 26% agree with the implementation of self-coaching as a self-management strategy that benefits the strengthening of human talent in the company.

With respect to the specific objective: To analyze the relationship between coaching and organizational climate in the automotive sector in Guayaquil, Ecuador. This shows a positive relationship between coaching and organizational climate, resulting in table 5, a p-value = ,000, with a perfect positive Spearman correlation coefficient = 1.000 [a], which determines that there is a positive relationship between the variables under study in the automotive sector. Quiroz Yerren (2021) in his study proposes a coaching program to improve the organizational climate in the general surgery department of a hospital in Peru. The level of perception was unfavorable in motivation 78.5%), leadership (72.9%), decision making (71.4%), conflict and cooperation (68.6%), innovation (60%), due to the inadequate organizational climate were evaluated phases that impair in the execution of activities within the institution, therefore it is necessary the implementation of coaching programs, leadership, motivation and teamwork to ensure the welfare of workers, promote the development of skills and abilities in order to provide a guaranteed service and improve the organizational climate. With the contribution of a coaching program it is possible to improve the situation of the automotive sector through communication and teamwork techniques, this has been favorable achieving a high impact on the relationship between coaching and organizational climate to achieve short-term goals within companies.

In the evaluation of the relationship between coaching and emotional intelligence in the automotive sector in Guayaquil, Ecuador, Table 6 shows that there is a high relationship between coaching and emotional intelligence, with a p-value = .000 and the strong positive correlation coefficient = 637 [a], which determines that the variables of the study are associated with each other to a high degree in the automotive sector. Since the study by Rodríguez Barrero et al. (2020) by including coaching as a tool that facilitates the achievement of business objectives in financial institutions in Colombia, gives great potential to achieve leadership through emotional intelligence, improves the lifestyle of

workers and encourages empowerment by releasing the burdens of fear and breaking paradigms in order to achieve assertive communication and competitive development to obtain the transformation of the mentality of workers and increase productivity in the company.

It is important to highlight that, within the study conducted, there is a significant relationship between the variables; it promotes teamwork with responsibilities according to the position held, motivates personnel to achieve better productivity and professional development, where the contribution of coaching and empowerment in the members that make up the companies to achieve good human talent management and maintain stability with strategies that improve job performance stands out.

Conclusion: The study conducted on coaching and empowerment in table 1 shows that, 60% of the workers agree that empowerment is good when coaching has a medium level; in table 4 shows a strong positive correlation coefficient = ,637 [a], with a value p= ,000, this shows the significant relationship of the variables, so managers must take the necessary measures to maintain a stable work environment and achieve a high impact on the development of competencies in the automotive sector.

Table 2 shows that 100% of the workers agree that the organizational climate is good when the coaching has a medium level; Table 5 shows a perfect positive correlation coefficient = 1,000 [a] with a p-value = ,000, this shows the positive relationship of the study variables, but a change in the management structure is required to make the right decisions in the work team in order to optimize resources and achieve the goals established in the automotive sector.

Regarding the evaluation of coaching and emotional intelligence, in table 3 shows that, 68.8% of workers are undecided that emotional intelligence is regular when coaching has a low level; in table 6 shows a strong positive correlation coefficient = 637 [a], with a p= ,000 value, this shows the high relationship of the study variables. It is necessary to manage the emotions of workers through coaching and emotional intelligence to make better decisions, improve interpersonal relationships and communication, from stress control and anger management in order to avoid disturbances within the company and achieve with soft skills the motivation of staff to work as a team and achieve high business performance in the automotive sector worldwide.

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THE COMPLEXITY BEHIND THE INCORPORATION OF THE ISO 14006 STANDARD INTO THE PROJECT'S DESIGN STAGES WITHIN MICRO, SMALL AND MEDIUM SIZE INDUSTRIES FROM MEXICO CITY AND METROPOLITAN AREA

LA COMPLEJIDAD AL INCORPORAR LA NORMA ISO 14006 EN LA ETAPA DE DISEÑO DE PROYECTOS EN MICRO, PEQUEÑA Y MEDIANA INDUSTRIA DE LA CIUDAD DE MÉXICO Y ZONA CONURBADA

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ABSTRACT

The efficient and effective incorporation of the sustainable element within product design and manufacturing companies has proven to be a competitive tool to attract new markets and at the same time, a complex challenge. The ISO 14006 Standard regulates the incorporation of the so-called "eco-design" in the creative stage of a project, but within the Mexican context, its integration inside micro, small and medium-sized companies has proven to be complex, because the vision which it contemplates comes from an Eurocentric context, where it is assumed that all companies have the necessary resources to incorporate better technologies, but within the Mexican reality, in which these small companies incorporate semi-artisanal processes, the effective and efficient implementation of such Standard results almost impossible to integrate and it is necessary to analyze viable alternatives to help them achieve it. Through a diagnostic questionnaire and an in-depth interview conducted to a panel of experts formed up by academics, industry leaders, and designers, focusing on the reality experienced by Mexican product companies and the challenges they face when addressing the integration of the environmental element to their projects, such is the case of the ISO 14006 standard. Amongst the findings there is a list of the challenges faced by small companies when incorporating the Standard, a description of the design processes within them and the contribution of a new design profile, capable of addressing complex projects, facilitating the transition of companies towards a more sustainable ones, closing

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with a discussion focused on the scope, challenges, and limitations of incorporating said change.

RESUMEN

Palabras clave:
ISO 14006, diseño, fabricación, productos.

La incorporación eficiente y eficaz del elemento sustentable dentro de empresas de diseño y fabricación de objetos ha demostrado, por un lado, ser una herramienta competitiva para atraer nuevos mercados, y a la vez, un reto complejo. La Norma ISO 14006 regula la incorporación de llamado "eco-diseño" en las etapas creativas de un proyecto, pero dentro del contexto mexicano, su integración en micro, pequeñas y medianas impresas ha demostrado ser compleja, porque la visión de la cual parte contempla un contexto eurocéntrica, en donde se asume que todas las empresas tienen los recursos necesarios para incorporar mejor tecnología, pero la realidad mexicana, donde estas pequeñas empresas cuentan con procesos de producción semi artesanales, la implementación eficaz y eficiente de la Norma, resulta difícil de incorporar y donde resulta necesario analizar alternativas viables para lograrlo. Mediante un cuestionario diagnóstico y una entrevista a profundidad realizada a un panel de expertos conformado por académicos, líderes de industria y diseñadores, se sondeó la realidad que viven las empresas mexicanas de productos y los retos que enfrentan al abordar la integración del elemento ambiental, como lo es la ISO 14006 en sus proyectos. Entre los hallazgos se enumeran los retos que enfrentan las pequeñas empresas al incorporar la Norma, una descripción de los procesos de diseño dentro de éstas y la aportación de un nuevo perfil de diseño capaz de abordar proyectos complejos, facilitando la transición de las empresas hacia unas más sustentables, cerrando con una discusión centrada en los alcances, retos y limitaciones al incorporar dicho cambio.

Introduction

Sustainability has become an increasingly important objective for companies seeking to respond to the demands of a society that is increasingly interested and active in the pursuit of nature conservation. The leaders of organizations have had to incorporate in their agenda, strategies and ways to achieve sustainability, which implies not only a change in their processes, but also in their culture and values (Martínez and Ibarra, 2015), and must start with the idea that sustainability is a strategic achievement necessary for companies and all stakeholders (Aguayo, 2013; Ceschin, 2016; Chávez and Ibarra, 2016).

The great challenge today is to meet emission reduction targets to mitigate the risk of global warming and the resulting severe climate change; time is pressing and it is necessary to reduce global temperature by 1.5°C to 2°C, seeking to return to pre-industrial levels (Berners-Lee, 2016; Chiotis, 2019; Raftery, Zimmer, Frierson, Startz, & Liu, 2017; O'Brien, 2018; UNEP, 2017).

Looking at the sustainable challenge from an industrial perspective, it is possible to understand the objectives that must be addressed from a production and consumption system perspective, reducing the speed at which they consume natural resources; by 2030, if they fail to reach a point of stability, it will be necessary to have a planetary system of resource regeneration and waste absorption equivalent to two planets, just to maintain the current trend (Chiotis, 2019; Crutzen and Stoermer, 2000; UN, 2016).

The challenge presented by climate change has been considered technical, falling on the practical side of transformation systems and their structuring schemes, seeking to facilitate or restrict responses within the productive system, necessary for a global transformation (Ehrenfeld, 2015; O'Brien, 2018).

Within this productive system, there is an actor who plays an important role in the decision making process that generates this impact: the industrial designer, a professional who shapes the material world and who makes the critical decisions that affect ecosystems and planetary health; because everything that exists in the modern world is the result of an act of design, every decision made in the product development process comes from such activity and the role played by the designer marks him as the main responsible (Davidová, 2019; García and Vezzoli, 2021; León and Rosa, 2015; McDonough and Braungart, 2002; Thomson, 2000). This makes the designer responsible for developing his work in an ethical, effective and efficient manner, if he seeks to reduce the impact derived from his work, and therefore a radical change is needed in the contributions made by design within production systems, where the sustainable approach represents a change from product design thinking to one of design systems, opening the door to new models of business organization (Ceschin and Gaziulusoy, 2020; García and Vezzoli, 2021; Papanek, 2005).

Industrial design is responsible for the material transformation of the world, implying also the consequences derived from its work, giving rise to the consideration that no other activity causes greater damage than the way in which we design the material world (Papanek, 2005; Wahl, 2008), marking design as one of the activities with greater environmental, social and moral responsibility, whose obligation should be to generate healthy products for the planet, ethical, socially responsible and incorporate efficient technologies that avoid the degradation of natural systems, instead it has led us to problems such as: resource scarcity, environmental pollution, health problems in the population, as well as social and cultural imbalance, putting at risk the quality of life of future generations, caused by an inability to generate lasting values, becoming obsolete, dangerous and unsustainable (Norman, 1999; Papanek, 2005).

It is known that more than 80% of environmental decisions are made during the conceptual and project stages of the design process, therefore, it is said that the sustainability problem is a design problem. (Thackara, 2005). And although there are strategies aimed at minimizing the damage produced by design practices (e.g. green design, eco-design, bio-inspired design), they are inefficient and insufficient to achieve the objectives of sustainable development (Alsamawi et al. 2017; McDonough and Braungart, 2002; Stegall, 2006) or, rather, of sustainable design development, assuming that design has the ability to develop products that consider environmental factors, transforming the professional practice of design (Ehrenfeld, 2015). The cited authors assume that the designer has the skills to implement the necessary change and face accountability for their actions and redirect the design efforts should help transform the system that determines that it should be designed (Boehnert, 2018).

The concept of eco-design is one that appears constantly in the bibliography consulted, as well as its great weakness: an industrial-economic perspective rooted within the guidelines of neoliberal policies, where the important element is the economic aspect, but not the environmental one, explaining its limitations as a strategy that allows achieving true sustainability, since it addresses only some elements of the industrial cycle or provides subsequent solutions and it is concluded that most of such approaches start from waste reduction and resource optimization (Berners-Lee, 2019; Gaziulusoy, 2015; Papanek, 2005).

Even the whole system concept that characterizes a Life Cycle Assessment (LCA) is limited in terms of aspects related to the human element and the impact on decision making (Bhamra, Lilley and Tang, 2011; Ceschin, 2020), completely discarding aesthetic, symbolic and spiritual issues that characterize holistic thinking (Gaziulusoy, 2020).

In Mexico, facing the challenge that sustainability presents to industries is not an easy one to achieve. There are several factors that combine social, political, cultural, technological and, above all, economic elements that make the task of seeking a sustainable future a difficult one to overcome.

According to the panel of experts, Mexico has not been able to successfully implement an environmental agenda due to several factors, but mainly because the industry does not have support for development, preventing micro, small and medium industries, incorporate clean technologies in their processes, but also because the industry in Mexico is an uninformed industry, with little real knowledge of cause in relation to the environmental crisis, climate change and the role that industries play within it, mainly due to two factors: poor dissemination on the subject and a deficient eco-centric training of workers, designers and managers alike; and at the center of it all, is the industrial designer, whose job is to provide a service through the design and development of products that satisfy in an integral way, the requirements requested by a client. The designer, as mentioned above, plays an important role, since much of the responsibility for reducing the environmental impact of industrial products lies in his or her hands.

Victor Papanek (2005) indicates that more than 70% of the impact derived from industrial products is decided during the early stages of product conceptualization, and it is the industrial designer who makes these decisions. And here is the central problem for the present research: if the designer is the crucial actor to reduce the environmental impact from the early stages of the design process, it is he who should be provided with all the possible tools to perform his work, in the most efficient way possible, appealing to the environmental element.

The irresponsibility of some actors within the industry has forced the search for new strategies that resonate within a context of environmental care and sensible management of our resources, and it is this need that has led man to develop new and

different ways of doing things, among them, the incorporation of the ISO 14006 Standard, which, at the industrial level, governs the incorporation of the so-called eco-design, an alternative proposed to reduce the environmental impact within the industry (Arana and Heras, 2010; Maderas, Pérez and Rubio, 2013).

The ISO 14006 Standard finds its origin within the Spanish standard UNE 150301, published on July 15, 2011, called "Environmental management of the design and development process: Ecodesign", a standard developed by the legal body responsible for Spanish technical standards, AENOR (Spanish Association for Standardization and Certification). The Spanish standard indicates that the design stage determines most of the impact of a product, and that is why it is necessary to incorporate the environmental component in the early stages of the design process, thus preventing more than half of the environmental impacts of products or services (Arana and Heras, 2010).

The ISO 14006 standard pursues the same objective: to reduce the environmental impact of products or services throughout their life cycle: from the design stage, through manufacturing, distribution, use, maintenance and recovery at the end of their useful life. The standard allows demonstrating compliance with existing legislative requirements and is incorporated through a life cycle analysis process, which leads to the identification of three important aspects of products and services: inputs, life cycle and outputs.

According to the panel of experts, incorporating the objectives of ISO 14006 in Mexico is a real challenge for companies that lack sufficient resources to implement this strategy, and in addition to this, the Mexican industrial context differs too much from that of developed countries, for which this standard was developed; mexican companies that generate consumer products must also propose social inclusion, interaction with users, differentiation of products and services and dynamization of the economy through innovation ecosystems that apply design as part of their strategy to boost the competitiveness of Mexican companies and sustainable development. Design generates jobs, opens new channels for citizen participation and helps to address environmental problems. When design is understood from this perspective, we can say that it is sustainable and, therefore, citizens, public administration, research centers and companies benefit from applying and consuming it (Ferruzca, M. and Rodriguez, J., 2011). Mexico City is the state with the most economic units in specialized design, followed by the State of Mexico, Jalisco, Guanajuato and Nuevo León. (Ferruzca et al., 2010).

In relation to the economic impact of design firms, one of the main challenges is the absence of studies on the supply and demand of design services, and the few documents that exist do not delve into the economic impact of design as an activity, but there is a high presence of cultural agents of design in Mexico City -universities, design schools, specialized publishing houses and research centers in technology, culture and the arts-.these are agents that can enhance the activities and functions of the system, either directly or indirectly, so that designers can play a more important role in improving productivity and in product design (Ferruzca et al., 2010).

In Mexico the so-called "PyMes" (small and medium enterprises) represent between 90 and 99% of the economic units, promoters of activity and employment, according to INEGI statistics of 2018, and there are at least 2811 factories within the manufacturing industry focused on the transformation of materials into consumer goods and many of their environmental efforts are channeled towards the recycling of stationery, waste separation for subsequent recycling (which is rarely done within the company) and some basic strategies for the use of raw materials.

The average design firm in Mexico apparently lacks an efficient environmental management program for its activities, and despite this, the virtual directory www.homify.es lists around 680 design firms with a sustainable approach, mainly in the

area of architecture and space design, as well as the so-called "eco-fashion" and small independent brands, demonstrating that in Mexico there is interest in sustainable design. Mexican designer Mario Ballesteros, in an interview during the Abierto Mexicano de Diseño 2018 commented that design must think about the post-industrial era and propose critical resolutions to face the socio-environmental emergency, implying that design within companies, a growing activity in Mexico, must manage and regulate its impact from the industry.

In general terms, we can identify three important aspects of proper design project management: 1) Search for the appropriate designer and the method that companies use to search for suitable profiles; 2) Drafting of project requirements, which refers to the method in which the company transmits to the design team the information necessary to perform its work, and it is in this communication where the key to the success of the projects is found; 3) evaluation of the design process and the feasibility of adapting ISO 14006 to the Mexican context in which small industries are developed (Bruce et al, 1999).

The great challenge of incorporating standards, such as ISO 14006, is that it is designed to address the specific needs of developed countries, countries whose production levels are in the billions, speaking of true industrial production, while the majority of Mexican companies that generate consumer goods reproduce their parts in the thousands; another factor to consider is that developed countries have state-of-the-art technology and the necessary means to invest in the transformation of their companies, while in Mexico, experts agree that the industry has a disjointed model that depends to a large extent on manual labor, artisanal processes and the outsourcing of many of its processes because it lacks the means to implement its own technology, in addition to not having the support to pay the high costs involved in incorporating new technologies, requested after the incorporation of the standard and much less to integrate the recommended measures; a possible solution is to use the guidelines proposed in the standard and adapt them to the Mexican reality.

Method

The results presented here are part of the body of a doctoral thesis, whose focus was to understand the industrial dynamics around environmental considerations, the crucial role played by the industrial designer and how to propose methodological alternatives, based on ISO 14006.

In order to structure the methodological proposal, we resorted to a non-experimental research of a mixed descriptive-explanatory type that incorporated very different scientific activities, both qualitative and quantitative, whose main objective was to generate a methodological support proposal, through the application of an analytical-synthetic method for data collection, analysis and treatment of the information obtained. This research sought to identify, document and relate the different actions and decision making, which lead to a cause and effect relationship between what the designer does and its effects on environmental damage; on the other hand, it seeks to understand what factors affect the way in which the designer makes decisions, determining the indirect variables (positions with decision making, manufacturing requirements, customer requests, etc.), as well as those direct variables (training, knowledge, professional development, etc.) that permeate their activity within the company.

By means of an exploratory questionnaire, a diagnosis was made to a group of designers working in different industrial companies; this was parameterized and quantified as far as possible, seeking to understand the characteristics of such broad and

ambiguous items as the type of environmental management in companies, the implementation of eco-design strategies, environmental performance, responsibility based on the position according to the organizational chart and the objectives pursued by companies that hire industrial designers in Mexico City and the suburban area; This information was nurtured and corroborated by means of an extensive work of bibliographic consultation and various sources of information, as well as a series of in-depth interviews with a panel of experts, thus helping to define quantifiable indicators and concepts as parameters.

This instrument was applied to 103 people who met the ideal profile, which was that of industrial designers or similar, who have worked professionally for at least two years in a company or industrial company that has a design department. The questionnaire did not include open-ended questions, only Likert-type rating scale questions, binary true or false questions, and concept recognition lists, which were later interpreted as graphs for visualization; due to the exploratory characteristics of the questionnaire and the nature of the questions, most of which were to identify multiple concepts, it was not possible to adequately run a validation using Cronbach's coefficient, since only three items out of 38 could be analyzed in this way. The diagnostic questionnaire allowed the drafting of the questions asked during the first portion of the in-depth interviews, the result of which made it possible to identify those concepts that should be included in this one.

The questionnaire was validated with the help of the teaching and research staff working in the Industrial Design Postgraduate Program at the National Autonomous University of Mexico, and its effectiveness was subsequently tested by means of pilot runs before being officially applied. The questionnaire was applied during the first half of the year 2021; due to the restrictions imposed by the COVID pandemic, the format was implemented remotely, using the *Google Surveys* platform and whose main objective was to diagnose and understand the different business dynamics in relation to environmental issues, knowledge about sustainable issues and the incorporation of environmental strategies, as well as knowledge about the ISO 14006 Standard, its existence, scope and implications.

The *Google Surveys* tool performed the categorization, validation and integration of results and generated the corresponding diagrams that can be observed in their entirety within the body of this document.

Prior to the development of the proposed methodology, an exhaustive review of bibliographic sources was required, validated and complemented by interviewing the panel of experts, a process that allowed the development of the diagnostic stage, and to correlate the information with the data obtained during the diagnostic questionnaire. Specifically, the purpose of the questionnaire was to understand the work situation in which they work, identify areas of opportunity, as well as the factors that are directly related to environmental performance within companies, and to identify which concepts related to environmental issues are part of their knowledge and which practical tools, such as eco-design, they apply in their professional work. The questionnaire was applied to three profiles: 1) recently graduated industrial designers, 2) designers who already have considerable experience in the field, and 3) professionals who meet the profile proposed in the research methodology.

The in-depth interview conducted with a panel of experts was the qualitative tool selected to seek to respond to several of the specific objectives, highlighting the delimitation of the professional profile of the industrial designer; the professional environment, as well as its current challenges, limitations and scope; the competencies that every industrial designer must develop and the role played by academic training;

definition of the historical, socio-political and cultural context of the design profession in Mexico; the factors within and outside the industry that affect professional performance and finally, to define the role of the industrial designer as a responsible and change agent, as well as the ideal profile that can address all the problems identified by the industry around the concept of sustainable development. The first part of the interviews was of vital importance to outline the concepts to be covered in the diagnostic questionnaire.

The panel of experts was divided according to the information to be obtained and the professional profile of the specialists, which is why the group of experts was categorized as: theoreticians and historians, academics and design teachers, directors of design schools, and finally, leaders of industries that hire industrial designers in Mexico City and the surrounding area. The in-depth interview was adapted to the content to be obtained, and was based on a series of basic questions, which, using the "*laddering*" strategy, were deepened until rich and detailed information was obtained about the topics to be investigated.

As with the questionnaire, due to health restrictions implemented because of the pandemic, the interviews had to be conducted remotely. The "zoom" video conferencing tool was used for its implementation.

The interviews were categorized based on the subject matter and the objective to be covered, transcribed and subsequently, the various items to be inquired about were identified. From coincidences, concepts that were repeated, different perspectives with respect to certain topics, and even contradictions, the different contents and final objectives of this thesis were built, to completely delineate the contextual framework within which the Mexican industrial designer has been formed and the industrial designer was exhaustively profiled, covering his professional training, the type of workplace in which he works, his practical, theoretical and cognitive tools, including a description of his competencies, limitations, scopes and challenges of his profession.

The panel of specialists made up of professors and academics focused on discussing the evolution of the discipline, curricula, graduate profiles and the incorporation of the environmental factor in training exercises, which helped to identify the role that university studies have played in generating professionals capable of using and integrating, in the workplace, the concepts learned during their training.

A second group of specialists was formed by some of the main historians and theorists of design in Mexico; they provided information about the emergence of the industrial designer and the role he or she has played in different economic, socio-political and cultural aspects, as well as its current importance and the reason why it has become such a popular discipline. These experts also provided a contextual framework for understanding the evolution of the discipline over time and the adaptations it has had to undergo to arrive at today's designer and the challenges he or she faces.

Expert designers who have developed their own industries formed a third panel, and the interviews they were given revolved around the challenges they have had to face as entrepreneurs, how they have adapted to new contexts and new visions, but, above all, how they have addressed, if at all, the issue of sustainability and the advantage, both sustainable and competitive, that this has given them.

