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La *Revista Cátedra,* which belongs to the Faculty of Philosophy, Letters and Education Sciences of Universidad Central del Ecuador has been a means of communication since 1992; the academic voice of the professors was expressed through the bulletins, whose relevant objective was to improve the educational quality based on their experience, wisdom and knowledge as professors forming other educators. On May 2018, Revista Cátedra reemerges as a space that creates and disseminates articles oriented to the improvement of the educational process and its linkage with society.

OBJECTIVE
To disseminate multidisciplinary scientific unpublished articles, elaborated under the parameters of the research methodology, written with academic rigor and based on the teaching practice.

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The topics covered are the theoretical bases of the Education Sciences in its different specialties and levels of the educational system. Priority will be given to papers describing pedagogical experiences, didactics used, innovation processes, and their relationship with new educational technologies.

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The Revista Cétedra is directed to all the national and international researchers interested in publishing quality works that contribute to the improvement of the educational process.

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Cátedra Journal, of the Universidad Central del Ecuador, Faculty of Philosophy, Letters and Educational Sciences, publishes scientific articles on various areas of knowledge related to Educational Sciences, based on the methodology of educational research and community service.

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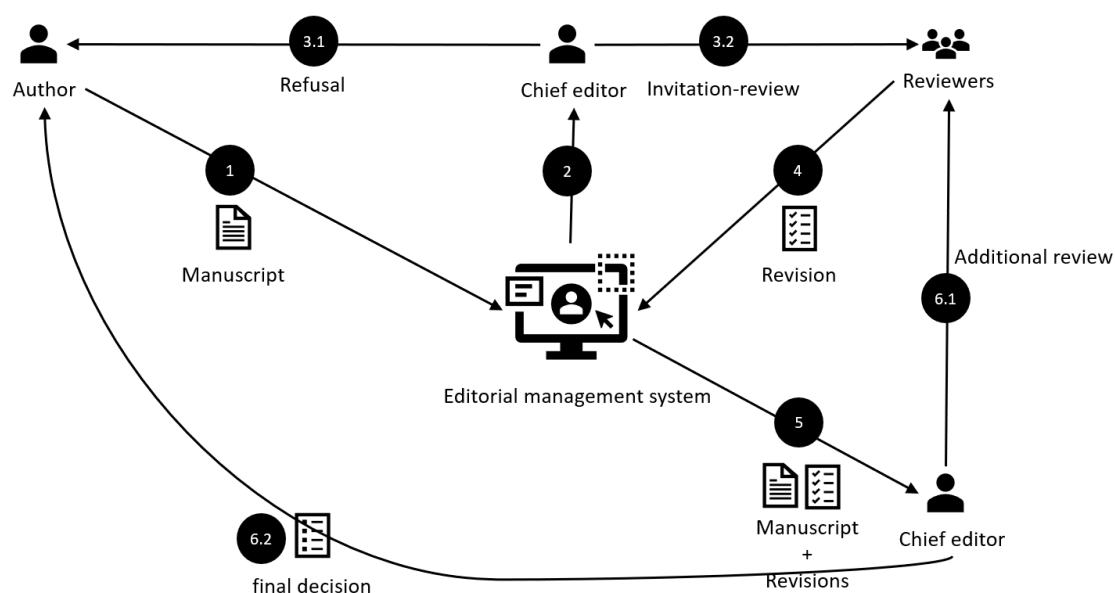
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EDITORIAL

It is a pleasure for the *Cátedra Journal* to present volume seven, number two in the electronic version. The thematic developed has its theoretical bases in the Educational Sciences in its different specialties and educational levels; thus, some relevant and outstanding aspects of each academic work such as education, hospital pedagogy, informatics and gender are exposed.

The contents presented in this new issue are characterized for being elaborated under the parameters of research methodology. In addition, they are elaborated with academic rigor under blind peer review and are based on teaching practice and theorization.

The issue consists of eight approved articles:

The first article entitled *The knowledge of learning strategies as an alternative for the strengthening of heutagogical competences in university students in virtual mode*, authored by Floralba del Rocío Aguilar-Gordón. This manuscript identifies as a central problem the lack of development of heutagogical competencies, that is, the necessary skills and abilities that allow university students to learn in an autonomous and self-directed manner. Faced with this problem, the author theorizes some questions about the philosophical, sociological, psychological and pedagogical foundations of learning strategies. This research has an exploratory qualitative approach, supported by theoretical methods such as the analytical-synthetic and inductive-deductive, as well as empirical methods such as the direct experience of the researcher, content analysis, documentary analysis and literature review. Among the most relevant findings is the need to propose diverse learning strategies that are intentional, autonomous, metacognitive, contextualized, active and adequately evaluated, with the aim of supporting the development of heutagogical competencies and facilitating the adaptation of students to social changes.

The second manuscript entitled *Relevance and prospective study of the chemical professional in the national, regional and current world scenario*, authored by Dennys Almachi-Villalba, Myrian Yépez-Padilla, Elithsine Espinel-Armas and Christian Alcívar-León. The objective of this research was to highlight the importance of chemical professionals at the national, regional and global levels. To this end, a systematic review was carried out to demonstrate the capabilities of these professionals, linked to regulations of the Ecuadorian Institute of Standardization (INEN), Codex Alimentarius, among others. In addition, surveys were conducted to representatives of companies in the industrial sector related to chemistry, consulting on cleaner production activities in the framework of the SDGs, where waste recycling stood out with 30. 43%. The findings of this manuscript evidenced the need to strengthen collaboration between industry and academia to improve the implementation of sustainable practices in companies, where chemical professionals play a crucial role in solving environmental challenges and promoting sustainable practices in various economic sectors.

In the same thematic line is the third article entitled *Measurement of the appropriation of learning achievements in physics in virtual and blended modalities*, authored by Jonathan Castro-Terán. The purpose of this study was to evaluate the impact of the covid 19 pandemic on the acquisition of learning achievements in Physics among students of the Lev Vygotsky Educational Unit in Quito. An evaluation matrix was designed to record learning achievements, along with their identification codes, levels and types of achievement. The instrument included 20 multiple-choice questions with four options each. The assessments were cumulative, covering all content for the first quarter of the 2021-2022 school year. Data were collected through assessments validated by the institution's mediators and analyzed to identify significant differences between virtual and blended learning methods. The results of the t-test indicated that there are no significant differences in the acquisition of learning achievements between students who attended blended classes and those who attended virtual classes.

The fourth article entitled *Pedagogic practice in a hospital environment,* authored by Ximena Pinos-Benavides. This academic work analyzes the importance of pedagogical actions in hospital contexts, where spaces are generated for the educational inclusion of children and young people facing illness and hospitalization. The problem of analysis is the scarce attention of educational and health administrations, and the lack of knowledge of processes that provide continuity of the school curriculum. The research approach is qualitative exploratory; it considers the inductive-deductive method and the empirical method as the immediate experience of undergraduate students of the Pedagogy of Experimental Sciences, Mathematics and Physics. The results of this article indicate that emotional support adapted to the special educational needs derived from illness and hospitalization should be provided through playful and didactic activities.

In the same line of hospital pedagogy, we have the fifth article entitled *Impact evaluation of the teaching and research process of the General Teaching Hospital of Calderón Quito-Ecuador,* authored by Luis Fernando Olmedo-Pérez, Patricia Benavides-Vera and Fernando Durán-Lucio. The manuscript evaluates the impact of the teaching and research process of the Calderón General Teaching Hospital-HGDC in the period 2016-2022 and aims to measure the impact of the Teaching and Research process regarding (1) academic process and resources, (2) evaluation and research, (3) learning, training and knowledge transfer and (4) clinical-surgical practice and performance; through the design and application of the impact evaluation methodology with orientation to measurable results, Balanced Scorecard-BSC. The target group was identified as undergraduate students, rotating interns, postgraduate students, teachers and health care personnel of the Higher Education Institutions (HEI) that perform their health care and academic activities at the HGDC. It was developed in three phases: the first phase comprises the period 2016-2020, with a total population of 949 participants; the second phase of 2021 has 382 participants; the third phase of the period 2022, has a total population of 344. The BSC monitoring matrix showed that the average Global Effective Impact Evaluation of the Teaching and Research process of the HGDC in the period 2016-2022 reached 87.39% effectiveness, reflecting that the

assistance and teaching activities are adequately fulfilled. The research contributes to improve the care and teaching processes of the hospital, and allows it to be a model to be replicated by other institutions.

The sixth manuscript, entitled *Kahoot in formative evaluation: teaching experience in Higher Basic General Education*, was written by Juan Carlos Cárdenas-Rogel, Grethy Quezada-Lozano and Reinaldo Guerrero-Chirinos. The main objective of this research was to evaluate the impact of the application of Kahoot as a didactic strategy to assess knowledge in Natural Sciences. The research question was: Does the application of Kahoot have an impact on the learning of Natural Sciences? The methodology used was quantitative, quasi-experimental, cross-sectional and descriptive. Two learning scenarios were considered: a traditional class (control group) and another in which Kahoot was used as an evaluation tool (experimental group). To collect data, a survey was applied to students through Google Forms. Among the main findings of this study, it is highlighted that the use of Kahoot as a didactic strategy for assessment significantly influences the levels of student participation in the learning of Natural Sciences.

In the line of Technology applied in education is the seventh article entitled *Digital competence in teaching: a case study from a sociocultural perspective*, authored by Yuliedys Ruiz-Aday, Elsa Montenegro-Moracén and Andrea Pacheco-Lemus. The objective of this research is to analyze the sociocultural influence on the digital competence of teachers of the first year of the General Unified High School (BGU) of the Fiscal Educational Unit (UEF) 24 de Mayo during the first quarter of the 2023-2024 school year. The importance of considering the cultural and social context of teachers in the integration of digital competencies within the didactic planning is emphasized. For this purpose, a mixed methodological approach was used and participants were selected through purposive sampling. The results show that the sociocultural perspective influences the integration of digital competencies, highlighting the need to overcome technological limitations and change perceptions rooted in the educational culture. It is concluded that addressing these challenges from a sociocultural perspective can improve the integration of technology in Language and Literature teaching.

The eighth article entitled *Gender and education In África: the case choice of the choice of baccalaureate studies in Ecuatoguinean educational centers*, authored by Pedro Bayeme Bituga-Nchama, Bonifacio Nguema Obiang-Mikue and Rebeca Nsuru Ondo-Mibuy. This research focuses on the study of the gender approach and education in Africa, highlighting the difficulties of access to education, where the training of boys is prioritized over girls. To better understand this situation, the analysis focused on the choice of baccalaureate studies in schools in Equatorial Guinea. Methodologically, a descriptive research based on the quantitative method was used. The population studied was Equatorial Guinea, with a representative sample of schools. One of the main conclusions is that girls tend to choose the letter branch, since it is associated with feminine stereotypes and is perceived as easier.

Cátedra Journal thanks all the authors and article reviewers who have made the publication of this issue possible. In addition, it invites the national and international academic community to submit their research papers related to Educational Sciences in its various specialties and educational levels.