Finally, a group composed of industry leaders complemented the vision of the previous group, defining in even greater detail the challenges faced by the industry that hires industrial designers every day. These specialists also delimited in depth the work with clients and how difficult it can be to work with them, as well as the relationship with suppliers, competition with other companies and the great challenge that has been to incorporate environmentally sound practices, often at the expense of what the environment and the client request. These businessmen were asked about the profile

they are looking for when hiring industrial designers, and how, according to them, the ideal profile would be to work in their companies and address the complexities derived from the current situation.

Once the documentary information and the results of the questionnaire and interviews were obtained and analyzed, the data were triangulated to meet the objectives of the research, which were: to define the industrial design activity in Mexico; to understand the industrial dynamics around the environmental issue; to propose a new profile of environmentally responsible designer and finally, the development of a proposal for a preventive methodology of practical use to be used by any designer seeking to reduce its impact, regardless of the size of the project at the door and that had as a starting point, the points proposed within the ISO 14006 Standard and its adaptation to the Mexican context

Results

The applied questionnaire yielded statistical information that helped to give context to the current situation of design firms in Mexico City and its suburbs and serve as a basis for the development of the in-depth interview. Among the most relevant results derived from the diagnostic questionnaire applied to industrial designers working in "MiPyMes" and "PyMes" companies in Mexico City and its suburbs, we find: 1) Figure 1 shows that 50.5% of respondents know little about climate change; Figure 2 shows that 54.3% know little about the environmental crisis, and despite knowing little about the subject, as shown in Figure 3, 87.6% of designers are convinced that what they design affects the environment. 2) An important fact is that 78.09% of the designers surveyed believe that the decision on materials and raw materials generates an impact and 79.05% say that the selection of the process also causes environmental damage; likewise, 61.9% affirm that the final finishes are related to the problem, these processes are selected by the designers themselves, demonstrating that there is inference in their decision making.

Figure 1

Knowledge of climate change, causes and consequences

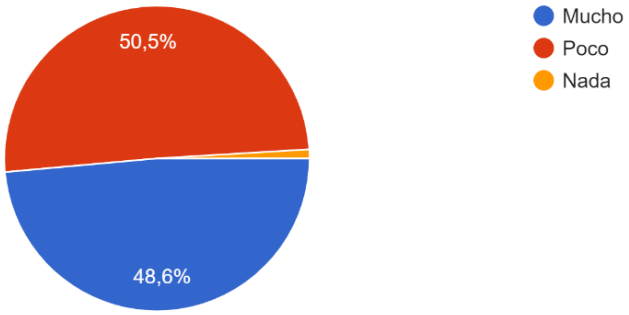


Figure 2
Knowledge of climate change, causes and consequences

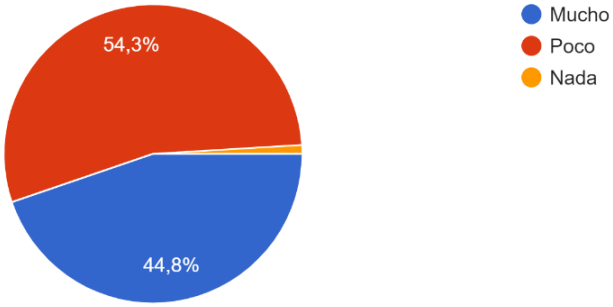
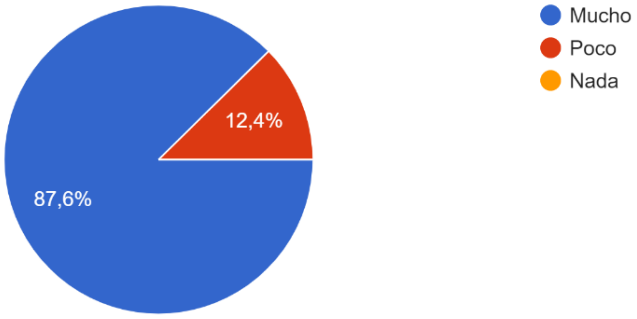
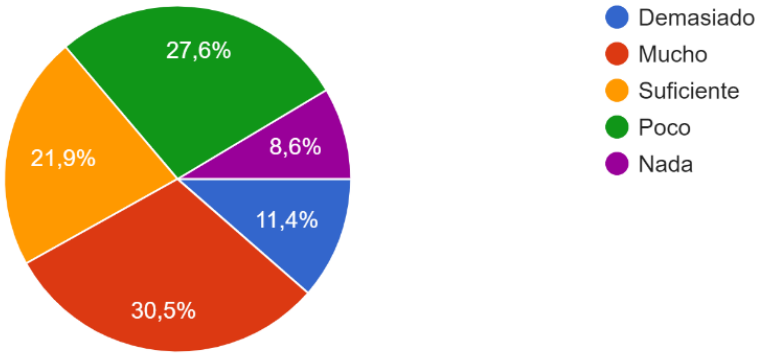


Figure 3
Belief that environmental problems derive from human practices and acts



The final part of the questionnaire focused on the implementation of environmental standards in their workplace, knowledge about them and the freedom they have when making design decisions related to environmental issues within the companies. The most important results were as follows: 1) 78.1% lack knowledge about ISO 14006 and its content; 2) 30.5% state that decisions made during the design process directly affect the environmental crisis and climate change (Figure 4) and 27.6% believe that the environmental element is very important within the work environment (Figure 5). 3) 40.7% of the designers state that the final decision on materials and processes is made by area heads and managers (Figure 6). In direct relation to knowledge of the Standard, 77.8% were unaware of its existence, procedures and strategies (Figure 7).

Figure 4
To what extent is the environmental factor considered in corporate decision-making.



Source: own elaboration, survey with *Google Surveys*, February-March 2021.

Figure 5
Degree of importance of the environmental element in the work environment

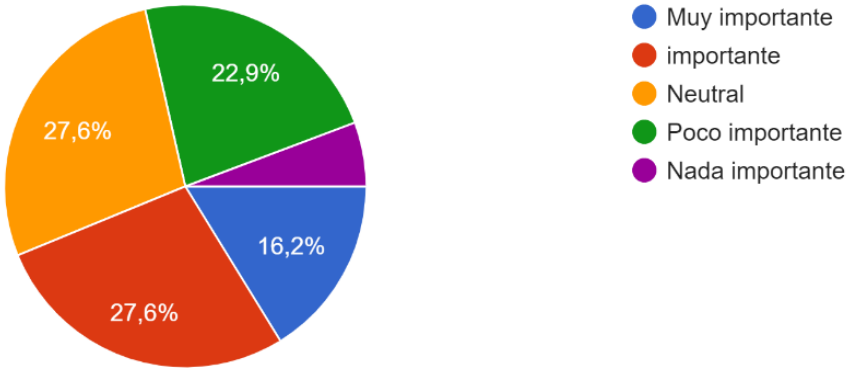


Figure 6

Person who makes the final decisions on the critical aspects of a project.

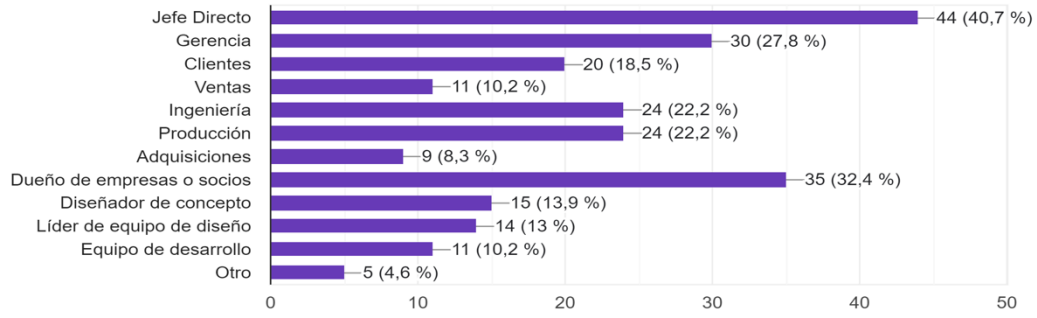
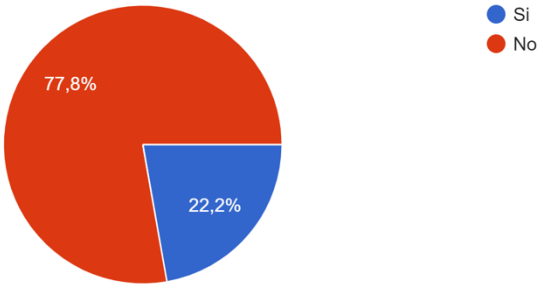


Figure 7

Index on awareness of the existence of the ISO 14006 standard.



Among the preliminary conclusions we find that industrial designers are aware that there are factors that affect the environment within their practice and recognize that they generate an impact, but they are not informed as to which of these processes are the most environmentally risky and much less, how to address these issues. At least half of the designers surveyed, many of them with an average of 9 years of professional work, claim to have no knowledge of the environmental crisis.

When talking about critical decisions related to the environmental crisis is that, in effect, the industrial designer working as an employee, has little or no freedom of decision making and must adhere to the decisions made by the managers under whom they work, 40.95% confirmed that their bosses made such decisions.

In general, designers within the industry have minimal knowledge of environmental strategies and issues, and those who do have knowledge of them either do not know how to implement them or are handicapped in making a real positive impact due to a number of constraints and limitations within the company in terms of decision-making on processes, strategies and materials. The designer must work invisibly and within the established limits, focusing his efforts to perform his work announcing the economic advantages and not the environmental ones, if he wants to achieve the consent of his employers.

The interviews took shape from the concerns derived from the diagnostic stage and the bibliography consulted; these interviews helped to delineate the profile of the Mexican industrial designer, understand the scope of their work, understand the complexity of the challenges they face daily within the industry, find areas of opportunity,

define in detail the techniques and methods they incorporate in their professional work and, above all, the important role they play as an agent of change.

The following are some of the results obtained from the interviews and the consensus among the members of the expert panel:

In Mexico, production runs are well below the truly industrial levels of developed countries, in addition to incorporating the extensive use of artisanal processes and manual labor. The Mexican industrial designer generates products, of any kind, from medium and hybrid technology, not very expensive and where he himself can manipulate and control the processes. Focusing on point-of-sale design, furnishings, unsophisticated products and decoration, whose production levels are low and whose manufacturing lines are easily adaptable to a wide range of objects and small runs.

The business landscape of the designer in Mexico has evolved differently from other countries, and has been forced to renew itself by necessity, diversifying its contribution, and where the name "industrial" is becoming more and more irrelevant every day and the panel of experts made up of industry leaders mentioned that the business and industrial environment presents designers with a much greater challenge; in Mexico, designers who decide to work within a company live governed by the needs posed by the national industry and the economic model that governs it.

Two types of designers are recognized in Mexico, the first is the renowned designer, a professional who has been able to position himself as a brand and who can freely choose what to design and to whom he provides his services, designers who are not subject to the needs of a traditional company and it is these design professionals who have the greatest opportunity to become agents of change: but the majority, designers who exercise the traditional practice, are obliged to respond to the needs of the predominant economic system and with little or no decision-making power.

There are several challenges facing the industry, but from the point of view of the incorporation of ISO 14006, designers have a deficient training, derived from the lack of a structured methodological discipline and the necessary knowledge to address complex issues, such as sustainability.

Another important challenge to overcome is the lack of control that the designer has when making decisions on projects: he has no control over the assigned budget, or the target price, nor does he have control over the information, both qualitative and quantitative, that a client provides, nor over those indirect variables that affect the industry, macroeconomic factors such as devaluations, pandemics, policies, legislation on processes and materials, among others.

A designer who considers making a change from within the industry must have two very important elements, the first, a boss or client with enough openness to change the course of projects or to want to make real innovation and the second, the ability to sell themselves, and for this, you need a solid foundation to convey the economic benefit of their ideas, since it is the only way a designer could implement a change within your company.

Mexican companies that hire designers face various challenges to stay within the changing labor environment, overcoming economic, environmental, cultural, social and political challenges, being the most important factor, the client and his needs, a variant that can make a company grow or make it disappear: among the challenges that clients bring are to provide the best possible service at competitive prices, which force design firms and industries to reduce their profits, and this is a factor that impacts on the environmental aspects of a project, where the objective to be covered is not a strategic one, but to achieve a target price.

When a client seeks to invest as little as possible, it prevents the designer from doing his job well: firstly, the response times requested are minimal, and without adequate time, an in-depth investigation cannot be carried out to consider all factors, including environmental, and in turn hindering the performance of tests and trials, or the selection of suppliers that are aligned with the objectives covered by ISO 14006.

Specialists agree that talking about environmental issues within the Mexican industry is an unfounded factor and that the industry is not prepared to achieve it, and in the race for the best cost, that which is not sustainable is usually the cheapest option.

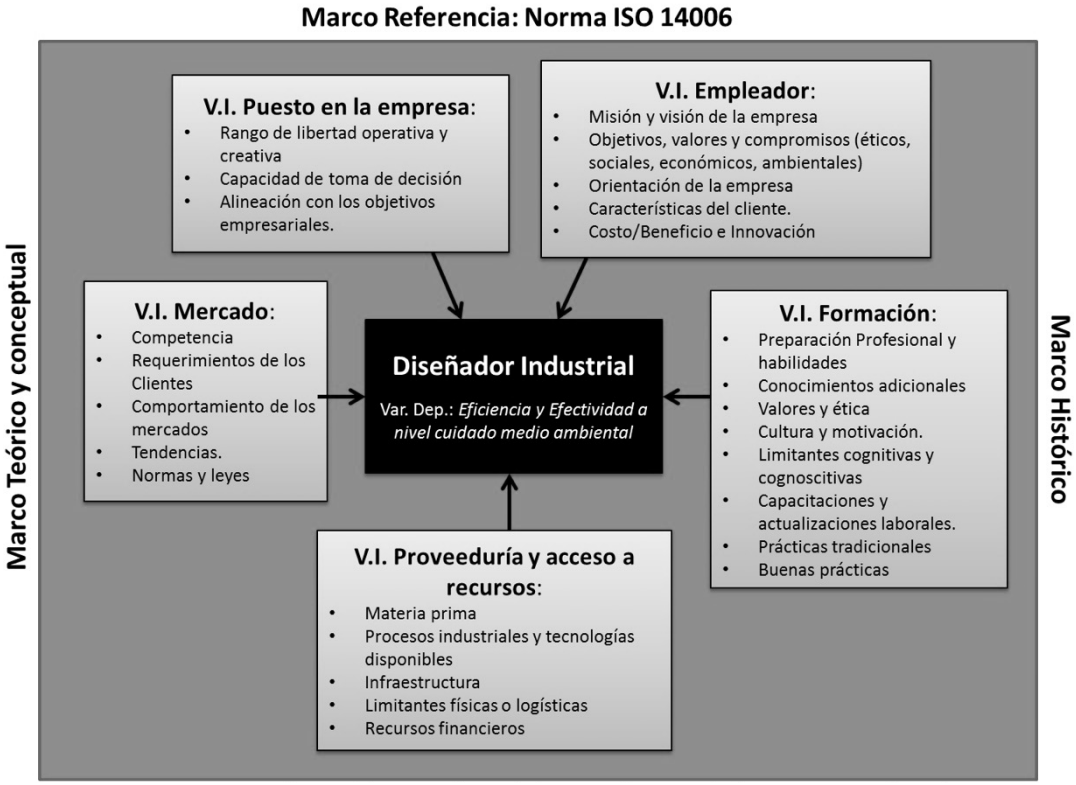
The panel of experts also mentioned that another major constraint for companies is the lack of government support for the acquisition of clean technologies, or incentives for companies seeking this change, and the lack of awareness programs at the industrial and training levels.

Finally, the external variables, those over which there is no control, and which the designer must find a way to deal with: economic crisis, changes in legislation, restrictions imposed on processes and materials, the parity with international currencies, the prevailing political regime and, of course, pandemics and other health crises, as well as other natural catastrophes.

The diagram in Figure 8 shows, by way of summary, all those factors that must be considered and overcome in professional design work if the objectives of ISO 14006 are to be achieved.

Figure 8

Diagram of factors affecting the industrial designer's job performance



Discussion and conclusions

It is necessary to accept the limitations of Mexican companies when they want to incorporate strategies such as those proposed by ISO 14006, starting from the fact that many work with reduced budgets, especially due to the lack of support from clients in their race to get the cheapest prices, punishing the growth of design companies, so without responsible clients and without government support, these businesses, factories and offices will have to find another way to become responsible, since being able to perform a life cycle audit or implement better technologies is completely out of their reach; these factors are sufficient to understand why incorporating a standard developed for advanced countries to the letter is also a complex, but perhaps not impossible, task.

In Mexico, the vision for a sustainable industry must arise from the needs of a semi-craft industry that does not produce in the quantities that first world countries do, adjusting the creation of products and services within the parameters and context of the real needs of the population; the engine that moves the incorporation of new methodological tools must be the context of a complex society, where everyone is involved in the development of products or services that need to be generated, and the need to integrate a disjointed industry, within local contexts, under a regime of care, respect and regeneration of resources, as well as a responsible management of those non-renewable resources, and that under this new scheme, more tools arise to nurture the work of the transformers of the artificial world, from the perspective of a developing country, and that truly takes into consideration the dynamics that are created between industry, planet and society, developing and incorporating every day more, new and better strategies that respond to the needs of production and economic development of the country.

The question now is: how could the ISO 14006 standard be incorporated into projects at the design stage?if it is indeed the case mentioned by several authors, that most of the environmental damage comes from the design stages of a product, I think it is from there that should be operated; the problem: the lack of the necessary means to perform an environmental audit and a subsequent technological update, but the standard can serve as a starting point for the implementation of good practices from the design, and why the need to provide it with practical tools to guide the process, without the need to have deep knowledge, you can simply take the proposed stages and go from there. This was corroborated by the panel of experts, industry leaders, who commented that there are elements that have been taken from the Standard, to be adapted by the design teams, who could be given prior preparation to incorporate into their work the most important aspects of eco-design, as indicated in the Standard.

The Mexican consulting firm on the incorporation of ISO 14006, *CSR Consulting*, during a recent interview commented that the standard focuses on the environmental management of product design and development, providing guidelines to achieve the incorporation of various environmental considerations in all stages of the product life cycle, when asked about what the industry leaders stated during the interviews, they corroborated that, in effect, most design companies are unaware of the existence of the Standard, or that they apply it in a flexible manner, adapting it to their needs and capabilities, mainly due to three factors: 1) lack of awareness, 2) limited resources and 3) the belief that a more flexible adaptation better suits the conditions of the work they perform.

Jesús Octavio Gámez, an intern with the firm, stated:

> In response to your question as to whether standard 14006 can be applied in Mexican industry, it is important to consider that its applicability may vary

> according to the circumstances of each company. Although the standard is designed to be adaptable, lack of knowledge and resources can be an obstacle. It is essential to assess whether companies can benefit from implementing the standard, whether it fits their operations and whether they are willing to invest in improving their design and manufacturing practices. In summary, while 14006 provides valuable guidelines for ecodesign and sustainability in the consumer products industry, its application in Mexican industry may require an approach that is tailored and mindful of the limitations of SMEs and microenterprises. Awareness, training and the perception of tangible benefits could influence the effective adoption of the standard" (Gamez, J, telephone communication, August 12, 2023).

This data confirms the statements of the panel of experts, it is possible to take relevant aspects and adapt them to the needs and context of each company, with their respective limitations, which would also limit the scope of the strategies, their efficiency and their effectiveness.

ISO 14006 refers to seven stages: project organization, product selection, establishment of ecodesign strategies, idea generation, concept detailing, communication and launching, and finally, product follow-up; of these stages, strategy selection and design detailing are the two critical stages, from the designer's point of view. Once the product to be developed has been selected, the designer should be informed about the alternatives available to implement an eco-design strategy, and without the need to master these issues, the development of a methodological tool containing the necessary information, such as applying an environmental assessment to existing products accompanied by a rubric, can help to identify the problems and where each new design challenge offers an opportunity for feedback from good practices previously learned, nurturing the design work, by performing such an exercise, sharing the results with colleagues, and generating a database with these good practices.

During the detailed design phase, it would be necessary that this same methodological guide, help the designer to evaluate his project, which could be through a checklist that allows to contemplate the selection of suitable materials, the appropriate process and issues such as packaging design, a valuation matrix can evaluate the alternatives, and through a numerical result obtained later, go to a table where solutions are listed, something similar to a matrix of contradictions, where the possible design problems and environmental challenges are listed in order to confront them with different solutions, showing possible ways to reduce the impact, and this does not require more than a trained person to develop these tools and teach designers to use them, but above all, to implement and develop them from the experience of each project, and this could serve as a first step to seek that design projects in these small companies can contribute from their own limits, seeking to permeate little by little, all procedures within them.

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LEARNING PROJECT USING 4.0 TECHNOLOGIES: CREATION OF A START-UP WITH CIVICAL PURPOSES

PROYECTO EDUCATIVO MEDIANTE EL USO DE LAS TECNOLOGÍAS 4.0: CREACIÓN DE UNA START-UP CON FINES CÍVICOS

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ABSTRACT

If anything can be considered today's society backbone, this is the technology, and with it, the digital world. As citizens it is impossible to ignore it and living apart of it because it has a decisive role in every day-by-day aspect. Furthermore, most population perceive technologies as entertainment tool; however, it is interesting to give coming generations some strategies for using technologies to improve the world. This project has the objective of applying 4.0 technologies to take care of the city through the students' application proposals. To achieve this the methodology has been the use of technology for creating content with civic purposes. The results are shown divided into two branches; on the one hand there are the students and their pedagogical objectives and on the other there are the citizens and their perceptions about the services given by 4.0 technologies in their daily lives, so, as a result, it has been a benefit to their community and a generalized use of the applications by the citizens. Overall, it has been a motivational and useful activity for the student's future.

Palabras clave:
tecnología 4.0, proyecto, aplicación, educación secundaria, civismo.

RESUMEN

Si algo vertebra la sociedad mundial hoy en día es la tecnología, y junto con ella, el mundo de lo digital. Como ciudadanos es imposible ignorar su existencia y vivir al margen de ellas porque tienen un papel decisivo en todos los aspectos de la sociedad. Por otro lado, la mayor parte de la población percibe las tecnologías como herramientas de divertimento, sin embargo, es interesante dotar a las generaciones venideras de estrategias para emplear las tecnologías en pro de un mundo mejor. El presente proyecto tiene como objetivo general la aplicación de las tecnologías 4.0 al cuidado de la ciudad mediante propuestas sencillas de los alumnos con la creación de aplicaciones digitales. Para lograrlo se utiliza una metodología basada en el uso de las tecnologías 4.0 aplicadas a la

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	creación de contenido con fines cívicos. Los resultados se muestran divididos en dos vertientes; los grupos de alumnos y sus objetivos pedagógicos y los ciudadanos y su percepción de los servicios brindados por las tecnologías 4.0 en su vida cotidiana, conque, ha supuesto un bien para la comunidad y un uso generalizado de las aplicaciones en los ciudadanos del municipio, y además, una actividad motivadora y útil para el futuro del alumnado.