MSc. Lizbeth Ponce Tituaña
Managing Editor

The knowledge of learning strategies as an alternative for the strengthening of heutagogical competences in university students in virtual mode

El conocimiento de estrategias de aprendizaje como alternativa para el fortalecimiento de competencias heutagógicas en estudiantes universitarios en modalidad virtual

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Abstract

The article analyses the importance of knowledge of learning strategies to develop heutagogical competences in virtual university students. The manuscript raises as a fundamental problem the lack of development of heutagogical competences or the necessary skills and abilities that allow university students to learn in an autonomous and self-directed way. In response to this problem, the author proposes a number of strategies such as problem-based learning, collaborative learning and the use of technology to foster autonomous and self-directed learning. She theorises some questions about the philosophical, sociological, psychological, and pedagogical foundations of learning strategies; she makes a conceptual approach to heutagogy, its characteristics, principles and

history. It examines the pillars of education as the main reference for understanding the formulation of learning strategies with a view to achieving an integral education of the human being. It is research with a qualitative exploratory approach that is supported by theoretical level methods such as the analytical-synthetic method and the inductive-deductive method and empirical level methods such as the direct experience of the researcher, content analysis, documentary analysis and literature review. Relevant findings include the need to propose various intentional, autonomous, metacognitive, contextualised, active and duly evaluated learning strategies in order to support the development of heutagogical competences, contribute with mechanisms for the adaptation of students to social changes, promote self-learning, enhance the sense of commitment and internal motivation, and, ultimately, promote the development of critical-creative-propositive thinking.

Keywords
Learning, autonomy, virtual education, strategies, heutagogy, metacognition.

Resumen
El artículo analiza la importancia del conocimiento de estrategias de aprendizaje para desarrollar competencias heutagógicas en estudiantes universitarios en modalidad virtual. El manuscrito plantea como problema fundamental la falta del desarrollo de competencias heutagógicas o habilidades y capacidades necesarias que permiten a los estudiantes universitarios aprender de manera autónoma y autodirigida. Ante este problema, la autora propone una serie de estrategias como el aprendizaje basado en problemas, el aprendizaje colaborativo y el uso de la tecnología para fomentar el aprendizaje autónomo y autodirigido. Teoriza algunas cuestiones acerca de los fundamentos filosóficos, sociológicos, psicológicos, pedagógicos de las estrategias de aprendizaje; realiza una aproximación conceptual a la heutagogía, sus características, principios e historia. Examina los pilares de la educación como principal referente para comprender para la formulación de estrategias de aprendizaje con miras a lograr una educación integral del ser humano. Es una investigación con enfoque exploratorio cualitativo que se respalda en métodos de nivel teórico como el método analítico-sintético y el método inductivo-deductivo y en métodos de nivel empírico como la experiencia directa de la investigadora, el análisis de contenido, el análisis documental y la revisión bibliográfica. Como hallazgos relevantes están la necesidad de proponer diversas estrategias de aprendizaje intencionales, autónomas, metacognitivas, contextualizadas, activas y debidamente evaluadas con la finalidad de apoyar al desarrollo de competencias heutagógicas, contribuir con mecanismos para la adaptación de los estudiantes a los cambios sociales, propiciar el autoaprendizaje, potenciar el sentido de compromiso y la motivación interna, y, en definitiva, propiciar el desarrollo del pensamiento crítico-creativo-propositivo.

Palabras clave
Aprendizaje, autonomía, educación virtual, estrategias, heutagogía, metacognición.

1. Introduction
In recent decades, and even more so in the last four years due to the events experienced during the health emergency, virtual studies have overcome geographical and space-time barriers, providing diverse opportunities to people from different latitudes and corners of the world. In the educational field, a set of training proposals supported by technology were

generated, and several educational programs and complementary courses were proposed with quality didactic tools and resources for those who had access to them.

However, despite the benefits derived from the flexible nature of this mode of studies in terms of time and schedules that facilitate the usual work performance of people, allowing them to take care of the family and the fulfillment of other acquired responsibilities, not all people who study in virtual or online mode have developed the necessary skills and abilities to learn in an autonomous way. Direct experience shows that 98% of a total of 225 postgraduate students in master's degree programs in education have not developed self-directed learning competencies to advance in their academic process; there are cases of university students at postgraduate level who enter master's degree programs without the necessary heutagogical competencies to assume their self-learning, which ultimately degenerates into obstacles for their academic performance.

One of the frequent problems detected in the teaching work with twelve groups of university graduate students linked to education and the humanistic area (master's level) under virtual study modality of four universities (3 private and 1 public) was that 98% of the postgraduates have serious difficulties to solve situations related to learning to learn, predominantly the ignorance and lack of application of learning strategies, the lack of knowledge of study techniques, the lack of reading, writing and research habits. To this problem is added the resistance presented by the student to "become more actively involved in their own learning and the scarce experience in the realization of metacognitions" (Aguilar, 2017, p. 51). In order to respond to this problem, we propose the formulation of learning strategies that allow the strengthening of heutagogical capacities in university students in virtual mode.

In a digital world like ours, the generation and application of learning strategies allow students to learn independently, adapt to technological development and approach complex problems with critical thinking. The knowledge of learning strategies becomes an alternative for the strengthening of competences that allow learning to learn and that enhance autonomous learning in the learning subject, hence, the objective of the manuscript is to analyze the importance of the knowledge of learning strategies as an alternative for the strengthening of heutagogical competences in university students in virtual modality.

The topic is topical, it is proposed to respond to the supreme objective of education: "learning to learn" as one of the main approaches made by Delors in the text Learning: The Treasure Within (1997) of the Report to the United Nations Educational, Scientific and Cultural Organization (UNESCO) from which the four fundamental pillars of education, essential for the development of people and societies, are derived. In this sense, talking about the strengthening of heutagogical competencies implies considering the four pillars of education as follows:

The **learning to know** pillar refers to the development of critical thinking skills, problem solving and knowledge acquisition in various areas; it aims to encourage curiosity, research, reflective, critical and innovative thinking, aspects that in terms of Martin (2008) "involves acquiring certain metacognitive skills, ..., capabilities that allow the student to know and regulate their own learning processes" (p. 73).).

The **learning to do** pillar focuses on the development of practical skills and the ability to apply knowledge in real situations; it explores the need to promote entrepreneurship, creativity and the ability to work in teams. To achieve this, Delors suggests that students

participate in professional or social activities in parallel to their studies, so that they can evaluate and enrich themselves.

The **learning to be** pillar focuses on the development of the whole person, including physical, emotional, ethical and spiritual aspects; it fosters autonomy, self-esteem and respect for oneself and others. This implies the need to explore oneself better.

The **learning to live** together pillar refers to the development of social, intercultural and global citizenship skills. According to Delors, the aim is to foster respect, tolerance, solidarity and the ability to live in harmony with others through the building of values.

Pillars considered by UNESCO as essential criteria for quality education and fundamental aspects for the sustainable development of societies. The implementation of these guidelines is intended to contribute to the integral formation of individuals in the complex society in which they live.

UNESCO considers that learning to learn is an essential competence in the 21st century, since the world is constantly changing and individuals need to be prepared to adapt to new challenges, "education must adapt at all times to changes in society" (Delors, 1997, p. 18). Some of the key skills included in learning to learn are the ability to identify and define problems; the ability to search for and process information; the ability to analyze and synthesize information; the ability to solve problems; the ability to think critically; the ability to learn from mistakes.

Methodologically, this study adopts a qualitative exploratory approach because it analyzes the autonomous learning problems of university students in virtual modality; it considers two main sources of data: one taken from the observation and direct experience of the author and the other, from the review of specialized literature on the subject; it relies on inductive-deductive methods to categorize common problems identified in direct experience and compare them with the literature on learning strategies; finally, for the analysis, understanding and interpretation of the information, the phenomenological and hermeneutic methods are used, respectively.

The manuscript is made up of three sections: the first section presents the theoretical foundation that approaches the understanding of the subject matter of the research, in this sense, it makes a conceptual approach to learning strategies, exploring their characteristics, principles and foundations; it addresses essential aspects related to heutagogy, its principles, origin, competencies and outstanding figures in the field of self-learning. The second section explains the methodology used in the research process and presents the analysis and discussion of the information gathered. The third section presents the results obtained in the research, explains the contributions of learning strategies to self-learning in virtual environments, with special emphasis on the general and specific strategies that can strengthen the heutagogical skills of students in the virtual modality.

1.1   Conceptual approach to learning strategies

Learning strategies refer to the actions that students use in a conscious and planned manner to improve their own learning process; these actions may include study techniques, organization of information, use of resources, self-regulation and reflection on their own learning. However, when it comes to defining a learning strategy, there is not always agreement on what is meant by it. Thus, for example, paraphrasing Monereo et al., (1999), it is found that learning strategies include different techniques and procedures used by students to learn and process information effectively. A learning strategy focuses on how

students will learn in an effective and autonomous manner, for which it is necessary to distinguish between methodological strategy, didactic strategy and learning strategy; the first refers to the general approach used by the teacher to teach or investigate; the second refers to the specific actions used by the teacher to facilitate learning; and the third refers to the actions used by students to improve their own learning process.

1.2   Characteristics of learning strategies

Learning strategies can be applied in different contexts, in different disciplines and can vary according to the needs, interests, motivations, learning styles and individual preferences of each student. Among the characteristics of learning strategies, the following can be pointed out:

They are used in a deliberate and planned manner by students to achieve specific learning goals. Valle et al. (1998) complement that learning strategies "have a conscious and intentional character in which decision-making processes are involved on the part of the learner adjusted to the objective or goal he/she intends to achieve" (p. 56). In other words, a necessary characteristic is intentionality.

They promote the independence and self-regulation of the student, allowing him/her to make informed decisions about the ways to approach and solve learning problems, i.e., they are characterized by the autonomous character that determines the actions of the learning subject.

They involve reflection and awareness of one's own learning process, which allows students to monitor and evaluate their own progress and performance. In this regard, Aguilar (2017) considers that strategies related to metacognition are those that "allow regulating and guiding learning through planning, monitoring and evaluation" (p. 50). Hence, one of its essential characteristics is its metacognitive tendency.

From the above, it is necessary to consider that the characteristics of learning strategies allow students to adapt to different learning contexts and propitiate the development of self-regulation skills.

1.3. Principles of learning strategies

The principles of georeferencing, diversification, dynamic perspective, finally, evaluation and feedback are essential to define the effectiveness of learning strategies. Among the basic principles of learning strategies, the following can be personally mentioned:

- Georeferencing, insofar as learning strategies must be contextualized and adapted to the specific characteristics of each learning task and situation, since there is no single strategy that works in the same way in all contexts, with all subjects and in all situations.
- Diversification, in that students must use a multiplicity of learning strategies to address different types of tasks and content, which allows them to develop diverse skills, abilities, competencies and approaches to face different learning challenges.
- Dynamic perspective, since learning strategies promote student participation in the learning process, involving them in activities such as the elaboration of summaries, the generation of questions and the practical application of the concepts learned.
- Evaluation and feedback, because it is important that students permanently evaluate their own learning and receive the corresponding feedback on their performance, aspects that allow them to identify strengths and areas for

improvement and adjust their learning strategies in accordance with the immediate and mediate reality in which they find themselves.

1.4 Fundamentals of learning strategies

A critical analysis of the subject shows that learning strategies have philosophical, psychological, pedagogical and sociological bases on which they are based.