Introduction

This educational project, framed within the Erasmus+ program of the European Union, consists of promoting the use of 4.0 technologies among secondary school students for the creation of start-ups with civic purposes, which provide some benefit to the local community. The students will create various applications to improve their city, the applications will compete with each other in the form of a start-up, to see which one is the most useful, the most downloaded and which one has a chance of staying in the market.

The reason for promoting this project is due to the fact that the industry has evolved in the last 12 years towards a decentralization paradigm, in which all the functions of the companies or organizations have gained prominence with respect to the previous paradigm. This situation can be extrapolated to a city, since smart cities are being a good vehicle for the growth of the cities themselves in terms of services, facilities, and their use. Thus, many local governments have opted for projects of this nature because they have been aware of their great potential in terms of savings (Li et.al, 2014), (Li, Eric and Ling, 2018), (Herrera and Martinez, 2018) and (Smith and Lihui 2018).

Industry as it was known years ago, has changed radically with the entry of 4.0 technologies in the economic-industrial landscape, in society, the way of working or interacting has changed as our mentality has also changed. In the old scenario everything was very hierarchical and isolated, each aspect of the industries had its particular plot and these in turn were organized in priority, with production generally being the rudder that guided the industries, but everything changed at the Hannover fair in 2011, (Li, Eric and Ling, 2018), (Naya, 2018) and (Zakaria, Nasir and Akhtar 2019) where the term industry 4.0 to define the new landscape that was coming: a decentralized industry, where the different plots would no longer be relegated to each other, but each would have a fundamental role in win-win terms.

This new panorama also requires the participation of the executing and beneficiary users, and here possibly this 4RI is where it has found its cornerstone: the user (Matende and Ogao, 2013), (Aloini, Dulmin, Mininno, 2007) and (Escobar-Rodrigueza and Bartual-Sopena, 2015), which in the case at hand would be the citizen.

Despite all the benefits of Industry 4.0 and its technologies, many users are reluctant to use them, because they think they are complicated and are not focused on diverse users, but are more suited to IT profiles. This fact happened, happens and will happen in the face of any change, as human beings normally do not respond to changes diligently and this with age increases (CCOO, 2017). There is a risk of further accentuating the generational digital divide, because technologies have penetrated every social, academic, professional, economic, etc., corner of society.

It is for this reason that it has been thought convenient that teenagers are the ones to carry out these actions of use of technologies for a civic purpose and that they are the ones to transmit to their relatives and acquaintances the importance of these resources to improve our lives and, in this way, to broaden their horizons regarding the possibilities of 4.0 technologies.

As some studies state, Industry 4.0, as a driver of 4RI is here to stay in today's social landscape, and as such, users have to develop their lives with 4.0 technologies (White, 2018) and (Brynjolfsson, 2014). Not using them would mean an obsolescence in terms of their vital performance that would result in a disadvantage and displacement with respect to the rest of the members of society. In a non-production industry, such as the care and management of a city, managers and directors do not feel the same economic pressure as

a company itself, whose economic benefit depends entirely on the work they produce. To this end, a series of objectives have been designed to be met, which are presented below.

The overall objective is the application of 4.0 technologies to the care of the city through simple proposals from students with the creation of digital applications. The specific objectives of the project are the creation of new projects through technologies (ICT); cooperation and teamwork to achieve the competence and improvement of the product; the contribution of services to the community with a novel and technological product; and the awareness of society with different uses of ICT for our benefit.

Method

After being approved by the school's management team, the project was presented to students in the third year of Compulsory Secondary Education (ESO) of the Spanish education system, aged between 14 and 15; in the area of Social Sciences, although it is a cross-cutting project, because it also covers the subjects of Spanish Language, for the production of written pieces to promote the applications; Computer Science, for the use of digital systems and social networks; and Mathematics, for the calculation of arithmetic averages, statistics, fashions, possible budgets, earnings, etc.

The project has been divided into several sessions during which the idea to be carried out has been introduced and the relevant steps for its performance have been followed. The first session should introduce what a start-up is, and for this purpose examples of different start-ups in the Region of Murcia are given, as this is the geographical location of the project. Then, the characteristics that they have will be explained and the introduction to them will end with a proposal for the creation of a start-up through a mobile application.

The students are divided into groups of a maximum of 5 and each group must create a product, an application in this case, that is innovative and useful to improve the lives of people in their city, although it can be extrapolated to other geographical scenarios. The essence of the application must be the provision of a useful good or service to society, a service to the community that can be used by everyone, regardless of their socio-demographic group. Before designing the application, students have to search online for ideas and information about the app market and the niche in which they want to develop their app. Students must present their developed idea prior to designing the application for evaluation of its relevance, feasibility, originality, etc.

Once the ideas have been approved, each group creates the application using the online tool "Apper", which can be downloaded on the tablets available at the centers. The software is intuitive and easy for students. With it they can add interactive maps, online chat services, photo galleries, voting systems, etc. All these services, hand in hand with an enabling technology such as tablets or smart mobile devices, facilitate the service to the human being. Technology at the service of human beings.

They must make the application itself with the previous tool and throughout the project they must use Android and IOS technology to launch the application, using the "Apper" tool they must make the necessary modifications to optimize the app.

The ideas that the students have come up with are: an application that determines the garbage points with the different types of waste in the city so that citizens can find the nearest one; the schedules and routes of public and private transportation that go around the city and to other locations to facilitate the sharing of these vehicles; points of sale for local farmers, to facilitate the sale of their merchandise and promote local commerce; among others.

Once they have been created, the applications have gone to the market and have been submitted to the evaluation of citizens, for this, the students have used the social networks of the center to publicize them, in addition to the technologies of online forms for surveys and voting to see the opinion of users and improve in terms of their realization, in this way they have learned an alternative use of social networks and have used them responsibly.

This project has been a long-term project, during the whole term the students have worked in their company every day, as they would do in a real environment. They have competed with the other groups to make their application the most downloaded, they have modified it to make it competent, they have coordinated as a team to face this challenge, they have planned the steps that their start-up has to take in time to establish itself in the market and above all they have learned from their first-hand experience.

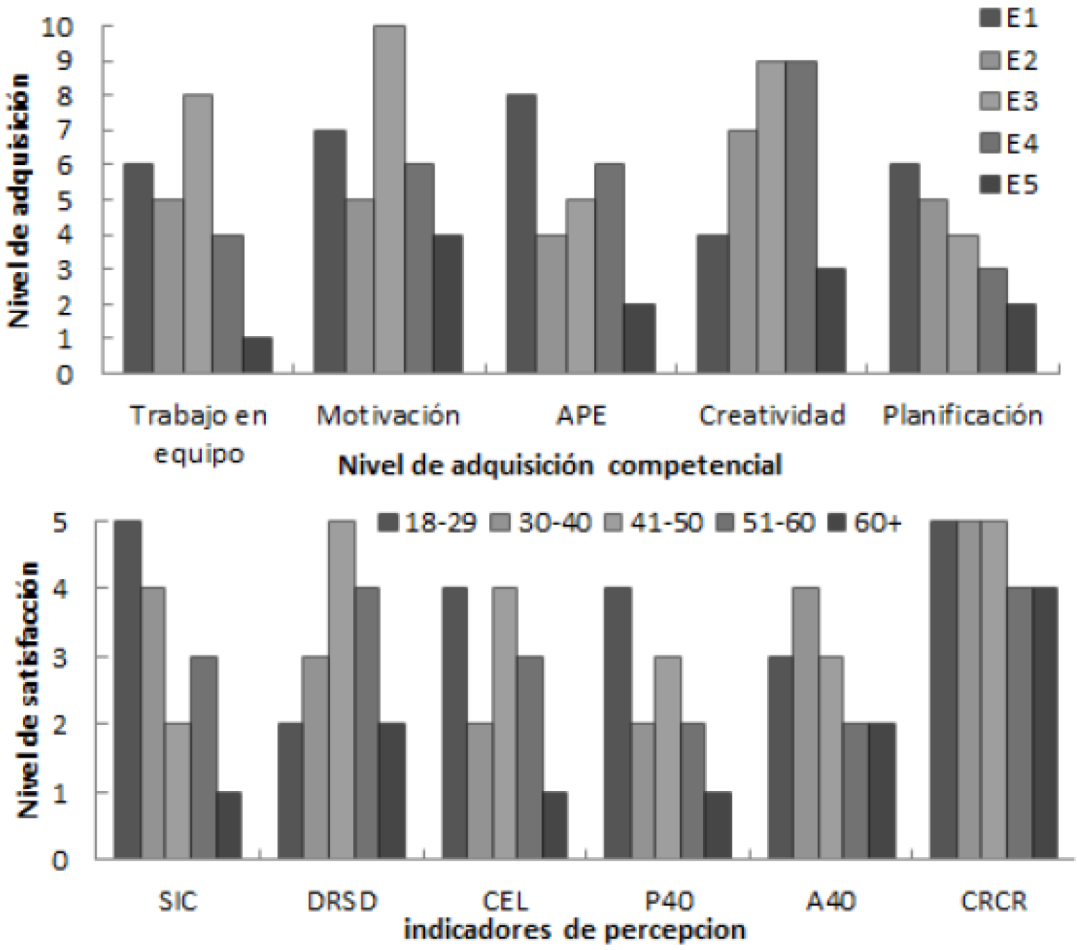
To make the exercise more motivating, a panel has been installed in the classroom, which will be "The Bag" in which the downloads have been recorded in a time graph and at the end, whoever has had more downloads over time has been the winning team.

Results

The results of this project can be divided into several groups given their interdisciplinary nature, so they are presented separately in two graphs, as follows (Figure 1):

Figure 1

Charts showing students' levels of citizen satisfaction and competence acquisition



The results of the "perception indicators" table were obtained by conducting a survey of a heterogeneous sample of fifty citizens from each social demographic group. For greater accessibility, they have been conducted both online and by telephone. The level of citizen satisfaction was measured by asking them to rate the following aspects from 0 to 5. The theme of the results of the surveys can be divided into two in turn, since it addresses two main aspects; On the level of the "smartification" of the city with 4.0 technologies, the modernization of communication systems in the city (SIC), an order, in terms of the distribution of resources, services and waste (DRSD), and, being the work of local teenagers, more involvement is achieved by families and environment. On the social level, communication between premises is improved (CEL), 4.0 technologies are perceived in a more favorable way (P40), teenagers discover a new useful application of technologies and their knowledge about them (A40), and they mean an improvement in terms of the use and consumption of resources in a more responsible and civic way (CRCR). Although high levels of satisfaction can be perceived, in the last group "+60", as it includes a social group with a high degree of analogism, the average satisfaction levels are not as high as in the other groups because, due to the existing digital divide, many reactions were of apathy with this initiative on the part of the elderly. As for its didactic application, at the didactic-educational level, students learn the applications of 4.0 by the students, they work on teamwork skills, since they work in groups and they manage their

own time and tasks, the motivation of the students is improved with the system of "the Bag", the students learn through experience, because they are the ones who carry out their own project, they improve their creativity, by pushing them to create something new and useful and, finally, it helps them to learn to plan actions to meet deadlines. These results have been obtained by averaging the grades obtained through rubrics by the 5 teams of students who participated in the project. Depending on the different attitudes and actions developed throughout the project, the groups have been obtaining their grades, and, although some are somewhat low, the average performance in all of them has been quite favorable, as can be seen in the results.

Discussion and Conclusions

Taking into account the initial objectives that were proposed at the beginning, the conclusions obtained from this research are the following:

- For the general objective, the application of 4.0 technologies to city care, it can be stated that the information that the applications have provided, in collaboration with the rest of the 4.0 technologies, guarantee energy savings and stable energy consumption by preventing situations of unnecessary expenditure that sometimes result in irrecoverable losses at the environmental level.
- For the creation of new projects using technologies (ICT); the students involved have a broader knowledge of the facilities and resources of their locality, resulting in very precise applications.
- For cooperation and teamwork to achieve competence and improvement of the product; the students have worked as a team to get the project off the ground in their city.
- To provide services to the community with an innovative and technological product; the fact that citizens have access to the applications favors the proper and efficient management of local resources and waste.
- And for the awareness of society with different uses of ICT for our benefit, the popularity of 4.0 technologies increases when citizens can see the improvements in their locality.

In summary, the study concludes that citizens have adapted well to the technologies when they have had the facilities and need to use them, i.e., each user accesses the applications according to their particular needs and performs their specific functions, and it is the properly parameterized application that, with all the information on locations, schedules, time, units, resources, etc., alerts and arranges for the personnel in charge to perform the tasks.

The study therefore shows that Industry 4.0 brings with it technologies that allow users and companies to make their work easier in terms of time and practicality, although at the beginning, like any new environment, it requires an initial adaptation that is more or less costly, but which, in the long run, will provide speed, comfort and sustainability.

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EFFECTS OF COVID-19 ON THE BEHAVIOR OF FOOD CONSUMER IN SANTA CRUZ DE LA SIERRA (BOLIVIA)

EFECTOS DE LA COVID-19 EN EL COMPORTAMIENTO DEL CONSUMIDOR DE ALIMENTOS DE SANTA CRUZ DE LA SIERRA (BOLIVIA)

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ABSTRACT

Consumer behavior is a multidisciplinary research area of interest to various disciplines such as economics, management and marketing. It has been treated from different approaches that have emphasized the incidence of economic, social, psychological, demographic, cultural and contextual factors in the actions of consumers when choosing the goods and services they will consume. The objective of this article was to explain the main effects of the COVID-19 pandemic on the behavior of food consumers in Santa Cruz de la Sierra (Bolivia) who shop at the Los Pozos Municipal Retail Market. Methodologically, it was based on the postulates of a quantitative research based on the review of specialized literature and the application of a questionnaire to a group of consumers who shop at the Los Pozos Municipal Retail Market located in Santa Cruz de la Sierra (Bolivia). In the conclusions of the research, it was highlighted that the main effects of the COVID-19 pandemic were evidenced in: a) the emergence of a new factor in consumer purchasing choices, which, due to its sanitary nature, was reflected in the increase in purchases of antibacterial gel, alcohol, liquid soap, among other personal care items and; b) the importance acquired by online shopping and delivery. These effects are positive and have been incorporated into the culture of consumers, since they facilitate the satisfaction of their consumption needs.

RESUMEN

El comportamiento del consumidor es un área de investigación multidisciplinaria de interés para diversas disciplinas como la

Palabras clave:

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COVID-19, comportamiento del consumidor, compras en línea, servicio de reparto.	economía, la administración y el marketing. El mismo, se ha tratado desde distintos enfoques que han enfatizado en la incidencia de los factores económicos, sociales, psicológicos, demográficos, culturales y, del contexto, en las acciones de los consumidores al momento de elegir los bienes y servicios que consumirá. Este artículo, se planteó como objetivo explicar los principales efectos de la pandemia del COVID-19 en el comportamiento del consumidor de alimentos de Santa Cruz de la Sierra (Bolivia que realiza sus compras en el Mercado Minorista Municipal Los Pozos. Metodológicamente, se fundamentó en los postulados de una investigación cuantitativa sustentada en la revisión de literatura especializada y, en la aplicación de un cuestionario a un conjunto de consumidores que realizan sus compras en el Mercado Minorista Municipal Los Pozos ubicado en Santa Cruz de la Sierra (Bolivia). En las conclusiones de la investigación, se destacó que los principales efectos de la pandemia del COVID -19 se evidenciaron en: a) la emergencia de un nuevo factor en las elecciones de compra del consumidor, el cual, por su carácter sanitario, se reflejó en el incremento de las compras de gel antibacterial, alcohol, jabón líquido, entre otros artículos de cuidado personal y; b) la importancia adquirida por las compras en línea y el Delivery. Tales efectos, tienen un carácter positivo y se han incorporado en la cultura de los consumidores, dado que facilitan la satisfacción de sus necesidades de consumo.

Introduction

In today's society characterized by globalization, economic internationalization, free markets, trade agreements, among other aspects, it would seem that the consumer is an actor with the capacity to choose freely in the market the goods and services he will consume based on the utility they bring in satisfying his needs. The objective of this article was to explain the main effects of the COVID-19 pandemic on food consumer behavior in Santa Cruz de la Sierra (Bolivia).

The study was located in the line of research related to consumer behavior. Therefore, the review of specialized literature was related to the analysis of the main approaches used for the study of consumer behavior, the factors that, from economic theory, induce changes in the demand for goods and services, as well as the impact of the COVID-19 health crisis, which became a major world economic crisis with an impact on the behavior of food consumers. The fieldwork was based on the application of a survey to a group of food consumers residing in Santa Cruz de la Sierra (Bolivia) who shop at the Los Pozos Municipal Retail Market.

Regarding consumption, it is worth mentioning that the economic discipline has historically used the concept of utility to denote "the way in which consumers choose among different consumption possibilities" (Samuelson, p. 82). For economists, utility is not simply a subjective benefit or psychological feeling derived from the consumption of a good or service; it is a theoretical construct used "to understand how rational consumers divide their limited resources among goods that provide satisfaction" (p. 82).

In this context, the traditional economic model explains consumer behavior based on the following determinants: a) the price of the good; b) the price of related goods (substitutes and complementary goods); c) income; d) tastes; and, e) population size. This model bases the market analysis on the perfect competition approach, characterized by the fact that all actors (suppliers and demanders) have perfect knowledge of market conditions.

However, in the real field, consumers face conditions of imperfect competition, since they do not have complete and sufficient information on the behavior of markets, as well as information related to suppliers and, in particular, on the aspects that explain the inherent complexity of "modern" goods and services (Sampedro, 2002). Therefore, in addition to the factors broadly based on the traditional model, consumer choice is also conditioned by other aspects such as the qualities of the good or service, the characteristics of related goods and advertising.

Another factor that also determines consumption is identified by Quintanilla (2010) in terms of the social qualities of self-identification of the good or service, given that these "are not only material goods or physical objects, they are much more, a symbol impregnated with cultural meanings" (Quintanilla, 2010, p. 48).

Henao (2007), based on the traditional approach to consumer behavior, summarizes the external factors that determine purchase and consumption decisions as follows:

- The demand environment: made up of demographic and economic factors that determine the consumption of goods and services. With respect to the former, the size of the population, its age and sex distribution, migration and educational level are the most important; while with respect to the latter, income, interest rates, unemployment and savings are the most important.

- The family and the household: these terms are used synonymously to refer to the changes generated in consumption as a consequence of changes in family economic well-being, emotional support, lifestyle, and socialization.
- Reference groups: changes in values, as well as in the norms, rules or patterns of behavior of the individual in society, have a determining influence on purchasing decisions and consumer behavior.
- Culture: comprises the traits associated with the beliefs, customs, morals and habits that characterize societies, as well as the laws and norms that regulate their functioning. Thus, the culture of a society is expressed in consumption.
- Social strata: they are differentiated by the consumption patterns and purchasing decisions of the individuals that comprise them. Thus, consumption is determined by the characteristics of human beings, their quality of life, tastes, need to maintain a certain social status, desire for self-improvement, among other aspects.

In the context described above, economics, in order to address consumer behavior, has started from the premise that consumers select those goods and services that provide the highest level of satisfaction or utility. Therefore, the analysis of consumer behavior involves understanding the various activities performed by individuals during the process of searching for, selecting, purchasing, using and evaluating the goods and services with which they expect to satisfy their needs. It covers all aspects related to "what is consumed, why, when, where, how often and under what conditions, as well as the final result of the process and the subject's satisfaction" (Henao & Córdova, 2007, p. 19).

Another approach that can also be used to understand consumer behavior is presented by Sheth (2020), which approaches consumption from both habitual and contextual perspectives. It has been shown that over time consumers develop habits related to the goods and services they will consume, places to make purchases, search for price and quality information, among other aspects. All of them underpin consumer behavior when making decisions about what goods and services to consume, when to consume and where to shop. Likewise, consumption is also determined by aspects of the context, especially those of a social nature (marriage, children, change of place of residence, place of work, among others); technological change (internet, e-commerce, online shopping); the rules and regulations of each particular country that regulate consumption (alcohol, tobacco, etc.); public policies that promote more sustainable consumption (solar panels, organic products, electric cars, etc.); and natural events (hurricanes, tsunamis, pandemics).

Precisely, the COVID-19 pandemic is one of the natural events that has induced important changes in consumer behavior. In fact, on March 11, 2020, the World Health Organization (WHO) declared the disease a pandemic, as it spread rapidly in different countries with considerable effects on the world population. Therefore, all countries, as a measure to protect the health of their population, declared a state of emergency (Pan American Health Organization, World Health Organization, 2020).

A study by the Economic Commission for Latin America and the Caribbean (ECLAC, 2020) warned about the socio-economic effects of the pandemic on the development of Latin American and Caribbean countries, highlighting the strong economic recession with an impact on the performance of the different sectors of the economy.

This worldwide crisis had considerable effects on both production and consumption, and the level of depth in each particular country was determined fundamentally by its economic conditions, the strengthening of companies, international trade relations, and the policies adopted to avoid contagion, among other aspects.

However, as Ortega (2020) states, regardless of the size of the economic sectors, industry, commerce, as well as tourism and educational activities, among others, were seriously "affected by the suspension of domestic productive activity, generating unemployment and lower economic growth" (p. 234).

With respect to the consumer, Nielsen (2020) highlights that the population, being aware of the existence of COVID-19 in their country and of the level reached by the pandemic, reacted quickly and established as a priority the supply of some basic necessities and biosecurity products to protect themselves from the disease (medicines for flu, cough, vitamin C, alcohol and anti-bacterial).

Likewise,Erikkson and Stenius (2020) express that the response of consumers to the effects of the pandemic was reflected in a change in their behavior, which may be temporary and may not necessarily be permanent. According to the authors, at the beginning of the pandemic, nervous purchases were made to stock up on food (hoarding) and, during its development, consumers became interested in new services such as online shopping and products with low environmental impact. In addition, some consumers took up culinary traditions, while others, as a consequence of isolation, found in the culinary practice the opportunity to share family experiences.

This behavior is explainedby the fact that during crisis periods consumers can be classified into four categories: a) panicky, b) prudent, c) worried and d) rational (Amalia & Ionut, 2009). The first, reacts quickly to the crisis by drastically reducing spending; the second, plans spending and makes major purchases; the third, also plans spending, but while maintaining loyalty to certain brands, is willing to incorporate new products into consumption despite the crisis. Finally, the fourth quarter maintained its performance without significant changes.

From this perspective, the main changes that have occurred in consumer behavior since COVID-19 are summarized in Sheth's (2020) and Casco's (2020) terms as:

- The stockpiling of basic commodities such as toilet paper, water, meat, disinfectants and biosecurity products led to shortages of these goods and temporary shortages.
- The development of consumers' creativity to perform some activities, such as, for example, attending church services through technological platforms such as zoom, online medical consultations, virtual education, among others.
- Reduced consumption of high-priced durable goods (cars, homes, etc.), as well as some services that contribute to consumer entertainment (concerts, movie theaters, restaurants, bars, etc.)
- The adoption of digital technology advances for the development of some activities that previously had a face-to-face nature (family meetings, movies, medical consultations, etc.).
- The emergence of new needs related to the preservation of health and the environment.
- The introduction of improvised changes in the home, which integrated at the same time the space for work, education, gymnasium and distraction.