1.4.1. Philosophical foundations of learning strategies

Learning strategies are based on several philosophical foundations that influence their development and application. Some of these bases are:

- The humanistic approach focuses on the integral development of the individual, emphasizing his or her needs, interests and capabilities. In the field of learning strategies, this implies considering the individual characteristics of each student and adapting strategies to his or her needs and preferences.
- The empiricist philosophical current, which holds that knowledge is acquired through observation and experience; according to this perspective, learning strategies focus on experimentation, practice and direct contact of the subject with the real world.
- The philosophical current of rationalism, which states that knowledge is obtained through reason, which has two fundamental characteristics: logical necessity and universal validity; according to this point of view, learning strategies are focused on reflection, analysis and problem solving.
- The philosophical current of critical thinking emphasizes the importance of questioning and critically analyzing existing ideas and knowledge. In the context of learning, this implies not passively accepting information, but examining it critically and looking for evidence and solid arguments. By applying criticality in learning strategies, students can develop critical thinking skills, evaluate the quality of information, and form informed opinions.
- Enlightenment, or the 18th century intellectual movement, which promoted reason, science, and education as means for human progress. In the context of learning, the enlightenment approach involves seeking knowledge through research, experimentation and logical reasoning. Enlightenment-based learning strategies encourage intellectual curiosity, the active search for information, the development of critical thinking skills, the evaluation of information, and the active pursuit of knowledge. These skills are essential for effective learning and for the development of a continuous learning mindset.
- Phenomenological philosophy and hermeneutic philosophy as important foundations for learning strategies by focusing on experience, interpretation, subjectivity, and critical reflection. These approaches can assist students in developing a deeper and more meaningful understanding of study materials, as well as enhance critical, creative, reflective, and purposeful thinking skills. They are essential foundations for learning strategies in several ways: a) Focus on experience and interpretation: both phenomenology and hermeneutics focus on understanding human experience and how we interpret the world. These philosophical perspectives help students develop a deeper awareness of their own learning experiences and reflect on how they interpret information. b). Attention to subjectivity: phenomenology and hermeneutics recognize the importance of subjectivity in understanding the world. By applying these approaches to learning, students can be encouraged to reflect on their own perspectives and to consider

how their experiences and beliefs influence their learning process. c). Interpretation and understanding: hermeneutics focuses on the interpretation and understanding of texts and contexts. By applying this approach to learning, students can learn to analyze and understand study materials more deeply, as well as to consider different perspectives and possible meanings. d). Critical reflection: both phenomenology and hermeneutics promote critical reflection and questioning of assumptions. By applying these approaches to learning, students can develop critical thinking skills and learn to effectively question and evaluate the information they encounter.

These philosophical foundations provide a theoretical framework for the design and implementation of effective learning strategies for autonomous and meaningful learning, and foster the integral development of students.

1.4.2. Psychological bases of learning strategies

Learning strategies are cognitive and metacognitive processes that students use to acquire, organize, remember and use information effectively. These strategies are based on psychological principles that explain how we process, store, and use information; in other words, they explain how the mind works and how information processing is generated. Among the psychological bases of learning strategies are the following:

- Information processing theory: this theory holds that learning involves the acquisition, storage and retrieval of information. Aguilar (2017) assumes that cognitive psychology offers interesting elements that favor "the analysis, description, understanding and explanation of the different mental processes that occur in human beings" (p. 53). Thus, learning strategies are based on the way we process and organize information in our mind.
- Social learning theory: this theory devised by Albert Bandura (1997) emphasizes the importance of learning through observation and imitation of others. Learning strategies may include observing effective role models and imitating their actions.
- Operant conditioning theory: this theory proposed by Skinner considers that a person's behavior is shaped by the positive or negative consequences that follow; it stresses the importance of consequences in shaping behaviors, states that through reinforcement and punishment, the consequences of a person's actions influence the likelihood that the behavior will be repeated or extinguished; it focuses on how the consequences of our actions affect our future behavior. Learning strategies may involve the use of rewards and reinforcement to motivate and strengthen learning.
- Motivation theory: motivation plays a fundamental role in learning; for Abraham Maslow, motivation is the human being's drive to satisfy his needs; he developed the theory of motivation based on the concept of hierarchy of needs that influence human behavior; he maintains that man is a creature, his needs grow during his life, and as they are satisfied, other higher needs will dominate his behavior. Maslow's theory, with an inward-oriented approach, represents a model for how people behave. Maslow's theory, McClelland and Herzberg approach motivation in a basic way; they believe that it is about a person's needs. A satisfied need does not give rise to any behavior; unsatisfied needs influence behavior and direct it toward the achievement of individual goals. Learning strategies may include techniques to increase motivation, such as setting clear goals, using rewards, and promoting self-efficacy.

- Memory theory: memory is fundamental to learning. Learning strategies may involve techniques to improve retention and retrieval of information, such as repetition, organization and elaboration.
- Autonomous learning theory: This theory focuses on the active role of the learner in his or her own learning process. The "learning to learn" approach promotes learner autonomy and self-regulation by encouraging the learner to take the initiative to seek and select relevant information, set learning goals, and evaluate his or her own progress.

Understanding these psychological underpinnings can help students develop effective strategies for improving their learning.

1.4.3. Pedagogical basis of learning strategies

The pedagogical foundations of learning strategies refer to the theoretical and conceptual underpinnings that support the use of learning strategies in the educational process. These foundations are based on an understanding of how students learn and how their learning can be enhanced through the use of effective strategies. The following are some of the most significant pedagogical bases of learning strategies:

Behaviorism: this approach focuses on observable behavior and how it can be modified through stimuli and rewards; it considers learning to be a simple stimulus-response association; the individual learns to know objective reality through the senses, but the learner is seen as a passive being who simply reacts to environmental stimuli. It has different approaches such as Pavlov's classical conditioning; Thorndike's connectionism; Gurthrie's contiguity principle; Thorndike and Skinner's operant conditioning; Bandura's observation and imitation. Learning strategies based on behaviorism focus on repetition, positive reinforcement and systematic practice.

Cognitivism: this pedagogical perspective focuses on the study of mental processes and how information is acquired, processed and stored. This theory holds that learning occurs through the gradual construction of knowledge. Among the different approaches, Piaget; Bruner with the well-known discovery learning; Ausubel with meaningful learning; Robert Gagné and his humanistic tendency; Gardner and the theory of multiple intelligences stand out. In the context of learning strategies, cognitivism refers to the use of techniques and strategies that promote comprehension, reasoning and retention of information.

Constructivism: this theory holds that students construct their own knowledge through interaction with their environment and the active construction of meaning. Among the approaches of this theory we find the radical constructivism of Vico, Von Foerster, Glasersfeld; the cognitive constructivism of Piaget with his micro and macrogenetics; the socio-cultural constructivism of Vygotsky in his historical-socio-cultural version and situated cognition; and the social constructivism of Max Sheler, Berger and Luckmann with their distributed cognition and the consequent learning communities that derive from their theories. Learning strategies are based on this approach, which leads to the understanding that students should be active participants in their own learning process, building their knowledge from their experiences and reflections.

Connectivism: this pedagogical basis is based on the idea that learning is a social and connected process, in which the individual benefits from interaction with others and access to digital resources and tools. This theory, promoted by Stephen Downes and George Siemens, is known as the learning theory for the digital age, and seeks to explain complex learning in an ever-evolving digital social world. In the field of learning strategies,

connectivism tends to promote collaboration, the exchange of ideas and the use of information and communication technologies.

Meaningful learning theory: according to this theory advocated by Ausubel, learning is most effective when students can relate new information to their prior knowledge and give it personal meaning. The "learning to learn" approach encourages students to be able to make connections between different concepts and apply them in different contexts, which facilitates meaningful learning. For the perspective of Valle, et al. (1998) meaningful learning involves a process in which the learner selects relevant information, organizes it into a coherent whole and integrates it into the existing knowledge structure.

Metacognition: Metacognition refers to students' ability to reflect on their own learning process, monitor their understanding and regulate their own learning. In the words of Aguilar (2010):

> .... the relating element in all the conceptions about metacognition is that it constitutes a mental activity composed of a series of capacities that the subject has to systematize, to organize by means of symbolic tools the processes associated with a mental activity of which we are conscious and can transmit it, communicate it to others; a mental activity constituted by a series of processes (thinking, analyzing, inferring, reasoning, solving problems, anticipating, perceiving, etc.) and their respective products (such as perceptions, thinking, ideas, models, concepts, etc.); a mental activity associated with the processes and products through which knowledge about the physical, social and psychological world is constructed; a conscious, organized and self-regulated mental activity of the processes being executed and the products being generated; a self-evaluative and self-corrective mental activity that allows the monitoring and evaluation of the results achieved according to the proposed goals; a mental activity that expresses reality through the use of signs, symbols and ideas, from which the representations on which the mind operates are constructed (p. 161).

Thus, interpreting Aguilar (2010), metacognition constitutes a mental process that involves a series of skills inherent to the subject to systematize and organize the processes related to a mental activity. Learning strategies promote metacognition by teaching students to be aware of their own thoughts, emotions and learning strategies.

Motivation: Motivation plays a crucial role in learning. Learning strategies seek to foster students' intrinsic motivation by making learning relevant, interesting, and challenging. They also focus on setting clear goals and providing positive feedback to maintain students' motivation.

These pedagogical foundations support the use of learning strategies as effective tools to enhance the teaching and learning process. By understanding and applying these foundations, educators can design and use learning strategies that are appropriate for the needs and characteristics of their students.

It is important to consider that the aforementioned foundations are not exclusive; on the contrary, many psycho-pedagogical approaches integrate different philosophical and epistemological elements. In this sense, by understanding the essential foundations of

learning strategies, educators can select and design strategies that align with their beliefs and theories about the way knowledge is acquired.

1.4.4. Sociological foundations of learning strategies

Learning strategies are cognitive and metacognitive processes that students use to acquire, process and retain information effectively. These strategies are not only influenced by endogenous individual factors, but also by exogenous sociological factors.

The sociology of learning focuses on how social factors, such as culture, structure and social interactions, influence the learning process. Thus, in the author's opinion, some sociological foundations of learning strategies include:

- The culture of a society that determines the norms, values and beliefs that influence the ways of teaching and learning. Learning strategies may vary by culture as societies value different approaches to learning.
- Social structure, including power distribution, hierarchy and social relations, also affects learning strategies. For example, in more egalitarian societies, learners are more likely to adopt collaborative strategies, while in more hierarchical societies competitive strategies may prevail.
- Social interactions, both within and outside the educational environment, may influence learning strategies; thus, direct interaction with peers and teachers may encourage the use of collaborative learning strategies, while lack of social interaction may lead to more individualistic strategies.

1.5. Elementary questions on heutagogy.

With the intention of clarifying the subject, this section refers to the definition, principles, characteristics, historical origin of heutagogy, heutagogical competencies, classes, representatives and other related aspects.

Heutagogy is an educational approach that promotes self-directed learning and learner autonomy. It focuses on the development of learning skills and provides a flexible and collaborative environment to support the individual learning process. Etymologically, according to Morales and Amaya (2019), the term heutagogy is derived from the Greek words "heuriskein" (discover) and "agogos" (guide), meaning "guiding discovery" (p. 557). Thus, heutagogy states that students are capable of learning autonomously and of directing their own learning and that the role of the teacher is to facilitate and support this process; accordingly, heutagogical educators must fulfill the role of facilitators of learning by providing students with the necessary tools and resources so that they can explore and discover on their own.