Based on the analysis of the changes described above, Sheth (2020) states that as a result of COVID-19, technological advances have facilitated the development of an important part of the daily activities carried out by the consumer (work, education, family) and, in particular, the consumption of goods and services (online shopping, home or delivery). All this has induced significant changes in consumer behavior, as they have become aware of the need to better manage resources and of the importance of the home as a space "where people work, study and relax" (Casco, 2020, p. 103).

On the other hand, in terms of food consumption, a study conducted by the World Food and Agriculture Organization (FAO, 2020) reveals that in low-income countries, consumers during the pandemic substituted the consumption of fruits and vegetables for that of basic carbohydrates and non-perishable foods.

Other major changes in food consumer behavior are summarized by Acevedo and Osorio (2022) in: a) the increase in food purchases, home consumption and online shopping; b) the increase in consumption of processed, frozen, long-life and healthy foods; c) the decrease in food waste; and, d) consumers to make decisions about the place of purchase in addition to the price and quality of goods, also considered the logistics efficiency and supply chain of stores, as well as digital marketing strategies.

On the other hand, Sudriá, Andreatta and Defagó (2020), in a study conducted in Argentina, found that even when during quarantines the kitchen became a favorable place to promote healthy eating, consumers maintained a high tendency to consume ultra-processed foods, particularly bread, cookies, cakes, soft drinks, cold cuts and sausages, and a low tendency to consume healthy foods such as fruits and vegetables. This may have induced a shift from a traditional diet based on the consumption of fresh foods to a diet characterized by heavy consumption of ultra-processed foods.

The situation described coincides with the findings of Almendra, Baladia, Ramírez, Rojas, Vila et al. (2021), which show that significant changes in food consumption by all population groups were reported during confinement. In general, unhealthy eating patterns were adopted, such as increased consumption of snacks, high glycemic index foods and ultra-processed foods. This eating behavior associated with reduced physical activity and sedentary lifestyles has negative effects on the health of the population. In addition, a significant proportion of the latter reported having suffered problems of depression, anxiety and stress during quarantine; symptoms associated with eating, sleeping and physical activity.

Likewise, a study conducted in Mexico by Jiménez, Martínez, López, Quero and Carrillo to evaluate the effects of COVID-19 on the purchase and consumption of food by university students revealed that the main changes that occurred in the food consumption of this population group were: a) the positive relationship of the consumption of ultra-processed foods with the individual's moods (depression, anxiety and boredom); and, b) the increased tendency to consume food at home and a greater interest in the consumption of healthy foods. The latter may be linked to the interest of a group of consumers in strengthening their immune system as a preventive mechanism against the possibility of a resurgence of COVID-19, as well as the tendency to cook at home to ensure a healthy diet (Fernandez, Agnetti, Baez, Caetano and Medrano, 2020).

Method

Epistemologically, the research was based on the inductive empiricist (positivist) approach, which conceives the generation of knowledge as the result of a set of "patterns of regularity from which the interdependencies between different classes of factual events are explained" (p. 33).

This approach is based on the assumption that the behavior of material and human events and occurrences, even when they are distinct and isolated, can be evaluated based on the observation of their regularity patterns (number of repetitions), which allows inferring their behavior or future trends.

In this orientation, the quantitative approach was adopted, whose postulates are summarized in the terms of Schettini and Cortazzo (2015) and, Hurtado and Toro (1998) in:

- The variables that explain the behavior of the object of study analyzed are limited.
- Emphasis on the establishment of cause-effect relationships between variables and their measurement or quantification.
- The objectivity of the subject-object relationship.
- The static approach to the data that explain the behavior of the variables, whose analysis is carried out using statistical techniques.
- The objectivity of scientific knowledge.
- The use of the hypothetical deductive method.
- The formulation of hypotheses to explain the relationships between variables.
- The use of theory for the recruitment of hypotheses.
- The selection of a population and a sample as the basis for collecting information.

Methodologically, the research had a descriptive and explanatory scope, since the review of specialized literature revealed a lack of studies that explain the main effects of COVID-19 (independent variable) on the behavior of food consumers in Santa Cruz de la Sierra (Bolivia) (dependent variable). For this reason, the Los Pozos Municipal Retail Market, located in District 5 of the Department of Santa Cruz de la Sierra, was selected as the empirical field.

A documentary and field strategy was adopted for data collection. The first was based on the theoretical understanding of the dependent and independent variables, a fundamental aspect for its operationalization (Table 1), while the second was based on a questionnaire applied to food consumers in Santa Cruz de la Sierra who shop at the Los Pozos Municipal Retail Market.

Table 1

Operationalization of variables

Objective: to analyze the effects of covid-19 on the behavior of food consumers in Santa Cruz de la Sierra (Bolivia) who shop at the Los Pozos Municipal Retail Market.

Dimension	Indicators	Techniques and instruments
Changes in food consumer behavior as a result of the effects of COVID-19	• Factors affecting consumer behavior in times of pandemic: economic and social; health; psychological; among others. • Consumer behavior before and after the pandemic.	Technique: survey Instrument: questionnaire

The questionnaire was structured in three sections. In the first, the socioeconomic aspects of the respondents were addressed; in the second, the level of incidence of economic-social, health, and psychological factors, among others, in their behavior as food consumers in times of the COVID-19 pandemic in Santa Cruz de la Sierra (Bolivia) was investigated; and finally, in the third, their behavior as consumers before and after the COVID-19 pandemic was investigated. The questions were formulated using the following Likert scale: a) very low, b) low, c) high and d) very high. It should be noted that the data

collection instrument was subjected to validation by the expert judgment mode, which consisted of two professors from the Universidad de Los Andes, Mérida-Venezuela and a professional in the area with extensive knowledge and experience in the area of food consumption and agri-food economics.

The execution of the fieldwork was based on the selection of a representative sample, which is defined by Kerlinger & Lee (2000) as the selection of individuals or elements of a population that accurately and reliably reflects its characteristics and properties. In this context, the sample was formed using the information provided by the administration of the Los Pozos Municipal Market. The choice of this source is due to the fact that they handle data revealing an influx of approximately 600 people between 6:00 a.m. and 6:00 p.m. on Saturdays, considered the busiest time of the week for shopping.

In addition, information was obtained that the influx of consumers is concentrated mainly between 7:00 a.m. and 12:00 p.m., with a participation of about 300 people. Consequently, we chose to select a sample equivalent to 10% of those who attended on Saturday, May 13, 2023 to make their purchases during that time slot, which is equivalent to 30 people. It is important to note that the sampling process was carried out randomly, a technique defined as the selection of a sample so that each element of the population has a known, non-zero probability of being included in the sample. This approach ensures that the sample is unbiased and representative of the total population, as described by Levin, Fox, and Forzano (2018).

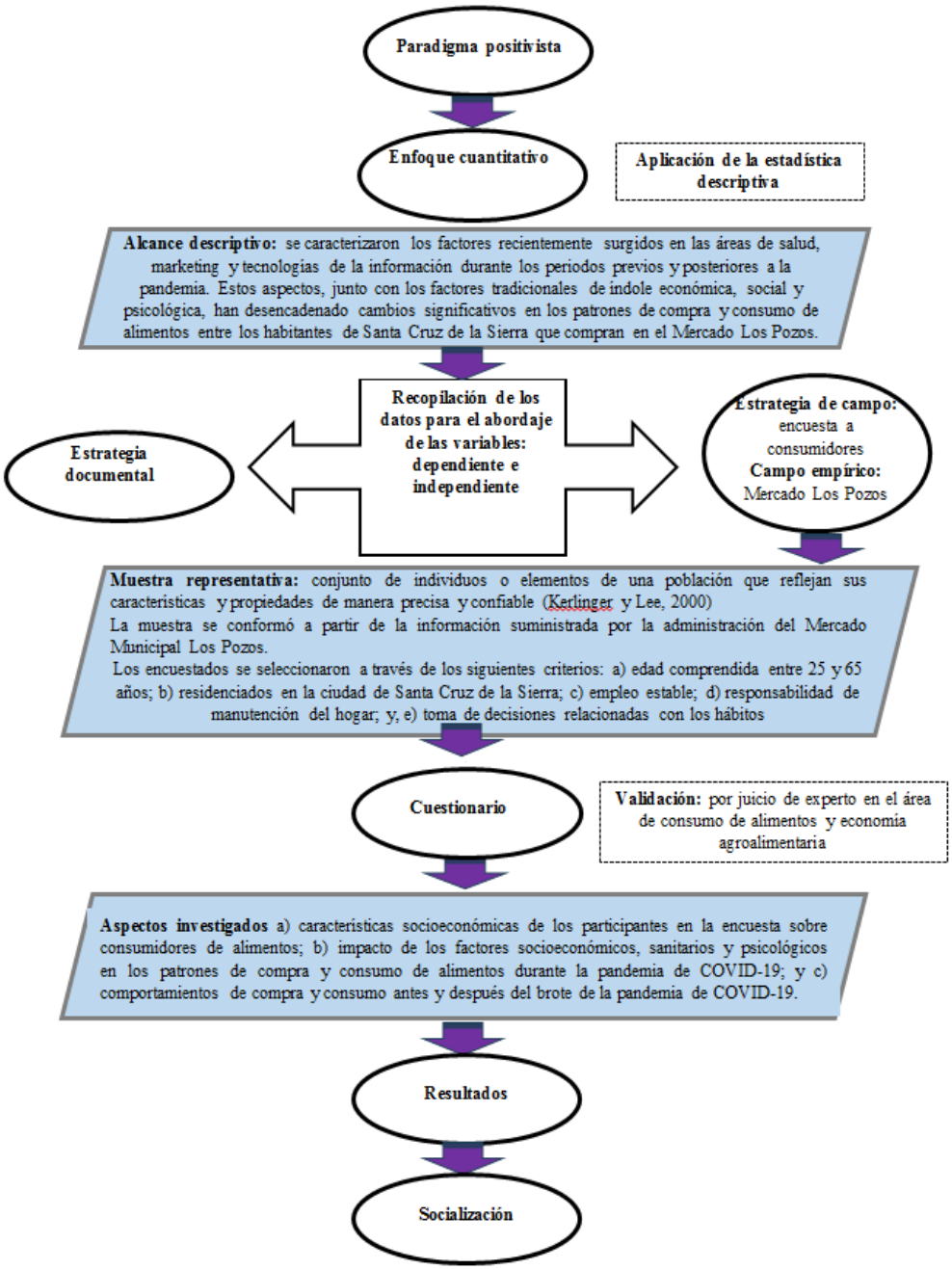
In addition, the selection of respondents was based on the following criteria: a) age between 25 and 65 years old; b) residing in the city of Santa Cruz de criteria: a) age between 25 and 65 years; b) residing in the city of Santa Cruz de la Sierra; c) stable employment; d) responsibility for household maintenance; and, e) decision making related to food purchase and consumption habits.

On the other hand, the design of the questionnaire applied to the study subjects comprised the following aspects: a) socioeconomic traits of the food consumers surveyed; b) incidence of socioeconomic, health and psychological factors on food purchase and consumption habits in times of the COVID-19 pandemic; and, c) purchase and consumption habits before and after the COVID-19 pandemic. The following Likert scale was used to design the questions: a) very low, b) low, c) high and d) very high.

Finally, the data were processed using IBM® SPSS® version 27 as special software for statistical analysis and Microsoft® Excel®. Figure 1 shows the general methodological aspects of the research:

Figure 1

Methodological aspects of the research



Results

Based on the application of the survey to the study subjects, it was found that 40% are men and 60% are women, aged between 25-35 years (60%), with a university education (76.7%) and with the capacity to make purchasing decisions in their family nucleus (90.0%).

With respect to the main factors that influenced food consumer behavior in times of COVID-19 pandemic in Santa Cruz de la Sierra (Bolivia), the findings revealed that for the respondents:

- Economic and social factors fluctuated between medium (70%), high (13.3%) and very high (6.7%).
- Health factors showed trends with fluctuations between medium (43.3%), high (30.0%) and very high (16.7%).

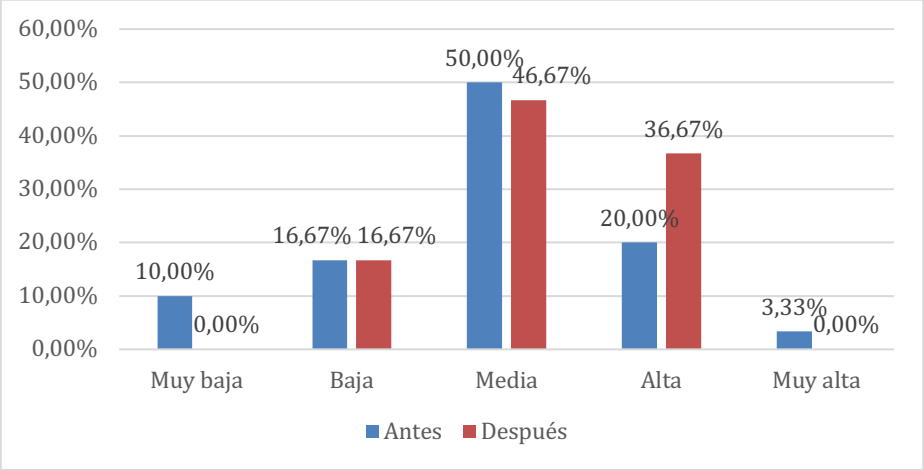
- The psychological factors were distributed between medium (40.0%), high (33.3%) and very high (10%) trends.
- Other factors revealed a behavior with fluctuations between a medium (56.7%) and high (10%) trend.

On the other hand, with respect to the predominance in purchases of staple goods, ultra-processed, frozen, healthy, basic carbohydrates and non-perishable foods, the following trends were found:

A. The purchasing trend for basic necessities before the pandemic fluctuated between medium (50%), high (20%) and very high (3.3%); while post-pandemic the trend ranged from medium (46.67%) to high (36.67%) (see Figure 2).

Figure 2

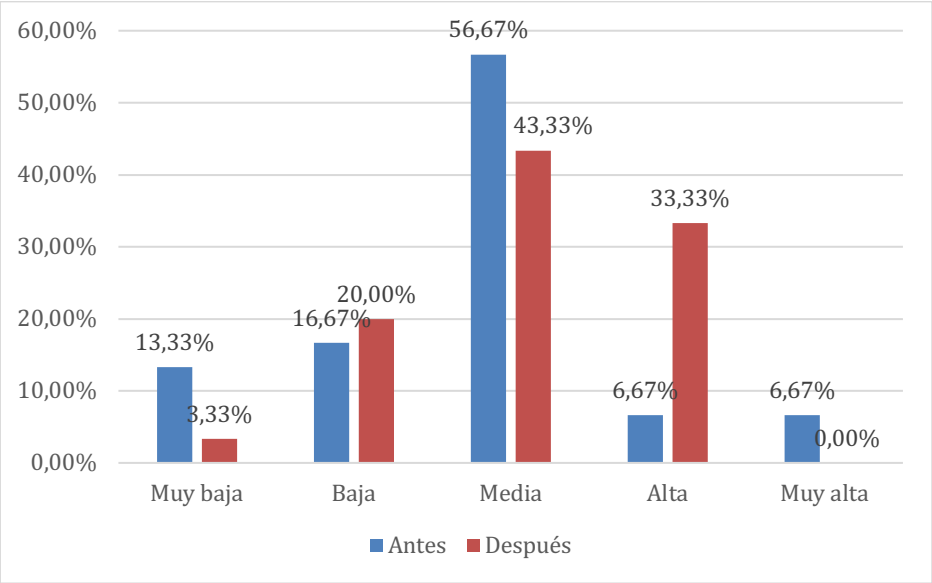
Predominance in the purchase of basic necessities (food and hygiene) - Before and after the pandemic



B. Ultra-processed foods, before the pandemic, showed a trend between medium (56.67%), high and very high (6.67%) respectively. Subsequently, the average trend decreased to 43.33%, while the high trend increased to 33.33% (see Figure 3).

Figure 3

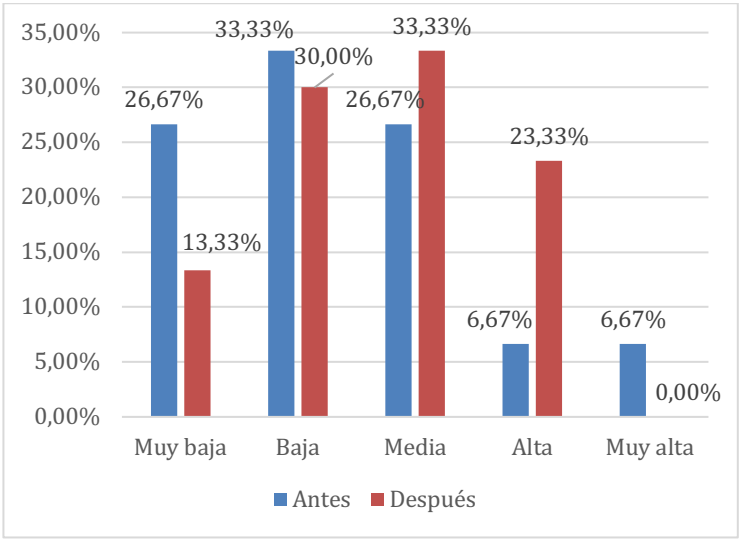
Predominance in the purchase of ultra-processed foods (bread, cookies, cakes, soft drinks, cold cuts and sausages) - Before and after the pandemic



C. Frozen foods, before the pandemic, presented a purchase trend with variations between medium (26.67%), high and very high (6.67%) individually; while, after the pandemic the medium and high trends increased to 33.33% and 23.33% respectively (see Figure 4).

Figure 4

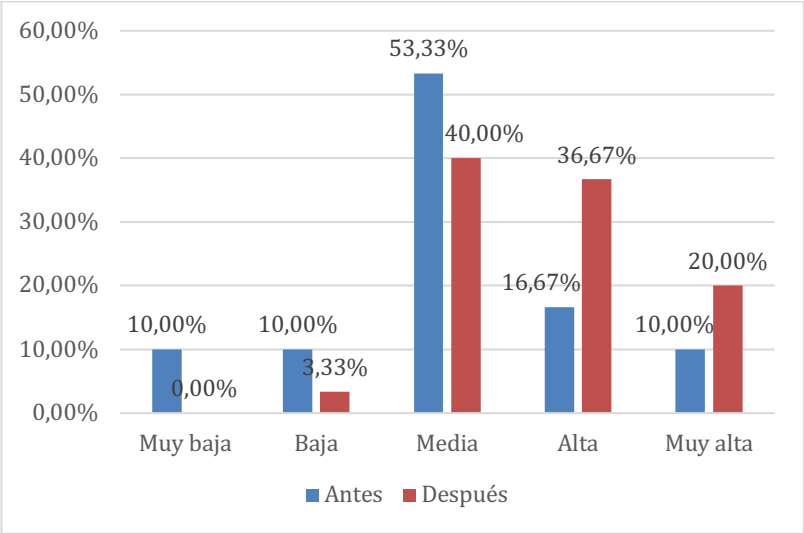
Prevalence of Frozen Food Purchases - Before and After the Pandemic



D. Healthy foods, before the pandemic, experienced a trend with fluctuations between medium (53.33%), high (16.67%) and very high (10%). Subsequently, after the pandemic, the average trend decreased to 40.0%, while the high and very high trends increased to 36.67% and 20.0%, respectively (see Figure 5).

Figure 5

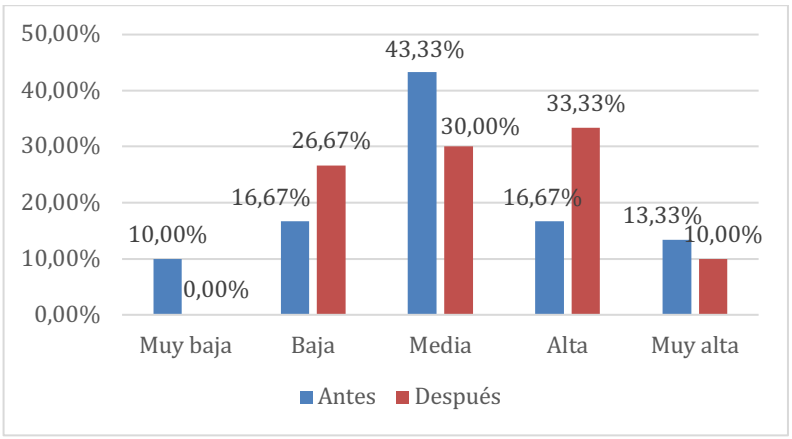
Prevalence of Healthy Food Purchasing - Before and After the Pandemic



E. Basic carbohydrates and non-perishable foods reflected a pre-pandemic trend of medium (43.33%), high (1.67%) and very high (13.33%) purchasing trends; whereas, post-pandemic, the medium trend decreased to 30%, the high trend increased to 33.33% and the very high trend decreased to 10.0% (see Figure 6).

Figure 6

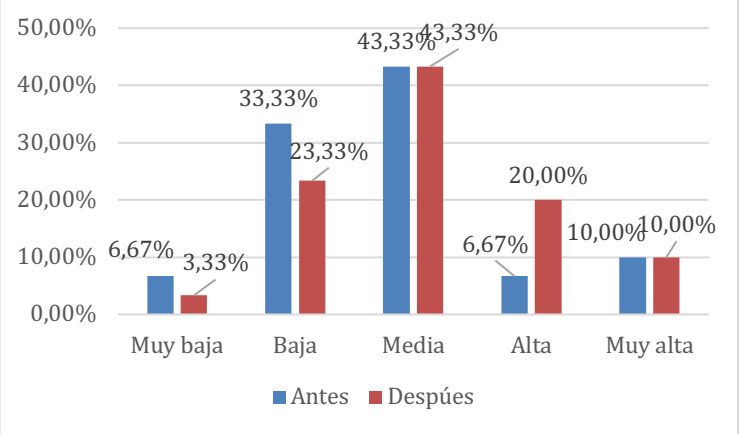
Predominance in the purchase of staple carbohydrates and non-perishable foods - Before and after the pandemic



On the other hand, with respect to the levels of compulsiveness and rationality in purchases by consumers, it was found that:

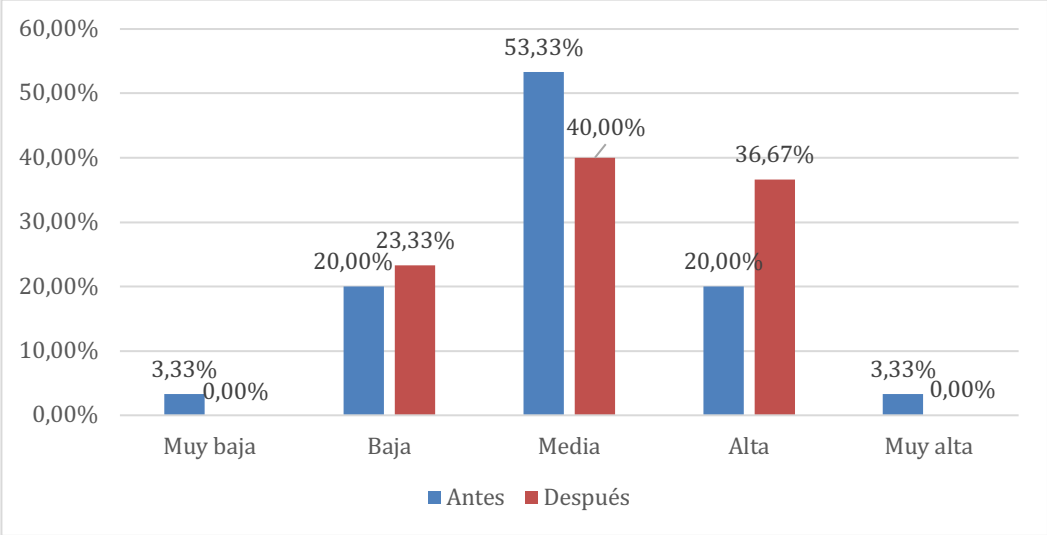
A. Before the pandemic, the level of consumer compulsiveness in purchases showed a trend that fluctuated between medium (43.3%), high (6.67%) and very high (10.0%). Likewise, after the pandemic there were no changes in the medium and very high trends, but the high trend increased to 20.0% (see Figure 7).

Figure 7
Level of compulsivity in food purchases - before and after the pandemic



B. The level of consumer rationality in purchases presented before the pandemic a trend that fluctuated between medium (53.33%), high (20.0%) and very high (3.33%); while after the pandemic the medium trend decreased to 40.0% and the high trend increased to 36.67% (see Figure 8).

Figure 8
Level of rationality in food purchases - Before and after the pandemic

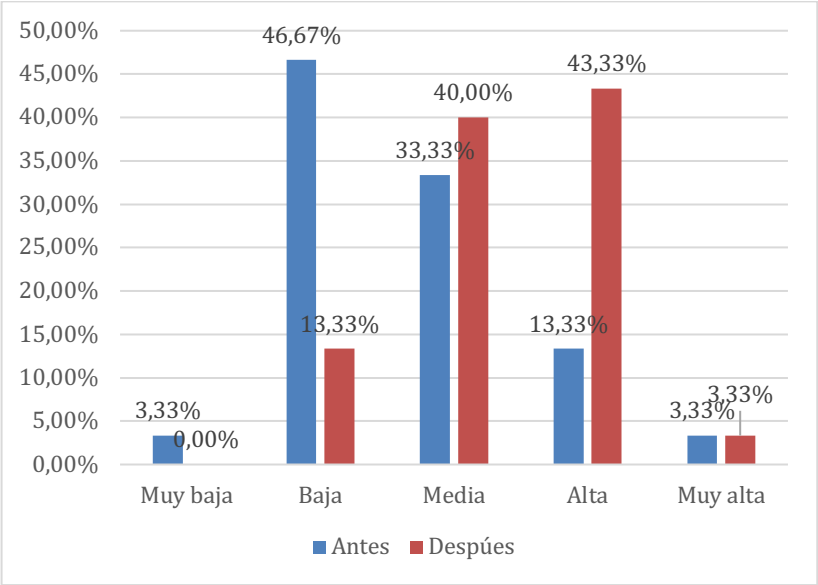


On the other hand, the following results were found regarding food storage, frequency of online shopping and use of the home for grocery delivery:

A. The stockpiling of food to meet their present and future needs as consumers, before the pandemic, presented a trend with important variations between low (46.67%), medium (33.33%) and high (13.33%). After the pandemic, these trends underwent significant changes, with the mean increasing to 40.0% and the high to 43.33% (see Figure 9).

Figure 9

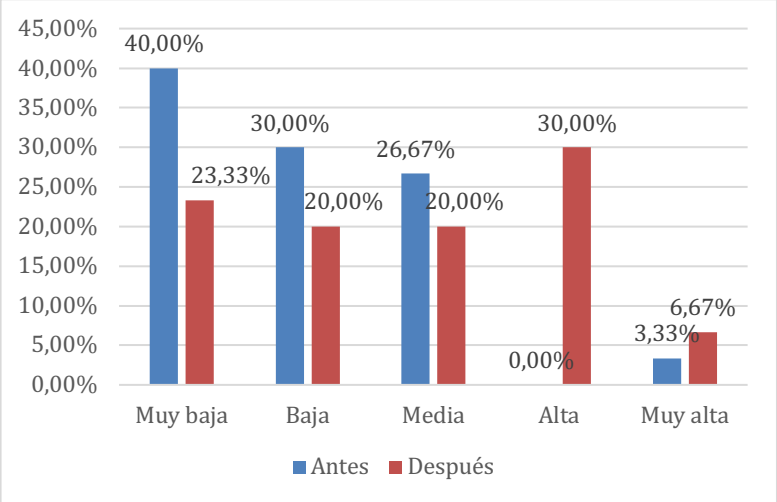
Tendency to stockpile food to meet present and future needs - Before and after the pandemic



B. The frequency of online food purchases showed before the pandemic, a trend with fluctuations between very low (40.0%), low (30.0%) and medium (26.67%); while post-pandemic the very low trend decreased to 23.33%, low and medium decreased to 20.0%, while high increased to 30% (see Figure 10).

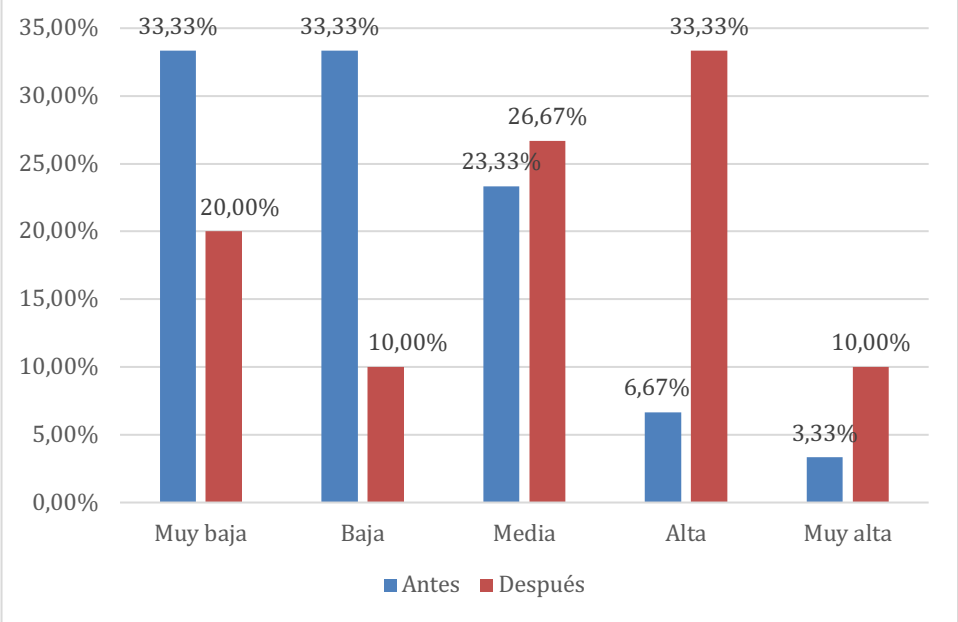
Figure 10

Frequency of online food shopping - Before and after the pandemic



C. The frequency of home use for food delivery was characterized by very low and low trends of 33.33% and 23.33%, respectively, while the average trend was 23.33%. After the pandemic, there was a decrease in the very low (20.0%) and low (10.0%) trends, as well as an increase in the medium (26.67%) and high (33.33%) trends (see Figure 10).

Figure 11
Frequency of home use for food delivery - before and after the pandemic



Discussion and Conclusions

According to the results obtained, as a consequence of the appearance of the COVID-19 pandemic, social economic factors had an average level of incidence of 70% in consumer behavior. This finding coincides with economic theory, since, as Henao (2010) states, the demand for goods and services is directly related to the social economic dimension, which includes variables associated with the price of the good, the prices of other substitute and complementary goods, economic policy, income, unemployment, inflation, discounts and promotions, among other aspects. The factors described above, together with confinement and quarantine, were decisive in the selection of the goods consumed.

With respect to the sanitary factor expressed in the use of masks, antibacterial gel and disinfection of the products purchased (in person or at home), the behavior ranged from a medium (43.3%) to a high (30.0%) level of incidence, since consumers had not experienced situations that regulated their mandatory use.

In this sense, the findings revealed that the sanitary factor is a new variable that induced important changes in consumer behavior, given that, as expressed by Espinoza, Motta and Acevedo (2021), as well as Rodríguez and Gamboa (2021), the pandemic generated uncertainty in consumers who made nervous purchases of some personal hygiene products, especially antibacterial gel, alcohol, liquid soap and masks. The demand for all of them increased, as they were recommended worldwide as a preventive and protective measure against the virus. As a result, new consumer habits emerged, as the demand for personal care products from a health perspective began to play a more important role in consumers' purchasing choices.

On the other hand, the psychological factors related to emotional intelligence as a consumer; self-management in mood (stress, depression, boredom); and, emotions, had an average trend of 40.0%, which coincides with the approaches of Henao (2010) in highlighting the incidence of factors associated with thinking, motivation and, consumer attitudes in their choices to purchase goods and services.

Finally, other factors expressed in eating habits, tastes, advertising, online shopping, culture, customs, beliefs and context, showed an average incidence level of 56.7%. Of these factors, it is worth highlighting the importance acquired by online shopping, which has positioned itself as a new factor that has induced important changes in consumer behavior, since consumers consider it as a "comfortable" and "trustworthy" activity that facilitates the purchase of goods (Rodríguez & Gamboa, 2021).

This argument corresponds to the results of a study by the World Trade Organization (2020), which show that, as a consequence of the pandemic, there was a worldwide increase in electronic commerce of goods both between companies and consumers, as well as between companies themselves. Therefore, it can be stated that the effect of the changes in the context was evidenced in the increase of online shopping, which became a new factor that began to form part of the consumer's culture and habits to the extent that it facilitates the choice and purchase of goods that will be used to meet their needs.

In another order of ideas, making comparisons with respect to the two moments, i.e., consumer behavior before and after the COVID 19 pandemic, it was found that the trend of purchase of:

- Consumer staples (food and hygiene) before the pandemic peaked at 73.33%. However, after the pandemic, these items became more important to consumers, since their purchase predominance was 83.34%, which shows that consumers are more concerned about keeping basic necessities at home and better distribute their income level.
- Ultra-processed foods (bread, cookies, cakes, soft drinks, cold cuts and sausages); before the pandemic it was approximately 86.67%; after the pandemic, it increased to 96.66%.
- Frozen food, before the pandemic reached 40.01%; while after the pandemic it increased to 56.66%. This may have occurred because consumers, given the confinement and purchasing restrictions, substituted some fresh foods for frozen foods in order to ensure a balanced diet high in protein and fruit.
- Healthy food stood at 80% before the pandemic; after the pandemic it increased to 96.67%. This can be explained by the fact that consumers are now more concerned about the consumption of foods low in sugars and carbohydrates.
- Basic carbohydrates and non-perishable foods, before and after the pandemic, stood at 73.33%.

With respect to the tendency to purchase basic necessities, the findings are in line with Sheth (cited by Casco, 2020), since in periods of crisis, consumers generally tend to prioritize purchases of basic necessities and postpone the consumption of non-essential goods.

On the other hand, the trend recorded for ultra-processed and frozen goods after the pandemic coincides with the findings of Acevedo and Osorio (2022), given that due to their non-perishable nature (long shelf life) their acquisition allowed consumers to have them available to meet their consumption needs, in a crisis situation characterized by shortages, hoarding, price increases, purchase restrictions and confinement.

Likewise, the increase in the consumption of healthy foods also coincides with the arguments of Acevedo and Osorio (2022), as consumers are now more careful about their health. They have begun to learn about the importance of a healthy diet and its contribution to strengthening the immune system, a fundamental aspect to avoid Covid-19 infection.

Finally, other factors that also reflect a change in consumer behavior at the time of making the purchase choice before and after the pandemic are summarized as follows:

- The level of compulsiveness in food purchases increased from 60% to 73.33%, due to consumers' need to stock up in times of pandemic and ensure their food security. Likewise, the level of rationality in food purchases practically remained between 76.66% and 76.67%, which reflects the priority that consumers give to satisfying their food needs. In addition, as a result of compulsive purchases, the tendency to stockpile food increased from 49.99% to 86.66%, which provided consumers with a level of security to meet present and future needs.
    - This finding corresponds to that found by Orellana & Orellana (2021), whose results show that, as a consequence of the pandemic, consumers adopted a compulsive behavior associated with a panic buying choice, characterized by an increase in the quantities and types of food. All of this stemmed from the stress, panic and uncertainty experienced during the pandemic. According to these authors, the level of compulsiveness was the result of various factors and processes of a rational, irrational, motivational, cognitive and emotional nature, which, together with the effects of the generalized economic and health crisis, created an atmosphere of uncertainty that characterized the pandemic at the global level.
- The frequency of online food purchases increased significantly, from 30% to 56.67%, as the measures of confinement and restrictions led to the positioning of online purchases; an aspect that was finally incorporated into the consumer's culture. This coincides with the findings of Acevedo and Osorio (2022), whose findings reveal the increase in online shopping in Colombia during the pandemic through the use of various digital channels and social networks.
- The trend in the use of the home for food delivery showed a significant increase from 33.33% to 70%. This finding is related to the findings of Casco (2020), given that businesses have rethought their marketing strategies to deliver their products to the consumer's home through the delivery service, which has made it possible to satisfy the need to purchase some fresh, ultra-processed and healthy foods.

Finally, by way of conclusion, it should be noted that the main effects of COVID-19 on the behavior of food consumers in Santa Cruz de la Sierra can be explained by the following changes in their behavior: (a) emergence of the health factor as a new variable that influences the choice of purchase; (b) increased demand for staple goods and, especially for ultra-processed and healthy foods; (c) positioning of online shopping as a mechanism that through digital channels and social networks facilitates the purchase of food goods; and, (d) incorporation of Delivery as a new service for the delivery of products to the consumer's home.

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ARTICULATION OF THEORY AND PRACTICE ON URBAN RESILIENCE AND ADEQUATE SOCIAL HOUSING. POPAYAN-COLOMBIA

ARTICULACIÓN DE TEORÍA Y PRÁCTICA SOBRE RESILIENCIA URBANA Y VIVIENDA SOCIAL ADECUADA. POPAYÁN-COLOMBIA

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ABSTRACT

As a result of the investigative process carried out in Popayán, it is concluded that Urban Resilience, it is the capacity and ability of an urban system to maintain its functionality in the face of impacts or catastrophes of natural or anthropic origin, being a continuous and dynamic process implemented in the public, private and community sectors, whose objective is to anticipate events that modify social, economic factors , physical, environmental and cultural of a city, with a look that promotes the return to normality and the improvement of the existing conditions before the occurrence of the event. On the other hand, considering Adequate Social Housing, as a basic need of every human being, construction immersed in an urban environment affected by various territorial, structural, social or organizational vulnerabilities, an articulation is proposed between the theory on Urban Resilience and Adequate Housing promoted by the United Nations Organization, its inclusion and applicability in processes of design, improvement and approval of these projects in the city of Popayán - Colombia. The resulting analyzes show a low inclusion of Urban Resilience in the regulations on social housing at the national and local level, reflected in the importance given to financing and provisions to make it affordable to the population, with medium inclusion at the academic level and low at the professional level. Also indicating the need to generate and implement territorial strategies of a political-administrative nature, in the long term, that involve these concepts in the development of Social Interest Housing at the urban level.

Palabras clave:

RESUMEN

Como resultado del proceso investigativo realizado en Popayán, el concepto de Resiliencia Urbana define como la capacidad y habilidad de

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vivienda adecuada, resiliencia urbana, teoría y práctica, arquitectura	un sistema urbano de mantener su funcionalidad ante impactos o catástrofes de origen natural o antrópico, siendo un proceso continuo y dinámico implementado en el sector público, privado y comunitario, cuyo objetivo es anticipar eventos que modifiquen factores sociales, económicos, físicos, ambientales y culturales de una ciudad, con una mirada que propicie el retorno a la normalidad y el mejoramiento de las condiciones existentes antes de la ocurrencia del evento. Por otra parte considerando la Vivienda Social Adecuada, como una necesidad básica de todo ser humano, construcción inmersa en un entorno urbano afectado por diversas vulnerabilidades de carácter territorial, estructural, social u organizacional, se propone una articulación entre la teoría sobre Resiliencia Urbana y la Vivienda Adecuada que promueve la Organización de las Naciones Unidas, su inclusión y aplicabilidad en procesos de diseño, mejoramiento y aprobación de estos proyectos en la ciudad de Popayán-Colombia. Los análisis resultantes demuestran una baja inclusión de la Resiliencia Urbana en la normatividad sobre vivienda social a nivel nacional y local, reflejada en la importancia dada a la financiación y disposiciones para que sea asequible a la población, con mediana inclusión a nivel académico y baja a nivel profesional. Indicando además la necesidad de generación e implementación de estrategias territoriales de carácter político administrativo, a largo plazo, que involucren estos conceptos en el desarrollo de la Vivienda de Interés Social a nivel urbano.

Introduction

Currently, one of the main challenges in the development of sustainable cities at international, national and local levels is the interdisciplinary development of political, economic, environmental, social and cultural aspects (Gómez, et al., 2020). Consequently, city decision-makers must integrate elements of the Sustainable Development Goals (SDGs) such as environmental regeneration, responsible consumption, environmental assessments, environmental education, among others, in order to achieve optimal development in the quality of life of their inhabitants.

The concept of sustainable city has been reinforced with the publication of the 2030 Agenda and the Sustainable Development Goals mainly Goal 11 on making cities and human settlements inclusive, safe, resilient and sustainable (United Nations, 2018). Specifically, with respect to Urban Resilience, the HABITAT III Cities Program (2015), contributes to the objectives of the New Urban Agenda to improve understanding of the causes of urban resilience, enable a city system to withstand and recover quickly from multiple and varied shocks and stresses and improve its performance over time. Due to the above, the interaction between the needs of citizens and natural or anthropic phenomena that could generate an imbalance in their daily activities is an issue that needs to be updated, mainly in the area of Adequate Social Housing. In order to present a diagnosis of the current situation of Urban Resilience in a case study and subsequently propose strategies that integrate factors that benefit the quality of human life, this research focuses on the city of Popayán, located in southern Colombia.

The architectural, urban, environmental, social, economic, political and cultural characteristics that currently govern the city of Popayán indicate the existing vulnerability to natural hazards such as earthquakes (Earthquake of March 31, 1983, which destroyed 40% of the historic sector of the city and caused more than 200 deaths), landslides and floods (Rio Molino - December 2013), and anthropogenic hazards (demonstrations, forest fires, citizen insecurity, vehicle accidents, etc.), added to the repercussions generated by the Covid-19 pandemic in 2020. The above justifies the origin of this study, focused on a proposal on the articulation of Urban Resilience and the development of Social Housing, added among other aspects by what is expressed in the Development Plan I believe in Popayán 2020 - 2023, where it is expressed that: "The housing deficit in the municipality of Popayán has contributed to increase the gap of injustice and inequity in our territory at the urban and rural level, that is why it is necessary an articulated and specialized response by public and private institutions, which allows to adequately invest the available capital, and manage new resources to attend in a prioritized way to the most vulnerable population groups reducing the housing deficit in Popayán that corresponds to the number of housing units that are needed to supply the number of existing households"(p. 96).

For this reason, the research focused on this problem, defining that Social Interest Housing (VIS) represents a fundamental role in the eradication of urban poverty, since it constitutes a right contained in the Universal Declaration of Human Rights, where the United Nations Organization - UNO, states that housing must be "decent and adequate": that is, it must allow the individual to achieve an acceptable standard of living. Starting from the SDGs (goal 11) and highlighting the work agendas and development plans of every city and every country, as expressed in the United Nations New Urban Agenda (2018): Promote housing policies at the national, subnational and local levels that support the progressive realization of the right to adequate housing for all as an integral element of the right to an adequate standard of living, that combat all forms of discrimination and

violence and prevent arbitrary forced evictions, and that focus on the needs of the homeless, people in vulnerable situations, low-income groups and persons with disabilities, while enabling the participation and collaboration of communities and relevant stakeholders in the planning and implementation of such policies, including by supporting the social production of habitat, in accordance with national legislation and standards (p. 14).

On the other hand, this paper relates housing to Resilience in cities by looking for: "Strengthen the resilience of cities and human settlements, in particular through quality spatial planning and infrastructure development." This theme is complemented and strengthened in this same document, when it states that it seeks to promote "the development of resilient and resource-efficient infrastructure and we will reduce the risks and effects of disasters, including through the rehabilitation and upgrading of slums and informal settlements", as well as "We will also promote, in coordination with local authorities and stakeholders, measures for the strengthening and adaptation of all housing at risk, particularly in slums and informal settlements, in order to make them resilient to disasters".

In accordance with the above and considering regulations and referents at the international level, such as that established by the United Nations ECLAC (2016) in Agenda 2030, Goal 11 about inclusive, safe, resilient and sustainable cities; the approach to planning and implementation of resilient cities, according to the United Nations Office for Disaster Risk Reduction (2017) and Habitat for Humanity - 5th Housing and Habitat Forum: Challenges in housing and settlements in the face of climate change and social crisis (2023), the research developed and named: Articulation of theory and practice on Urban Resilience and Disaster Risk Management, based on cause-effect analysis. The study of urban social housing in Popayán-Colombia, shows the relationship between the high disarticulation between the theory of disaster risk management and the public policy of social housing applied in Popayán. The above, aimed at legislative and political personnel, professionals, teachers and students of Architecture and Civil Engineering as the main actors involved in the design and approval processes of social housing projects. It is important to mention that, in order to achieve an integration between the normative, structural and social aspects of resilient cities, it is necessary to generate an interdisciplinary work, therefore, this work was carried out under the perspective of teachers and students of architecture and civil engineering, leaving to the future the integration of other disciplines to propose strategic plans to achieve timely urban resilience.

In the first instance, on the concept of resilience, whose Latin origin *Resilio* means to go back, there are multiple studies, initially focused on the psychosocial area, developed by Luthar (1993), Michael Rutter (1991) and Edith Grotberg (1995) in a first generation. Later Luthar and Cushing (1999), Mastern (1999), Kaplan (1999) and Bernard (1999) in a second generation, understand resilience as "A dynamic process where the influences of the environment and the individual interact in a reciprocal relationship that allows the person to adapt despite adversity" (p.34). A concept that, by expanding into other fields of knowledge, such as economics, anthropology, urban planning and the environment, has now become a very common term in public policies related to the effects of climate change, urban planning and Disaster Risk Management.

As stated by Silva (2010), international cooperation agencies currently consider it as an axis of strategies or policies aimed at mitigating the negative effects of climate change, environmental sustainability and poverty; therefore, resilience becomes the essential human explanatory component of environmental sustainability in the management and habitation of the territory.

According to Melillo (cited in Gauto, 2007, p.243) "the appearance or not of resilience in subjects depends on the interaction of the person and his/her human environment", similar to the definition of Resilience established by Community & Regional Resilience Institute (2013) when recommending that "Resilience should be defined in a way that allows making useful predictions about the capacity of a community to recover from adversity. This will allow communities to assess their resilience and take steps to improve it if necessary."