Heutagogy focuses on the development of autonomous learning skills, such as self-reflection, self-regulation and the search for resources, in this sense, it establishes that students are responsible for their own learning process, making decisions about what, how and when to learn and about how to evaluate their own progress. From this perspective, Palomino (2018) understands that heutagogy is a theory of self-determined learning that modifies existing knowledge to generate new ones. Likewise, Silvain and Díaz (2018) mention that andragogy is the main antecedent of heutagogy, and that, unlike pedagogy and andragogy, which focus on teacher-directed teaching and learning, heutagogy focuses on autonomous and self-directed learning performed by the learning subject.

As stated in preceding lines, self-learning is an educational approach in which students assume responsibility for their own learning and guide themselves through the acquisition

of knowledge and skills on an ongoing basis. For Morales and Amaya (2019) "the continuing education of the university professional implies the improvement and scientific, humanistic, sociological and cultural updating not only complementary but at the same time, deepening of the initial training" (p. 558). Self-learning is a broad concept, practiced by various subjects and in different contexts. Some of the significant representatives of this type of learning are:

Malcolm Knowles: prominent adult learning theorist who in turn promoted the concept of "andragogy", which refers to the teaching and learning process of adults. Dieck (2020) comments that Knowles emphasized the importance of self-direction and intrinsic motivation in the learning process. He described six principles that include need to know, self-concept, prior experience, readiness to learn, learning orientation, and motivation to learn.

Maria Montessori: Italian educator known for her pedagogical approach based on the search for the autonomy and freedom of the child; she argued that the innate potential for learning and development that every human being has should be valued; she designed a learning environment that encourages exploration and self-learning. The Montessori method emphasizes the strengthening of independence, the valuing of observation, monitoring and timely correction of the child, the prepared environment, the use of complete material and evaluation process according to the mentality of the subject.

Carl Rogers: American psychologist and therapist known for his humanistic approach to education, who according to Mcleod (2023) promulgated the importance of authenticity and empathy in the learning process, and advocated a learner-centered approach in which the learner takes responsibility for his or her own learning.

Each of them has contributed significantly to the development of theories and practices related to self-learning or self-directed learning.

1.5.1. Principles of heutagogy

It is important to remember that heutagogy focuses its attention on the development of fundamental skills for lifelong learning; skills such as the ability to research, analyze information, solve problems and communicate effectively become essential for the achievement of meaningful learning. To fulfill this purpose, heutagogy proposes to provide a flexible and adaptable environment that allows students to personalize their learning experience, considering them as "people with the potential to explore, change and transform the world" (Aguilar, 2010, p. 164).

Hence, from the author's perspective, the characteristic principles of heutagogy could be summarized as follows:

- Self-directed learning. This principle promotes regulated self-learning as a mechanism for the formative process. According to Mendo et al. (2019), self-learning is understood as "the way of learning by oneself" (p. 55), which implies that students are able to make decisions about their own learning, establish personal goals and objectives, select learning resources and evaluate their own progress. This principle becomes the dynamizing entity of the learning process to the extent that students assume responsibility for their own learning (self-directed learning). According to heutagogy, students should not depend on a teacher to guide their learning process. In this regard, Hase and Kenyon (2007) warn that the teacher should not control the student's learning experience; on the contrary, students

themselves should develop the ability to identify their own learning needs, seek and use resources, strategies and mechanisms to evaluate their own progress.

- Autonomy. This principle promotes the need for students to be autonomous and take control of their own learning as a fundamental basis for personal and social growth.
- Reflection and metacognition. This principle establishes that it is essential for students to develop the capacity to reflect on their own learning process, to identify strengths and weaknesses, and to make adjustments according to their contextual requirements (reflection and metacognition).
- Collaboration and social learning. According to this principle, while it is true that heutagogy focuses on autonomous or self-directed learning, recognizing that learning is an individual process, that each student has different needs and learning styles, it also values collaboration, knowledge sharing and social learning among students whereby students can benefit from interacting with others through networking, participating in learning communities, exchanging ideas with others, etc.

1.5.2. Historical origin of heutagogy

Heutagogy has gained recognition in recent times, however, according to Blaschke and Marín (2020) historically the term was coined in 2000 by theorists Stewart Hase and Chris Kenyon, who proposed heutagogy as a response to traditional teaching-learning approaches, approaches centered on the transmission of knowledge by the teacher. Hase was inspired by the self-directed learning theory of Malcolm Knowles and the self-determination theory of Edward Deci and Richard Ryan respectively.

In the 2000s, Australian educator Fredricka Reisman popularized the term and promoted heutagogy as an effective approach to learning in the digital age; since then, heutagogy has gained recognition and has been adopted by educators worldwide; it states that students are capable of learning autonomously and that the role of the educator is to facilitate the process and motivate students to achieve their learning goals. Hence, in agreement with Blaschke (2016) in heutagogy, the student is the one who establishes the curriculum and who develops his or her learning map, emphasizing the development of his or her capabilities.

The history of heutagogy dates back to theories of self-directed learning and self-determination, it has evolved over the years as an educational approach that promotes autonomous and self-directed learning. Over time, heutagogy has been applied in different educational contexts, in higher education, in vocational training and in online learning; it has been shown that heutagogy fosters intrinsic motivation, autonomy and lifelong learning capacity.