Concepts applicable to the research conducted in Popayán, where the housing deficit and the precarious conditions of the population are evident, generating high levels of insecurity and poverty at the urban level, in the face of risks due to natural hazards (earthquakes, floods and landslides) and anthropogenic hazards such as crime, with the need to strengthen resilience, defined for this study as the capacity and ability of a community to anticipate events that may generate material and human losses, as well as its adaptation to the adversities that may arise in its environment.

Now, when analyzing the concept of *Urban Resilience* fundamental element of the present research, Ultramari & Denis as cited in Mallqui (2013), define it as:

> The capacity of urban systems - or better yet their managers - to anticipate events that will affect urban dynamics; and how the implications of certain economic, social or cultural factors of such dynamics will transfer to the city elements that will allow it to respond to the adversities that may arise in the process of urban management (p.2).

And according to HABITAT III (2016) United Nations Conference on Housing and Sustainable Urban Development: "Resilience is a quality of sustainable urban development and at the level of a city it recognizes the urban area as a complex and dynamic system that must continuously adapt to various challenges in an integrated and holistic manner" (p.1).

When analyzing the articulation of urban resilience with VIS, it is important to quote Leal del Castillo (2004):

> The notion of housing goes far beyond the physical dimension and is projected onto multilateral aspects of the development of the people who live there. It is at this moment, when the difference becomes explicit, it is there when extrapolating, no longer the material dimensions, but those that arise as a result of the process of inhabiting, the complex universe of dynamics that reflect the system of spatio-temporal relations becomes evident, which within the framework of habitat are no longer limited to the physical-spatial dimension, but also transcend to the socio-anthropological and the environmental-natural (p.38).

In the sense of the socio-anthropological and natural environmental dimensions referred to by Leal del Castillo, Popayán, despite having been a city of relevance in the history of Colombia, since the process of emancipation in the Colonial period, then in the Republican period, being rebuilt by the effects caused by several earthquakes, the last of which, occurred on March 31, 1983 generated until now a complex social situation as expressed by Vargas (2011):

> "Faced with the impossibility of fully complying with the urban and housing solutions proposed in the aforementioned reconstruction and development plan and of physically controlling the entire reconstruction process, illegal groupings on the outskirts of Popayán overflowed the city limits constituting large marginal sectors that, over time, have developed in some areas considered high risk and vulnerability, increasing the risk at the urban level that already existed before the last earthquake."

This situation is reflected in the Comprehensive Diagnosis of the Land Use Plan-POT of Popayán (2015), due to the phenomenon of both population growth and subnormal settlements, causing a serious problem by not considering the condition of poverty and situation of marginalization in vulnerable communities.

In conclusion, from the research conducted, in the urban area of Popayán, it is required to strengthen Urban Resilience, considered as expressed by Leal de Castillo, not only from the physical dimension, but also from the habitat process, from the socio-anthropological and natural environment, taking into account that every VIS project should be multidisciplinary with contributions from architects, civil engineers, ecologists, lawyers, economists, among others, so that there is an integral relationship of resilience with its habitat from a human vision and the satisfaction of the needs of the community for which the housing is projected.

Background on the generation of Urban Resilience in Social Housing

By examining references such as: Barcelona walking towards Urban Resilience in the Vallcarca Neighborhood by Rafael De Balanzo Joue (2014); The Inclusive, Resilient and Sustainable Cities of the Latin American Urban Agenda by Gustavo Pandiella (2016); The study of resilience in natural disasters in six neighborhoods of the city of La Paz, Bolivia by Luis A. Salamanca (2009); Resilient Medellin - A strategy for the future by the Rockefeller Foundation, Mayor's Office of Medellin (2017) and the Guide to Urban Resilience Government of the Republic of Mexico (2016), the following were defined as the basis for solutions, taking into account the actors referred to in the research hypothesis : professionals, teachers and students of Architecture and Civil Engineering, involved in the processes of design, approval and construction of VIS projects, under the experience in academic, institutional spaces and professional practice:

a) Urban Resilience in Latin America. A brief guide for local authorities, which concretely studies housing conditions in the face of resilience by Fundación Idea (2017) a pioneering public policy think tank in Mexico and Colombia, where it defines that resilience "is not just a policy or a program: it is the integration of a set of capacities and resources". Further ensuring that, as of the date of that publication in 2017, a key urban system such as housing is excluded from the resilience discussion.

This guide sets out some challenges for integrating the conceptual framework of resilience into urban planning, as follows: Challenge A: Resilience must be local, with key components such as social housing, generally overshadowed by policies focused on climate change. Challenge B: Resilience recognizes risks. Challenge C: Resilience requires participation because there is a lack of accountability and effective mechanisms for citizen participation. Challenge D: Resilience meets resistance. Challenge E: Resilience is not obtained immediately: its interventions are long-term. Challenge F: Resilience is complex: the lack of capacity of local institutions continues to be a major obstacle, hence the need to find points of interception and generate continuous learning.

It is important, therefore, to understand that *Urban Resilience* is not just a policy or a program. Consequently, the articulation between the political and social actors that in one way or another are part of the process and in the case of the research conducted in Popayán, the professionals involved in the design, approval and construction of the VIS, so that its projection and materialization also meet the requirements for it to be considered as Adequate Housing. However, a guideline is required, a starting point (policy, strategy, plan and/or program) that guides the development of the project to be executed and provides the opportunity to manage economic resources for its implementation.

b) Habitat III themes. 15 - Urban Resilience. Secondly, the objective of this publication is to contribute to building resilience by including three pillars of the New Urban Agenda, namely: Urban Planning; Urban Legislation and Municipal Financing, through key drivers for action described as follows (p.7):

- Leveraging the city's planning instruments to reduce existing risk and prevent the creation of new risks while reducing exposure to hazard from uncontrollable but predictable conditions of climate irregularities and disaster risk, in particular by strengthening technical and scientific capacity to capitalize and consolidate existing knowledge; building the knowledge of government officials at all levels, civil society, communities and volunteers, as well as the private sector, through sharing experiences, lessons learned, good practices, and training and education.
- Develop or enhance existing policies (including national policies at the city level) that promote compact, socially inclusive, more integrated and connected cities that foster sustainable urban development.
- Develop mechanisms / tools to promote coherence between systems, sectors and organizations related to their policies, plans, programs, processes and investments in urban resilience.

Under these drivers, the research conducted in Popayán includes the concepts of *Urban Resilience* and *Adequate Housing* applied to urban planning and legislation, from the experience of professionals, teachers and students of Architecture and Civil Engineering, involved in the design and approval processes of VIS projects:

a) Principles for climate change resilient social housing design. Rolando Arturo Cubillos González, defines *resilient social housing* as a housing model characterized by minimizing future risks from natural events and that is simpler and faster to rebuild or repair in its physical dimension and describes four design principles of Resilient Social Housing: Housing must be flexible, energy efficient, livable and affordable, emphasizing that incorporating the concept of resilience in social housing will surely require a transdisciplinary sustainability science. In addition to the incorporation of integrative design processes focused on urban systems and participation in the formulation of resilience-oriented housing policies (p.20).

Therefore, it is essential to articulate all these aspects (social, political, public and ecological) with the regulations applicable to theVIS, in environments susceptible to the generation of physical, social, environmental and economic vulnerability, such as the urban area of Popayán, which presents natural and socio-cultural hazards, defined among others by the Comprehensive Diagnosis of the Ordinance Plan (2015) and the Popayán Development Plan (2020-2023), documents where the prospective or anticipated vision of disaster risk is not incorporated.

Hence, from the research developed, it is necessary to incorporate the policy implementation process of Van Meter, D.S., and Van Horn, C. (1993), by establishing a policy implementation system that includes feedback from the system environment, made up of: demands and resources, the transformation process, the policy and the results:

"Four additional factors are included in our model: communication between organizations and induction activities, the characteristics of the agencies responsible for implementation, the influence of the economic, social, and political environment on the jurisdiction or organization where implementation takes place, and the disposition of those in charge of implementation" (p. 122).

The above with the objective that the implementation of policies that incorporate the theory on Urban Resilience and Adequate Housing generate "Compliance", another concept discussed by Van Meter and Van Horn (1993), related to obedience or disobedience to a law or directive and includes manipulation, rewards and symbolic deprivations with remunerative power.

Aspects applicable in the case of the VIS in Popayán and the research conducted, which concludes that the VIS should focus on the real needs of a family, of a community, where the quality of life prevails, not the quantity of housing solutions, with flexible, habitable, safe spaces, with public and complementary services that contribute to the generation of *Urban Resilience* through production chains, productive capacity and quality of community life, where the implementation of policies generates the "Compliance" referred to by Van Meter and Van Horn (year), so that, for example, the urban planning and construction licenses required for their development are processed legally and in a timely manner by the owners.

Method

The development of the research focuses on a mixed design, by exposing in a qualitative way the analysis of an exhaustive bibliographic review about the concepts and implications of urban resilience and social housing; in a quantitative way, surveys were applied to analyze the variables that, from the point of view of the actors in the design and construction of this type of housing, have regarding the introduction and execution of the key concepts of this research. In addition, the analysis focused on the study of a reality of academic, professional and institutional character without intervening, describing the correlations of the content analysis AC[b], in six steps defined for this purpose: (a) Selection of sampling units (Normativity VIS in Colombia); (b) Selection of analysis categories (Urban Resilience and Adequate Housing vs. VIS); (c) Selection of register units (Normativity articles, directly related to the development of VIS at the urban level); (d) Determination of analysis units (Theoretical concepts of Urban Resilience and Adequate Social Housing); e) Determination of the variables (Properties of Urban Resilience and Adequate Social Housing) and f) Selection of the modalities for measurement and evaluation (Quantitative or extensive modality, according to Álvarez, I (2021) applied, when the amount of material is large and an overall view is desired in order to make comparisons (statistical data, frequencies and their relationships).

The content analysis included 16 laws and decrees at the national level such as Law 1523 of 2012 (National Disaster Risk Management Policy) and Decree 1077 of 2015 (Single Regulatory Decree of the Housing, City and Territory Sector), in addition to the development plans at the national, departmental and municipal levels, as well as in-depth or qualitative, unstructured interviews and surveys to architects and civil engineers of the existing guilds in Popayán; teachers and students of architecture and civil engineering of academic programs in the city; public officials of entities responsible for the process (Municipal Mayor's Office - Savings and Housing Corporations, Urban Curator's Offices).

For the CA, on the VIS, and following the United Nations (2010) principles on Adequate Housing, 9 Dependent Variables (DV) were applied as follows: (1) Security of tenure; (2) Availability of services; (3) Materials; (4) Facilities and infrastructure; (5)

[b] According to Álvarez, I (2021) the Content Analysis (CA) method can demonstrate the behavior of different variables in an official or political discourse over a significant period by means of log percentages that indicate the degree of importance attached to them.

Affordability; (6) Habitability; (7) Accessibility; (8) Location; and (9) Cultural appropriateness.

In the same process for Urban Resilience, 4 Dependent Variables (DV) were applied: (1) Metabolic Flows, (2) Social Dynamics, (3) Governance Networks and (4) Built Environment, according to Mallqui (2012).[c]

Results

As a result of the CA, the corresponding national, departmental and local regulations applicable to the development and improvement of VIS and its articulation with Urban Resilience are presented (Figure 1). In this regard, only 2.33% of the regulations applicable to the VIS (1,628 articles) include variables related to Urban Resilience, emphasizing Social Dynamics with 15 points, followed by Governance Networks with 9 points; the Built Environment with 8 points and Metabolic Flows with 2 points.

Figure 1

Analysis of VIS regulations in relation to the 4 variables on Urban Resilience

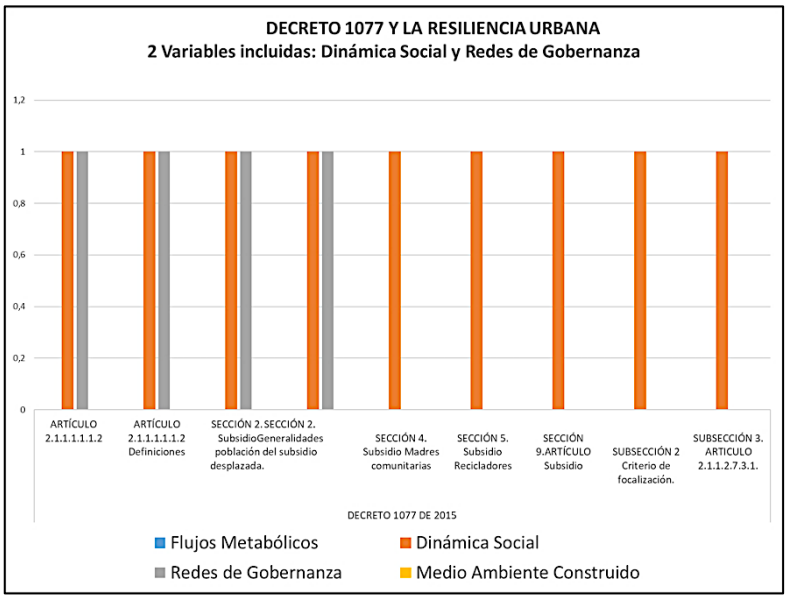
	NORMA	Flujos Metabólicos	Dinámica Social	Redes de Gobernanza	Medio Ambiente Construido	Total sobre 4 variables
1	LEY 388 de 18 de julio de 1997. Modifica Ley 9 de 1989 y Ley 3 de 1991.	0	1	1	1	3
2	Plan de Ordenamiento Territorial. Municipio de Popayán. Acuerdo 06 del 5 de agosto de 2002. Por el cual se adopta el Plan de Ordenamiento Territorial para el municipio de Popayán.	1	1	1	2	5
3	LEY 1454 del 28 de junio 2011. Normas Orgánicas sobre el Ordenamiento Territorial.	1	3	2	1	7
4	LEY 1523 del 24 de abril del 2012. Por el cual se adopta la Politica Nacional de Gestión del Riesgo de Desastres y se establece el sistema Nacional de GRD	0	1	2	1	4
5	LEY 1537 del 20 de junio del 2012. Normas tendientes a facilitar y promover el desarrollo urbano y el acceso a la vivienda	1	0	2	0	3
6	DECRETO 1807 del 2014. Reglamenta el artículo 189 del Decreto-ley 019 de 2012 en lo relativo a la incorporación de la gestión del riesgo en los planes de ordenamiento territorial	0	0	1	0	1
7	DECRETO 1077 del 2015. Decreto único regalmentario del sector Vivienda, Ciudad y Territorio.	0	9	4	0	13
8	LEY 1848 DEL 18 de julio del 2017. Formalización, titulación y reconocimiento de las edificaciones de los asentamientos humanos de predios urbanos.	0	0	0	1	1
9	PLAN NACIONAL DE DESARROLLO.Colombia potencia mundial de la vida. 2022-2026	2	4	6	3	15
10	DECRETO 1533 DE Agosto 2019. "Por el cual se modifican algunas disposiciones del Decreto 1077 de 2015 en relación con la asignación del Subsidio Familiar de Vivienda y se dictan otras disposiciones"	0	2	5	0	7
11	PLAN DE DESARROLLO DEPARTAMENTAL DEL CAUCA 2020-2023. Ordenanza 032 del 11 de junio del 2020	1	1	1	0	3
12	PLAN DE DESARROLLO " CREO EN POPAYAN" 2020-2023. Acuerdo 007 del 29 de mayo del 2020	0	8	2	4	14
13	LEY 2044 del 30 de julio del 2020. Normas para saneamiento de predios ocupados por asentamientos humanos ilegales.	0	1	1	0	2
14	DECRETO 1232 del 14 de septiembre de 2020. Adiciona y modifica Decreto 1077 de 2015	1	1	2	2	6
15	LEY 2079 del 14 de enero del 2021. Disposiciones en materia de Vivienda y Hábitat	0	4	3	1	8
16	DECRETO 651 del 27 de abril del 2022, Se adiciona el Decreto 1077 de 2015	0	0	0	1	1
		2	15	9	8	34

[c] According to Malqui (2012) these variables are described as follows: Metabolic flows are the chains of production and consumption within an ecosystem whose size always exceeds the limits of a city; it is it is the productive capacity of energy, material goods and services necessary for the well-being and quality of community life; the social dynamics related to demographics, human capital, inequality, population, distribution and diversity; governance networks referring to institutional structures and social organizations; the built environment, focusing on eco-systemic services and urban landscapes.

Regarding the norm with the greatest articulation with the research, Decree 1077 of 2015, the basic document for the development of this type of housing, 8 of the 517 articles that refer to VIS (total: 1879 articles) include some indicator on the topic of Resilience. That is, 1.54%, referring to only 2 variables: Social dynamics: 9 points and Governance Networks 4 points (Figure 2).

Figure 2

Analysis of Decree 1077 in relation to Urban Resilience



It should be noted that the variable with the greatest weight is Social Dynamics, which refers to the population that can benefit from government subsidies and households affected by anthropic vulnerability. This is followed by the Governance Networks variable, which includes the territorial entities involved in the process, their activities, self-management systems or community participation; therefore, it is a policy approach to aspects related to housing affordability.

Regarding the analysis of procedures and processes required for the development and improvement of constructions destined to VIS, these results on Urban Resilience are presented, at the level of the Housing Office and the Planning Secretariat of the Mayor's Office of Popayán and the Urban Curator's Offices:[d]

- Basically, the Ministry of Housing, City and Territory only focuses on economic issues, not on environmental, health and hygiene issues. Support for housing that reflects the social term is considered limiting in terms of safety, quality of life and human integrity.
- The current projects do not respond to the productive capacity, favoring a culture of non-compliance, the ignorance of norms and laws that socially benefit and economically activate the cities and their inhabitants, and favoring unlicensed construction causing an exposure not only of their homes, but of the loss of life of its inhabitants.

[d] Private entities in charge of processing and issuing construction licenses.

- The last houses built are only designed based on profitability, not on how the family is supported (self-sustainable housing), which saves water, energy and transportation due to its location in relation to work.
- Overcrowding: No thought is given to the integrity and safety of the population (Pandemic). The resilience of human beings to situations that limit access to new opportunities for growth and development will be complex.
- There is no direct relationship of resilience and housing design and construction. The POT determines where the threats are for VIS in general. This is a cultural issue, people build what they can, even if it does not meet the standard (e.g., kitchens and rooms without ventilation).
- The VIS standard cannot be the general standard for housing. The foregoing is based on geographical characteristics, exposure to natural and/or anthropic hazards, the areas of cession, the burdens in relation to the projection of common areas, among other considerations. As a result, it is necessary to achieve a balanced integration between infrastructure development and the quality of life of cities and their inhabitants. The municipality has not managed to generate the VIS standard and, in addition, the POT is temporary, as it has not been updated for 20 years.
- Incentives are required for sustainable construction, which is not applied in Popayán, it is necessary to start demanding it and define what the incentives are. For example, defining integral improvement zones.
- The production of housing is important, but not the generation of living conditions for the population.

Concluding, in the results of the interviews applied to demonstrate the hypothesis defined in the research, it is corroborated that the current regulations focus on economic aspects, do not include the productive capacity, the profitability of housing, its habitability, its improvement, without a precise definition on Adequate Housing and its characteristics, as seen in the analysis made to Decree 1077 of 2015, where only 7 of the 517 articles that refer to the VIS (total : 1879 items), include some indicator on the topic of Adequate Housing. That is, 1.35%. with variables of Availability of services 7 points; Habitability: 5 points: Affordability with 3 points: With 1 point the variables of security of tenure; Accessibility and Location and with 0 points the Cultural Adequacy, this last aspect is very common in projects of this type where the architectural response to the cultural identity of each city is complex (Figure 3).

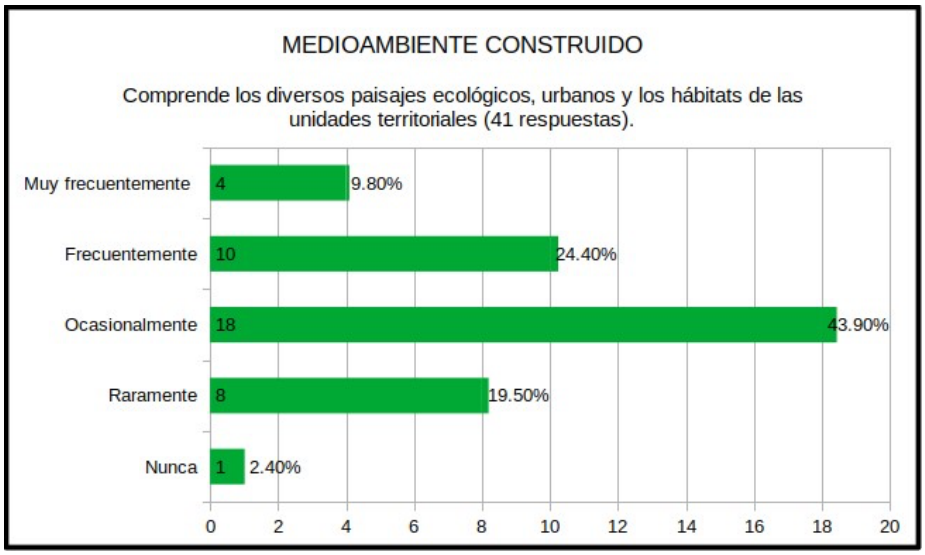
Figure 3
Social housing project in Popayán

On the other hand, at the academic level, relating the knowledge and experience of the three academic programs of Architecture in Popayán: Universidad del Cauca; Fundación Universitaria de Popayán and Institución Universitaria Colegio Mayor del Cauca, the results obtained by applying surveys to students are related as follows:

From a sample of 41 students linked to the 3 Architecture programs in the city, a predominance of the following variables is found with respect to Urban Resilience: Metabolic Flows with 36.6 % and Social Dynamics with 41.5 %; Governance Networks with 34.1 % and Built Environment with 43.9 %. Results that reflect knowledge from training in Architecture in relation to metabolic flows (as mentioned above, related to production chains, supply and consumption) and Social Dynamics related to human capital, with deficiencies in the area of governance networks or institutional structures and social organizations vis-à-vis public policies. As well as deficiencies, as shown in Figure 4, in the built environment variable referring to the ecosystem services or benefits that nature contributes to the city.

Figure 4

Results of the Architecture-Resilience (Environment) student surveys.



Aspects included in the analysis of the study plans in Architecture, of the three institutions of Higher Education involved, whose results define that of the 503 credits that correspond to the study plans of the academic programs of Architecture, 40 corresponding to 8 subjects are related to the variables of social dynamics and the built environment, but not exactly from the vision of *Urban Resilience,* but as components of urban analysis focused on architectural and urban design.

In the analysis related to the study plan of the Civil Engineering academic program, the knowledge on Disaster Risk Management predominates, another transversal aspect to the problem analyzed in the research and at the level of the students' surveys, the variables of social dynamics, metabolic flows and built environment prevail, with shortcomings as in the Architecture programs, with the variable of governance networks.

Discussion and conclusions

In view of the results obtained on the high existing disarticulation of only 2.33% between the theory on Urban Resilience and the public policy of Social Interest Housing applied in Popayán, as well as the low levels of knowledge on Urban Resilience among professionals and students of Architecture involved in the processes of design, improvement and approval of VIS projects and considering that the period in which the present research is concluded, corresponds to the process being carried out for the review and adjustment of the POT by the Secretary of Municipal Planning of Popayán, added to the end of the term of the Mayor of Popayán and therefore the termination of the term of the Mayor of the city and therefore the termination of the Development Plan analyzed in the research, the proposed solution involves the generation of a long-term territorial strategy of a political and administrative nature, which includes the articulation of Urban Resilience with the development of SIV, from the approach of the United Nations for Adequate Housing.

The project proposed as a result of the research is called: Adequate Social Housing and its articulation with Urban Resilience in Popayán. Its objective is to propose political and administrative strategies to articulate and apply Urban Resilience in VIS projects.

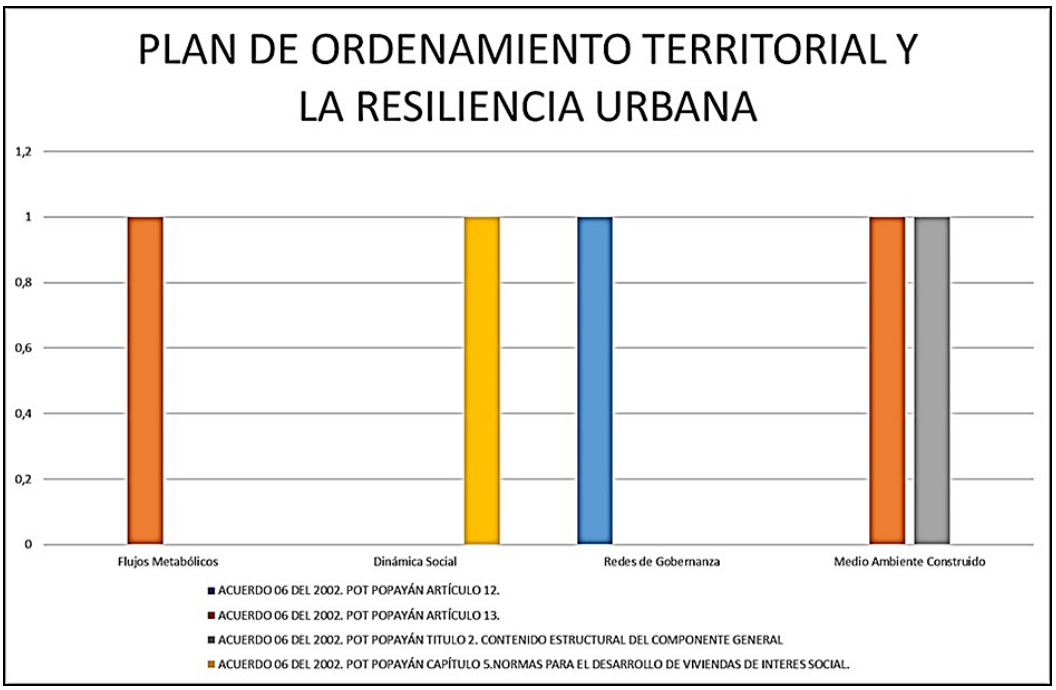
Project based on the analysis of the mission of the Secretary of Municipal Planning: "to guide the formulation, execution and evaluation of the Municipal Development Plan and coordinate the Municipal Planning System, formed by the institutional and community sectors by conducting comprehensive studies of the municipal situation in order to visualize strategic orientations towards the economic, social, environmental and institutional development of the municipality through the formulation, implementation and evaluation of plans, programs and projects with community participation and articulated to the departmental, regional and national planning".

The conclusion of the research on the inclusion of Urban Resilience in 25% of the 20 articles of the Development Plan that relate to the VIS, its inapplicability so far, without actions that demonstrate that in addition to the responsibility of all authorities, decision makers need to implement actions that help to decrease the direct impact with the daily activities of citizens or settlers.

In addition to the study of the current POT, a fundamental document for urban development, it is found that 4 of the 236 articles that are part of the regulation and are related to the research topic include some indicator on resilience, that is, 1.69%, related to the built environment with 2 points; metabolic flows, social dynamics and governance networks with one point each, as shown in Figure 5.

Figure 5

Analysis of the current Land Management Plan in relation to Urban Resilience



Consequently, the following policies related to the research approach are proposed, by analyzing regulatory, academic and professional aspects in design, improvement and approval processes of social housing projects, as follows:

1. Link the theory on Urban Resilience with public policy related to the development of the VIS, through the updating of the regulatory framework that defines the Land Management Plan for the municipality of Popayán, with emphasis on the urban area, so that its applicability is mandatory, promoting corrective and anticipatory risk management, in addition to preparedness for response to natural or anthropogenic events that may affect a community.

2. Strengthening of the Municipal Planning Secretariat, with the creation of an office or unit to support activities related to Urban Resilience, with citizen participation and covering not only Social Housing, but other factors involved in the urban process. To this end, it is necessary to develop a specific project that justifies the need for this function to be part of the processes of the Planning Secretariat, considering that it is a strategic management area, with an impact on the action plans and the project bank of the municipality of Popayán.
3. To promote alliances with Higher Education Institutions to promote knowledge and research on Urban Resilience and its articulation with the VIS.
4. Establish a collaborative work with the Architects and Civil Engineers guilds, to link Urban Resilience in the processes of design, improvement, approval procedures and construction of the VIS.

Proposal in line with the brief guide for local authorities of the Idea Foundation (2017) and the six challenges that include a local knowledge of the problem that recognizes the risks, citizen participation, the ability to face the resistance that may arise because it is a political project, also considering that the process is not immediate, but requires a medium to long term and the complexity of this by incorporating several actors.

The proposal is also based on the publication Habitat III Issues. 15 -Urban Resilience, by seeking to contribute to building Resilience, through the three pillars of the New Urban Agenda namely: Urban Planning; Urban Legislation and Municipal Financing, by taking advantage of planning instruments, such as the POT, the updating of existing public policy for the study area at the local level, specifically Chapter 5 Norms for the development of Social Interest Housing, articles 197 to 205 of Agreement 06 of 2002, which adopts the Land Management Plan for the municipality of Popayán, and the development of mechanisms and instruments that facilitate consistency between the regulations and entities such as the Urban Curators of Popayán, developing instruments that promote consistency among the actors and encourage compliance with these changes in the regulations.

Regarding the standard related to housing design and improvement, as recommended by Rolando Arturo Cubillos González (2017) by incorporating four Resilient Social Housing design principles: Flexibility, energy efficiency, habitability and affordability (p.20), according to the research carried out, it is necessary to add other aspects such as spatial and constructive quality, safety against natural and anthropic hazards, adequate public and complementary services, access to production chains, productive capacity and quality of community life.

To initiate the management of the 4 policies (linkage, strengthening, dynamism and collaborative work) we propose the internal analysis of the Municipal Planning Secretariat, the Housing Office of the Municipal Infrastructure Secretariat and the Municipal Risk Management Office, based on what is established in the Guide of the Fundamentals for Project Management PMBOK seventh edition (2021), so that it is possible to know the tools, documentation, existing databases in each unit, the tacit knowledge of officials who can support the process or the need to hire other professionals, data protection, the infrastructure available for the jobs required, equipment, communication channels, hardware and software, automated systems, employee capacity and availability of resources, by way of a general diagnosis.

As part of the external environment, similar aspects should be analyzed in the institutions of Higher Education analyzed that have academic programs in Architecture and Civil Engineering and that were part of the research, with the possibility of involving other academic programs of these institutions or others, with areas of knowledge related

to the topics, such as disaster risk management, delving into the research groups, the lines of research they manage, the research workshops, social practices, internships, agreements and other academic alternatives that can contribute to the process.

Externally, it will also be necessary to know the conditions and contributions that may be generated by associations such as the Colombian Society of Architects (SCA) Cauca regional and the Cauca Association of Engineers, in compliance with Article 5, among other aspects. - SCA's corporate purpose is to integrate architects in solidarity in order to develop professional activities to foster, develop and promote the academic and cultural social function of architecture.

The analysis conducted in this research presents as a prelude to the formulation of the proposed policies, so as to have a basis to start the process with the community, users and beneficiaries of this type of housing, bearing in mind the definition of the Idea Foundation (2017), when expressing that resilience "is not only a policy or a program: is the integration of a set of capacities and resources" , therefore, the proposal to generate a territorial strategy that contributes to the solution of the existing problematic regarding Urban Resilience and Social Housing, as a result of a research project, will require continuing with a process that implies among other aspects for its implementation, what is established by Van Meter, D.S., and Van Horn, C. (1993) as a successful implementation when commitments to the marginal situation and consensus to unattainable goals are integrated from a particular and specific perspective for each of the communities and cities that are obliged to be resilient to extreme situations, whether natural or anthropic. Finally, this research shows that political and administrative imposition of major changes and consensus on goals is very low, resulting in doubtful prospects for effective implementation. Furthermore, we can affirm that policies involving major changes and, simultaneously, a high degree of consensus will be implemented more successfully than those involving minor changes, but also under a low degree of consensus.

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FACTORS RELATED TO DIGITAL MATURITY AND TRANSFORMATION IN MANUFACTURING SMES IN NUEVO LEÓN

FACTORES RELACIONADOS CON LA MADUREZ Y TRANSFORMACIÓN DIGITAL EN LAS PYMES MANUFACTURERAS DE NUEVO LEÓN

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ABSTRACT

The objective of this research is to determine the factors related to the digital maturity of manufacturing SMEs in the state of Nuevo León, in order to contribute to the knowledge about their digital transformation. Through the literature review, five independent variables were defined: knowledge absorption capacity, level of technological infrastructure, organizational culture, innovation capacity and company environment; as a dependent variable, the degree of digital maturity was defined. The research design was quantitative, cross-sectional, with an exploratory and descriptive correlational scope. A survey was designed for data collection and validated by a panel of experts in the field. To check its reliability, a pilot test was conducted, and Cronbach's Alpha was measured. It was then applied to employees and managers of 69 manufacturing SMEs in the state. From the data, a multiple linear regression model was generated in SPSS software, which was subjected to various statistical tests to evaluate the variables and their significance. The model was approved. The results indicated that three of the variables, knowledge absorption capacity, level of technological infrastructure and company environment were significant with a p-value < 0.05. Additionally, specific analyses were recommended for the two variables that were not accepted. From the statistical analysis, an equation was obtained to measure the degree of digital maturity in manufacturing SMEs in Nuevo León that contributes to

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the progress in the digital transformation of manufacturing companies in the state.

RESUMEN

Palabras clave:
madurez digital, pymes manufactureras, transformación digital.

El objetivo de esta investigación es determinar los factores relacionados con la madurez digital de las Pymes manufactureras del estado de Nuevo León, a fin de contribuir en el conocimiento sobre su transformación digital. Mediante la revisión de literatura se definieron cinco variables independientes, capacidad de absorción del conocimiento, nivel de infraestructura tecnológica, cultura organizacional, capacidad de innovación y entorno de la empresa; como variable dependiente, se definió el grado de madurez digital. El diseño de la investigación fue cuantitativo, transversal, con alcance exploratorio y descriptivo correlacional. Se diseñó una encuesta para recopilación de datos que fue validada por un panel de expertos en el área. Para comprobar su fiabilidad, se realizó una prueba piloto y se midió el Alpha de Cronbach. Posteriormente se aplicó a empleados y directivos de 69 empresas Pymes manufactureras del estado. A partir de los datos se generó un modelo de regresión lineal múltiple en el software SPSS, el cual se sometió a diversas pruebas estadísticas para evaluar las variables y su significancia. El modelo resultó aprobado. Los resultados indicaron que tres de las variables, capacidad de absorción del conocimiento, nivel de infraestructura tecnológica y entorno de la empresa resultaron significativas con un p-value < 0.05. Adicionalmente se recomendaron análisis específicos para las dos variables que no fueron aceptadas. A partir del análisis estadístico se obtuvo una ecuación para medir el grado de madurez digital en Pymes manufactureras de Nuevo León que contribuye al avance en la transformación digital de las empresas manufactureras del estado.

Introduction

Industry 4.0 refers to the incorporation of new digital technologies into the value chain of organizations with a network of infrastructure, services, energies, factories and smart cities to generate innovative solutions for the benefit of humanity (Basco et al. 2018; Joyanes, 2020). This concept appeared in 2013 in Germany as part of the so-called Fourth Industrial Revolution.

In the organizational context, digital transformation is defined as an evolutionary process that leverages digital capabilities and technologies to enable business models, operational processes and customer experiences to create value in an organization (González Varona, 2021). The Covid-19 pandemic in 2020 triggered a forced digitalization making it necessary to use new technologies in favor of the survival of the companies.

Kane (2017) has used the degree of digital maturity to measure digital transformation in companies. This author defines digital maturity as the evolutionary stage in a continuous process of consistent adaptation to respond to digital transformation, as well as the achievements made by the organization in its transformation efforts.

Currently, in Mexico there is no national strategy to drive the necessary changes regarding technological advancement in organizations (Riquelme, 2019). ECLAC (Dini et al., 2021) confirms that the level of penetration of digital technologies in Latin America and the Caribbean has been profoundly uneven in its speed of adoption by sector.

A particular aspect in Mexico is that the economic sector of SMEs (small and medium-sized enterprises with less than 250 workers) dedicated to manufacturing, contribute almost 45% of GDP and generate 68% of jobs nationwide (INEGI, 2019). In Nuevo León, SMEs contribute 37.3% of the state's total economic income.

Given the above, digital transformation in SMEs is a key aspect to boost this important business sector in Mexico and Nuevo León. However, previous studies concerning the adoption of Industry 4.0, indicate that SMEs present higher barriers to implement new technologies due to their structure, availability of resources, financial, cultural, technical and legal aspects (Ghobakhloo and Ching, 2019; Horváth and Szabó, 2019).

In Mexico, there are exploratory studies related to technology integration in companies (Ynzunza, 2017; Perez and Lopez, 2019) and road maps (Gallegos, 2020). Specifically for Nuevo León, little literature was found regarding the factors that affect the digital maturity and technologies of SME organizations in the state of Nuevo León (Martínez, 2020).

According to previous studies, Nuevo León is one of the states in Mexico that shows the greatest progress in the process of technology integration and digital transformation, through important initiatives such as the so-called Nuevo León 4.0; however, in 2021, around 75% of companies in the state had not yet begun the transition to Industry 4.0, and only 5% of SMEs were participating in global value chains (Eunice, 2021).

Among the new technologies related to the advancement in digital transformation are: integration systems, robots, Internet of Things (IoT), additive manufacturing, big data analytics, the cloud, simulation in virtual environments, artificial intelligence, cybersecurity, augmented reality, blockchain, autonomous vehicles, cyber-physical systems, among other emerging technology applications. These new technologies are combined with new business models and organizational changes as organizations adapt to digital transformation (Basco et al., 2018).

There is significant research regarding the progress in digital transformation and adoption of Industry 4.0 in other regions of the world (Mittal, 2018; Ghobakhloo and Ching, 2019; Horváth and Szabo, 2019).

Souza et al. (2017) and Palos Sánchez et al. (2019) conducted a review of the most commonly used technology adoption models, and their combinations, having as most cited: 1) Davis' (1989) Technology Acceptance Model (TAM); 2) Tornatzky and Fleischer's (1990) Technology, Organization, and Environment (TOE) Framework; 3) Rogers' (1995) Diffusion of Innovations Theory (DOI).

According to Oliveira and Martins (2011), DOI and TOE are the only ones focused on organizations. The TOE framework (Tornatzky and Fleischer, 1990) was used in this research; it contains a solid theoretical basis and consistent empirical support that identifies three aspects of a firm's context that influence the process of adoption and implementation of technological innovation, which are the technological context, the organizational context and the environmental context (Oliveira and Martins, 2011).

Baker (2011) mentions that the technological context describes both internal and external technologies that are relevant to the organization, including internal practices and equipment, as well as technologies used outside the organization. Subsequently Dini et al. (2021) analyzed different levels of technologies found in the operations of companies in different Latin American countries.

Organizational context refers to descriptive measures such as focus, size of the company, individual, internal and external characteristics of the organization and its structure (Tornatzky and Fleischer, 1990). Several empirical studies demonstrate relationships between organizational factors (knowledge, managerial gender, size, capital and age of the firm, among others) and the use of technology (Zhu et al., 2003; Cuevas-Vargas, 2018)

The environment refers to the external environment in which the organization conducts its business, e.g., the industry, competitors, government policies (Tornatzky and Fleischer, 1990). Baker (2011) later includes the characteristics of the market or suppliers, the regulatory environment, intense competition that stimulates innovation adoption, and the influence of dominant firms in the value chain to initiate the adoption of innovations. Authors such as Rivas and Stumpo (2011) and Consoli (2012) analyzed the relevant elements of the environment that affect the appropriation of digital technologies in organizations.

Earlier Cohen and Levinthal (1990) introduced the concept of absorptive capacity as the ability of firms to acquire, assimilate and apply external knowledge for business purposes.

Zahra and George (2002) recognized knowledge absorptive capacity as a set of organizational processes through which firms acquire, assimilate, transform and exploit knowledge to compete in changing markets and capitalize on opportunities. Flatten et al. (2011) developed a validated tool to assess the dimensions of acquisition, assimilation, transformation and exploitation.

Pérez Hernández et al. (2019) provides empirical evidence in Mexico on the relationship of absorptive capacity and its influence on the generation and exploitation of technological knowledge.

According to the literature, another factor related to digital maturity is the capacity for innovation. Faced with such a concept, various authors provide elements for its understanding: the Oslo Manual (OECD/Eurostat, 2018) defines innovation as the implementation of significant changes in the product, process, marketing or organization of the company with the purpose of improving results. In Mexico, the National Council of

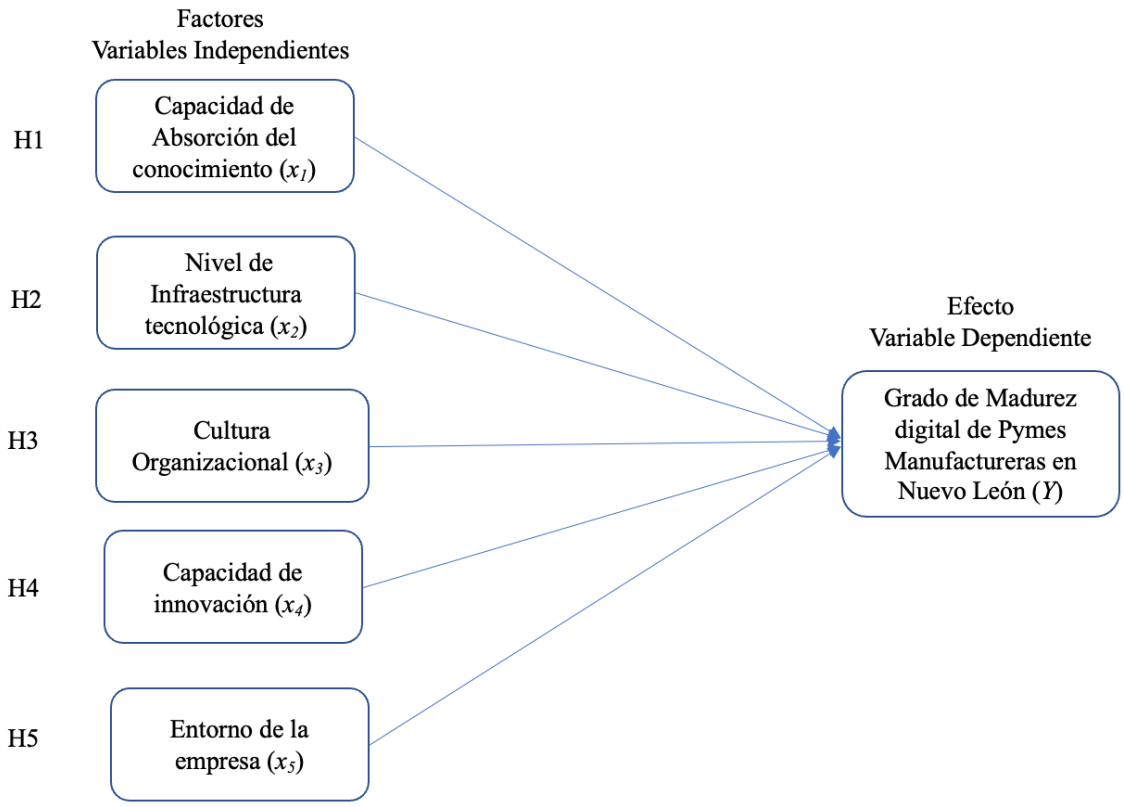
Science and Technology (CONACYT) defines innovation as the capacity to generate new products, processes, services, methods or to increase the value of existing ones.

Among the empirical studies related to factors related to innovativeness with digital transformation were found Breard and Yoguel (2013) and Zhu et al. (2003).

Based on the literature review and previous empirical research, this research analyzes the current situation of the degree of digital maturity in the region and the relationships found according to the most significant factors. Thus, the graphical model of the hypotheses shown in Figure 1 was constructed.

Figure 1

Graphical model of the hypotheses



Fuente: elaboración propia

The hypotheses presented in this research are as follows:

H_1: Knowledge absorption capacity is directly related to the digital maturity of manufacturing SMEs in Nuevo León.

H_2: The level of technological infrastructure is directly related to the digital maturity of manufacturing SMEs in Nuevo León.

H_3: Organizational culture has a direct relationship with the digital maturity of manufacturing SMEs in Nuevo León.

H_4: Innovation capacity is directly related to the digital maturity of manufacturing SMEs in Nuevo León.

H_5: The business environment has a direct relationship with the digital maturity of manufacturing SMEs in Nuevo León.

Method

The present research is quantitative because data collection was used in an objective manner to test the hypotheses generated through numerical measurement and statistical analysis of the variables considered. The type of design is cross-sectional because the measurement is performed at a single opportunity. The scope is exploratory by analyzing a topic little studied in the region, descriptive because the purpose is to investigate the incidence of the variables in the sample, explanatory correlational because it establishes the relationship of the variables based on the cause-effect relationship, it is non-experimental since the phenomenon was observed without performing any type of manipulation of the variables of the model (Hernández-Sampieri et al., (2018).

The sample was determined using the simple random probability sampling technique in a finite population of SMEs (small and medium-sized manufacturing companies) in the state of Nuevo Leon, at a 90% confidence level and a 10% error, resulting in the calculation of the sample in 66 participating subjects of SMEs manufacturing companies in the selected sample universe. The measurement instrument was developed based on studies cited in the literature review (Flatten, 2011; Kane, 2017; Rivas and Stumpo, 2013; Zhu, 2003; Consoli, 2012) and was sent to the selected companies with prior authorization from the surveyed subjects.

For data collection, a survey was applied with evaluation on a Likert scale from 1 to 5, type 1) Strongly disagree, 2) Disagree, 3) Neither agree nor disagree, 4) Agree, 5) Strongly agree, (Soriano, 2014). Through the evaluation of each survey item, a quantitative value was obtained for each variable, which was then used to analyze the results with the use of multiple linear regression. Table 1 shows the items, variables, classification, type and measurement of each variable.

Table 1
Variables, classification, type and measurement of study variables

Items	Variable	Variable Name	Ranking	Type	Measurement
CABC1 to CABC8	X1	Knowledge Absorption Capacity	Independent	Ordinal-discrete	Quantitative Likert Scale 1-5
NIT9 to NIT 19	X2	Technological Infrastructure Level	Independent	Ordinal-discrete	Quantitative Likert Scale 1-5
CO20 to CO27	X3	Organizational Culture	Independent	Ordinal-discrete	Quantitative Likert Scale 1-5
CI28 to CI35	X4	Innovation capacity	Independent	Ordinal-discrete	Quantitative Likert Scale 1-5
EE36 to EE43	X5	Company environment	Independent	Ordinal-discrete	Quantitative Likert Scale 1-5
MD44 to MD48	Y	Digital Maturity Level	Dependent	Ordinal-discrete	Quantitative Likert Scale 1-5

To determine content validity, the measurement instrument was submitted to a group of experts for review, resulting in the modification of the wording of some items and several recommendations regarding the scale used.

A pilot test was also conducted to check the reliability of the measurement instrument, in which the responses of 22 surveys from manufacturing SMEs located in Nuevo León were analyzed. Data analysis was performed using SPSS (Statistical Package for the Social Sciences) software. Cronbach's Alpha indicator was used for each variable to demonstrate the existing correlation. Table 2 shows the items eliminated in each variable and the items considered, in order to improve the internal consistency of the instrument. Finally, the survey was left with 41 questions for data collection.

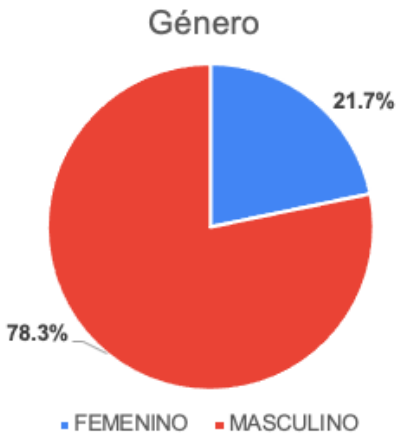
Table 2
Cronbach's Alpha values pilot test

Variable	Variable Name	Final Cronbach's Alpha	Items eliminated from the total	Items considered
X1	Knowledge Absorption Capacity	0.86	0/8	CABC1 to CABC8
X2	Technological Infrastructure Level	0.83	0/11	NIT9 to NIT19
X3	Organizational Culture	0.73	1/8	CO20, CO21, CO22, CO23, CO24, CO26, CO27
X4	Innovation capacity	0.85	1/7	CI28, CI29, CI30, CI31, CI32, CI33, CI35
X5	Company environment	0.77	3/8	EE38, EE39, EE40, EE41, EE42
Y	Maurez Digital Grade	0.72	2/5	MD44, MD46, MD48

Results

The results of the present investigation are shown below, presenting first some of the most important characteristics of the sample and then the results of the multiple linear regression for each variable. The number of surveys applied was 77, however, there were outliers in some of the samples, resulting in 69 surveys considered valid. This information is shown in Figure 2.

Figure 2
Gender of respondents



The descriptive statistics of the study items of the independent variable X1 Knowledge Absorption Capacity are detailed in Table 3, from which it is highlighted that the mean of the responses obtained tends to 3, an intermediate level of promoting and applying knowledge and training in new technologies.–The results of the CABC7 item average were 4, highlighting that employee education and training is fundamental for the improvement of the organizations in the companies surveyed.

Table 3
Descriptive Statistics of the Knowledge Absorption Ability Variable

	N	Minimum	Maximum	Media	Standard Deviation
CABC1	69	2	5	3.74	1.05
CABC2	69	1	5	3.62	0.99
CABC3	69	2	5	3.52	0.95
CABC4	69	2	5	4.00	0.91
CABC5	69	2	5	3.49	0.964
CABC6	69	1	5	2.94	1.29
CABC7	69	1	5	4.04	1.05
CABC8	69	1	5	3.81	1.13

In the case of the independent variable X2 Level of technological infrastructure, the descriptive statistical information is presented in Table 4, which shows that the average of the responses tends to be 2, indicating that there is knowledge of the technologies mentioned, but they are not used in the companies surveyed. It is interpreted in terms of the use of the technologies analyzed that the Cloud is the most used technology and Artificial Intelligence and Blockchain are the least used in the companies surveyed.

Table 4
Descriptive Statistics for the Variable Level of Technological Infrastructure

	N	Minimum	Maximum	Media	Standard Deviation
NIT9	69	1	5	3.16	1.02
NIT10	69	1	5	2.86	1.17
NIT11	69	1	5	2.52	0.95
NIT12	69	1	5	2.84	1.21
NIT13	69	1	5	2.02	0.91
NIT14	69	1	5	2.29	1.00
NIT15	69	1	5	2.35	1.19
NIT16	69	1	5	3.64	1.18
NIT17	69	1	5	1.90	0.79
NIT18	69	1	5	3.10	1.20
NIT19	69	1	5	1.62	0.97

In reference to the Organizational Culture variable, the information is presented in Table 5, it is observed that the average of each of the items is oriented towards 4, which refers to the importance that the surveyed organizations give to the organizational aspects in the company. In item CO27, the question refers to the importance of the leaders' vision in directing digitization efforts, which shows the greatest variation in the responses collected.

Table 5
Descriptive Statistics of the Organizational Culture Variable

	N	Minimum	Maximum	Media	Standard Deviation
CO20	69	2	5	4.33	0.83
CO21	69	2	5	4.45	0.80
CO22	69	1	5	3.87	1.04
CO23	69	1	5	3.78	1.11
CO24	69	1	5	4.13	0.97
CO26	69	1	5	3.48	1.16
CO27	69	1	5	3.74	1.16

Regarding the independent variable Innovation Capacity, an intermediate level is observed in terms of innovation aspects, new initiatives and research and development aspects in their organizations, since the average of the answers in all the items tends to be 3. Item CI33 refers to research for product or process improvement and shows greater variability without being significant. This can be seen in Table 6.

Table 6
Descriptive Statistics of the Innovation Capacity Variable

	N	Minimum	Maximum	Media	Standard Deviation
CI28	69	2	5	3.97	0.98
CI29	69	2	5	3.88	0.98
CI30	69	1	5	3.94	0.97
CI31	69	1	5	3.51	0.96
CI32	69	1	5	3.74	1.02
CI33	69	1	5	3.75	1.16

In the case of the independent variable Company Environment, a mean of 3 was obtained in 4 of the items that make up this variable, only in the case of item EE38 was a mean of 2.93, which inquires about the development of e-commerce or e-business in the value chain in its environment, also having the highest standard deviation of the items that make up the variable, with 1.10. This is shown in Table 7.

Table 7
Descriptive Statistics of the Company's Environment Variable

	N	Minimum	Maximum	Media	Standard Deviation
EE38	69	1	5	2.93	1.10
EE39	69	1	5	3.49	0.99
EE40	69	1	5	3.62	0.94
EE41	69	1	5	3.36	1.04
EE42	69	2	5	3.71	0.99

In the case of the dependent variable Digital Maturity, item MD44, which inquires about the company's digital transformation strategy being clear and coherent, an average tending to 3 is observed, with a standard deviation of 1.11, being the highest of the items that make up this variable, it is interpreted that the respondents do not have a clear and coherent perspective on the digital transformation strategies adopted by their organization. The other two items MD46 and MD48 show that the average respondent places their company at a beginner or learner level in terms of their level of digital maturity as shown in Table 8.

Table 8
Descriptive Statistics of the Company's Environment Variable

	N	Minimum	Maximum	Media	Standard Deviation
MD44	69	1	5	3.11	1.12
MD46	69	1	4	2.78	0.72
MD48	69	1	4	2.57	0.67

The results of the respondents show that the variables are between points 2 and 3 of the selected scale, indicating an intermediate level, beginner-learner in digital transformation, in terms of the constructs formulated in the survey.

Multiple linear regression results

The following section shows the results of the data analysis using multiple linear regression. In multiple linear regression the coefficients of the independent variables measure the absolute change resulting in the dependent variable in the face of the change in the independent variables (Hair et al., 2014). In this research, the effect of the five independent variables (X_1, X_2, X_3, X_4, X_5) on the dependent variable (Y) was evaluated using multiple linear regression modeling.

The model generated was tested against the principles of linear regression to check the correlation and significance of the variables and the hypotheses proposed.

Measure of goodness-of-fit: linear correlation coefficient

This test is used to determine the fit of data to a distribution in a population with a probability model. The R^2 statistic is used to indicate how close the data are to the fitted regression line. The R^2 indicates the percentage of variation in the response variable that is explained by a linear model. A value of 0 means that the model does not explain any percentage of the variability of the response data, i.e. there is no linear correlation, a result between 0 and 0.2 shows a very weak linear correlation, between 0.2 and 0.5 refers to a weak linear correlation, between 0.5 and 0.7 shows a medium linear correlation and between 0.7 and 0.9 is a strong linear correlation.

SPSS version 25 software was used for this research, first using the forced entry method and then the stepwise method, which generated 3 models shown in Table 9. According to the R^2measure, model 3 is the one with the highest validity, since an R^2 of 0.73 and an adjusted R-squared of 0.714 were obtained, as well as a strong linear correlation of 0.85 between the independent variables level of technological infrastructure, knowledge absorption capacity and company environment with the dependent variable digital maturity, which were included in the model. The variables excluded in this model were Organizational Culture and Innovation Capacity.

Table 9

Models developed by the method of successive steps.

Model	R	R square	R-square adjustment	Standard error of the estimate	*Durbin Watson*
1	0.744	0.553	0.55	0.64	
2	0.832	0.692	0.68	0.53	
3	0.852	0.726	0.71	0.51	*2.03*
Model 1		Independent Variables: Level of Technological Infrastructure (NIT)			
Model 2		Independent Variables: Level of Technological Infrastructure (NIT), Knowledge Absorption Capacity (CABC)			
Model 3		Independent Variables: Level of Technological Infrastructure (NIT), Knowledge Absorption Capacity (CABC), Enterprise Environment (EE) Dependent variable: Digital Maturity (DM)			

Analysis of Variance: ANOVA

1. Analysis of Variance (ANOVA) is used to compare the variances between the means of two or more groups of data. In this analysis, Fisher's F equation from equation 1 was used, resulting in an F of 57.47, which is significant with a significant *p-value* of 0.00. This analysis is shown in Table 10. According to the results, the null hypothesis, which indicates that there are no interactions between the independent and dependent variables, is

rejected and the alternative hypothesis, which establishes that there is an interaction between the independent and dependent variables, is accepted, indicating that the model is significant.

Equation 1. Fisher's F Equation

$$F = \frac{FMS\ Regresión}{FMSResidual}$$

Fuente: (Montgomery, 2004)

Table 10

Analysis of Variance (Anova)

Model		Sum of Squares	F	D Mean	Quadratic	F	Sig.
3	Regression	44.14	3	14.71		57.47	.00
	Waste	16.64	65	0.26			
	Total	60.78	68				
Model 3	Independent Variables: Level of Technological Infrastructure (NIT), Knowledge Absorption Capacity (CABC), Enterprise Environment (EE) Dependent variable: Digital Maturity (DM)						

Significance of the t-student variables

The t-student statistic was used to demonstrate which variables have an impact on the model. In this study, the stepwise method determined that 3 of the 5 variables entered in the model were significant. These variables are level of technological infrastructure (NIT), knowledge absorption capacity (CABC) and business environment (EE), all with positive impact. The standardized coefficients for the resulting model are shown in Table 11.

Table 11

t-student and standardized coefficients

Model Variable	Coefficients not Standardized		Standardized coefficients t	Coefficients	
	Beta	Standard error	Beta	t	Sig
Constant	-0.03	0.06		-0.41	0.68
Level of technological infrastructure	0.49	0.07	0.52	7.11	0.00
Knowledge absorption capacity	0.26	0.08	0.27	3.10	0.00
Company Environment	0.23	0.08	0.25	2.85	0.01

Linearity

This test is used to verify that the dependent variable and the independent variables have a linear relationship. The result of Pearson's correlation coefficient is

analyzed according to the following parameters: coefficient of 1 indicates a perfect and positive relationship, between .90 ≤ r ≥ 1.00 is very high, .70 ≤ r ≥ .90 is high, .40 ≤ r ≥ .70 is moderate, .20 ≤ r ≥ .40 is low, r = 0 is null and r = -1.00 is large, perfect and negative.

Table 12 shows a high correlation for the variable level of technological infrastructure and a moderate correlation for the variables knowledge absorption capacity, company environment, organizational culture and innovation capacity; however, the stepwise method did not consider the variables organizational culture and innovation capacity in the proposed model.

Table 12
Pearson correlation

Type of Variable	Variable Name	Correlation
V.I	Level of Technological Infrastructure (NIT)	0.74
V.I	Knowledge Absorption Capacity (CABC)	0.66
V.I	Company environment	0.64
V.I	Organizational Culture	0.56
V.I	Innovation Capacity	0.56

Multicollinearity

This is a test to detect whether the independent variables of the linear regression present similarities, i.e. the existence of a strong correlation between them, so that the forecasts of the model obtained would not be reliable. The variance inflation factor (VIF) calculated in Equation 2 was used to demonstrate non-multicollinearity in the investigation. A VIF value must be below 10 to indicate that there is no multicollinearity. In practice, multicollinearity is considered to exist as from 5.

Equation 2. Multicollinearity calculation

$$VIF = \frac{1}{1 - R^2}$$

Table 13 below shows the statistical results that are within the ranges established by the literature.

Table 13
Multicollinearity

Model	Collinearity Variable	Tolerance	VIF
3	Constant		
	Level of Technological Infrastructure (NIT)	.78	1.28
	Knowledge Absorption Capacity (CABC)	.55	1.82
	Enterprise Environment (EE)	.56	1.79

A. Dependent Variable: Digital Maturity (DM)

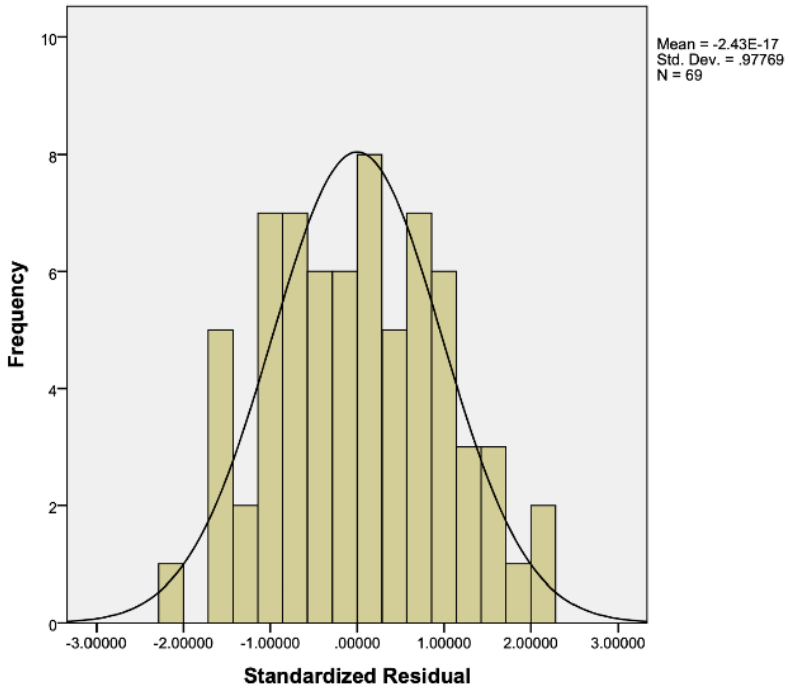
Durbin-Watson

The Durbin-Watson statistic is a test used to detect the presence of autocorrelation between residuals. The value of this statistic ranges from 0 to 4. The Durbin-Watson value should be at 2 or take allowed values between 1.5 and 2.5 to indicate that there is independence between the residuals. In this research the Durbin-Watson value is 2.03, indicating that there is no autocorrelation between the residuals.

Normality

Normality indicates that according to the results of the explanatory variables X, the dependent variable Y follows a normal distribution. To visually confirm normality, a histogram was generated showing that the data present a normal distribution with a slight asymmetry as shown in Figure 3.

Figure 3
Normality Graph



In addition, the Kolmogorov-Smirnov test was performed. In this test a result less than 0.05 indicates that the distribution is not normal, if it is greater than 0.05 the distribution is normal. A significance level of 0.99 was obtained for the data analyzed, concluding that the distribution is normal.

Hypothesis Testing

Table 14 shows the consolidated acceptance or non-acceptance of the hypotheses for the dependent variable Digital Maturity according to the statistical analysis performed.

Table 14
Consolidated Information of the Independent Variables

Variable	Hypothesis	Beta	P value	Accepted or Rejected
Knowledge Absorption Capacity	Knowledge Absorption Capacity is directly related to the digital maturity of manufacturing SMEs in Nuevo León	.26	.00	Accepted
Technological Infrastructure Level	The level of technological infrastructure is directly related to the digital maturity of manufacturing SMEs in Nuevo León	.49	.00	Accepted
Organizational Culture	Organizational culture has a direct relationship with the digital maturity of manufacturing SMEs in Nuevo León	-	-	Not accepted
Innovation Capacity	Innovation Capacity has a direct relationship with the digital maturity of manufacturing SMEs in Nuevo León	-	-	Not accepted
Company Environment	The business environment has a direct relationship with the digital maturity of manufacturing SMEs in Nuevo León	0.23	.00	Accepted

Given the above, equation 3 of the proposed multiple linear regression model is constructed, which when applied to a larger sample would explain 71.4% of the phenomenon studied.

Equation 3. Statistical model of the study

$$\Delta Y = -.03 + .26X_1 + .49X_2 + .23X_5 + \in$$

Where:
Y = Degree of Digital Maturity
X_1 = *Knowledge absorption capacity*
X_2 = *Level of technological infrastructure*
X_5 = *Company environment*

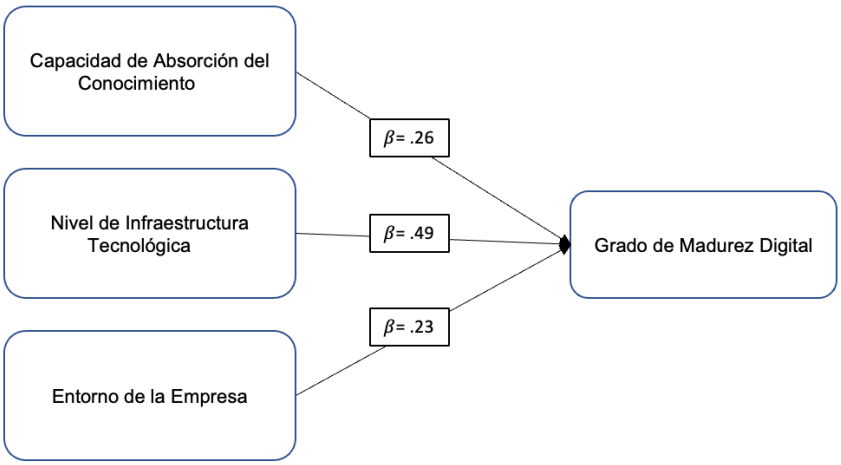
Discussion and Conclusions

The results indicated that of the five independent variables of the proposed model, three have a direct relationship with the dependent variable digital maturity in manufacturing SMEs in Nuevo León, which are knowledge absorption capacity, level of technological infrastructure and company environment.

On the other hand, the organizational culture and innovation capacity variables were not accepted because they were not significant according to the statistical method used. Figure 4 shows the results of the cause-effect model of digital maturity for manufacturing SMEs in the State of Nuevo León.

Figure 4

Final Cause-Effect Model



The statistical results obtained are consistent with the research of Zahra and George (2002) who recognize the capacity of knowledge absorption to acquire, assimilate, transform and exploit knowledge to generate change, improve organizational performance and maintain competitive advantages. Likewise, the research conducted coincides with the findings of Pérez Hernández et al. (2019), which indicates that knowledge absorption capacity is essential for the exploitation of technology, as well as the generation of new products or processes.

Regarding the level of technological infrastructure variable, the model developed coincides with Baker (2011) in indicating that it has a direct relationship with the digital maturity of manufacturing SMEs in Nuevo León. These results are consistent with the empirical study by Zhu et al. (2003), in which the use of technology is a driver in the adoption and transformation to a digital business.

Regarding the organizational culture variable, a direct relationship of this variable with digital maturity was not accepted, which contrasts with Kane (2017), who indicated the importance of changes in organizational culture and leadership in organizations to obtain a higher degree of digital transformation. The results also contrast with Tornatzky and Fleischer (1990), who established the importance of the organizational factor in technology adoption. It was considered that the result was due to the influence of the size of the company and the type of very flat structure where organizational leadership and decisions regarding the organization are centralized, i.e. generally taken by the owner or founders of the business and on whom depends the openness to new technological decisions, which affects the organizational culture of the company.

The Innovation Capacity variable was not significant in the adoption of new technologies. This result contrasts with several theories based on DOI or Diffusion of Innovations theory (Rogers, 1995; Oliveira and Martins, 2011). It is thought that the result in this study is due to the fact that, by participating in the survey, the owner or a senior manager of the company may have a bias in their answers, because they have a different view of what is happening in the innovation aspect compared to the employees of the company.

It should be noted that in the results of the two variables Organizational Culture and Innovation Capacity it was identified that the answers of some items are overvalued compared to other questions, which affects the final result. Regarding Organizational Culture, the items ask about the degree of importance of different aspects related to organizational culture, for example: how important is data analysis for decision making in your organization? When answering, the respondent may think that it is indeed important, but this does not mean that data analysis is applied for decision making, so it is recommended to restructure the wording of the questions in this section and change it to "How much does your organization apply data analysis for decision making?", in this way the answers would be closer to reality since the question is focused on the application of the tool.

Finally, the business environment has a direct relationship with the digital maturity of manufacturing SMEs in Nuevo León. The results are consistent with the contributions of various authors such as Dini (2021), who mentions the quality of the logistics infrastructure, the level of competitive pressure and the degree of digitalization of suppliers, Rivas and Stumpo (2011), who mention the economic environment, the productive sector, the legal and regulatory framework, the telecommunications and information technology infrastructure, and finally Consoli (2012), who points out factors such as customer innovation requirements and public policies, aspects that were questioned in the measurement instrument.

Limitations and recommendations

As for the limitations of the study, it was found that it was a difficult task to gather the responses of the participating companies, since the management levels generally have a very complicated agenda.

As future lines of research, it is recommended to improve the wording of the questions Organizational Culture and Innovation Capacity and to validate again the measurement instrument, since according to the literature these two variables are important for digital maturity in other regions in the world. It is also important to understand the impact of the size of the organization on the results, given that the analysis was conducted in SMEs, which show specific conditions different from large companies. On the other hand, a qualitative study is recommended in order to better understand in a descriptive manner the context of these two variables in manufacturing organizations in the state of Nuevo León.

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