1.5.3. Heutagogical competencies required of university students in virtual mode

Heutagogical competencies are a set of skills and abilities that allow people to learn in an autonomous and self-regulated manner, highlighting reflection, continuous learning and adaptability. In this regard, Mendo et al. (2019) state that heutagogical competencies constitute "a process of acquiring knowledge, skills, values and attitudes that the person carries out on his or her own" (pp. 55-56). These competencies are related to the process of self-learning and the ability to reflect, make decisions and adapt to different learning situations. In the virtual modality, university students must develop certain heutagogical competencies to succeed in their learning, in this sense, Aguilar (2017) conceives that "the learner chooses the learning strategies according to his/her needs and criteria" (p. 51), so

that, the essential characteristics required in a university student with heutagogical competencies for his/her performance in virtual modality are the following:

- Autonomy: it is necessary to possess autonomy, to have the ability to direct their own learning, setting goals, planning their study and evaluating their progress, since according to Hase and Kenyon (2007) heutagogy provides students with the opportunity to determine what they want to learn. Students should be able to self-manage their learning by setting goals, planning their time and formulating initiatives to seek resources and solve problems.

- Self-regulation: it is required to have the capacity for self-regulation, to be able to regulate their own learning process, monitoring their level of understanding, identifying areas for improvement and applying strategies to overcome obstacles. It is essential that students have the ability to regulate their own emotions, motivation and effort; that they can stay focused on their learning objectives, overcome obstacles and adapt to different learning situations.

- Metacognition: students with heutagogical competencies are aware of their own thinking and learning processes. They can reflect on their own strengths and weaknesses, identify effective study strategies, and monitor their understanding and progress. In this way, as Aguilar (2010) asserts, the student becomes an active agent in his learning process, capable of reconfiguring his mental structures, assimilating the information he acquires from his environment and constructing knowledge, giving meaning and significance to every aspect of his educational experience.

- Reflection: develop the capacity to reflect on one's own learning, analyzing strengths and weaknesses, identifying thinking patterns and adjusting study strategies. Students should be guided to analyze and evaluate their own learning.

- Self-discipline: it is important that students are disciplined and committed to completing assigned tasks and activities, even without the direct supervision of a teacher.

- Continuous learning. Possessing the ability to engage in lifelong learning, having an attitude of constant learning, seeking opportunities to acquire new knowledge and skills throughout life.

- Adaptability: having the capacity for adaptability or adapting to different learning environments, taking advantage of learning opportunities in different contexts and using different resources and tools. Blaschke and Marín (2020) consider heutagogy as "non-linear learning because it is located in an open framework" (p. 57).

- Critical thinking: students must be able to analyze, evaluate, critically synthesize the information they find online, identifying reliable sources, questioning assumptions and making informed decisions supported by evidence. For Morales and Amaya (2019) "university education should enable the empowerment of the individual in their self-training and lifelong learning" (p. 560).

- Virtual collaboration: although learning in virtual mode can be individual, it is also important that students can collaborate effectively with their peers through the use of online tools, such as discussion forums, chats or group work platforms in order to take advantage of the strengths of others to enrich their own learning.

- Digital literacy and technology management: students must have the ability to adapt to new digital tools and platforms, possess basic skills in the use of information and communication technology tools, such as web browsers, online learning platforms and productivity software.

- Effective communication: in a virtual environment, written communication is essential. Students must be able to express their ideas clearly and coherently through e-mails, messages using different digital tools, forums and written work.
- Problem solving: students must be able to identify problems, come up with creative solutions and apply strategies to solve them.

These heutagogical competencies are essential for virtual university students to make the most of their learning experience in order to achieve their academic goals.

2. Methodology

This study is based on theoretical methods, based on the method of critical review of the existing literature on the subject, we proceeded to the search for information, the assessment of various authors and outstanding works. It uses empirical methods, which in education are those based on observation and direct experience that were key to obtain knowledge; these methods have several important contributions for the educational field: they promote active learning; stimulate critical thinking; foster creativity; improve knowledge retention; develop practical skills, etc. Likewise, the analytical-synthetic method was used to process and evaluate the different points of view on the subject. This is an exploratory study, which analyzes different conceptions about autonomous learning faced by university students in virtual mode. It adopts a qualitative approach that combines the direct experience of the teacher with bibliographic verification, using the inductive-deductive and phenomenological-hermeneutic methods to understand in depth the challenges faced by students in their self-learning process.

From the data collected, the inductive-deductive approach allowed studying common problems identified in the direct experience to categorize them and subsequently, the data were compared with the existing bibliographic information on learning strategies that strengthen heutagogical skills in students in virtual modality.

Applying the phenomenological-hermeneutic approach, we deepened the understanding of the subjective experiences of students in the context of autonomous learning; we were able to observe significant patterns in their school performance, which were manifested, among other aspects, in the fulfillment of tasks and the results of the evaluations as indicators of their learning in graduate studies at the master's degree level. Finally, the results were interpreted based on previously documented pedagogical theories and experiences.

2.1 Collection of information

In order to obtain data, the researcher's direct experience as a teacher of master's degree programs in different public and private universities was the starting point for the diagnosis of the problem, the identification of limitations in the learning process, the absence of heutagogical competencies, the identification of alternative solutions regarding the dynamics, challenges and specific challenges faced by university graduate students in the virtual modality. Frequent interaction with university students, observations in virtual class sessions and direct dialogue with them allowed a deep understanding of their learning experiences.

As a complement to the direct experience, the respective bibliographic review was carried out on topics related to autonomous learning, intrinsic and extrinsic motivation, self-regulation of learning, availability of educational resources in virtual environments, as well as effective strategies for knowledge assessment in university students.

2.2 Analysis and discussion

The common problems associated with the aforementioned are linked to the following:

Lack of motivation: of virtual mode master's students, 98% have difficulties in finding the necessary internal motivation to learn autonomously; without the guidance and direct supervision of the teacher, they tend to lose the interest and discipline necessary to learn on their own. In the words of León (2023), many teachers focus on having students who are motivated to learn that they intend to impart and point out that it would be better if "… students are motivated to learn on their own" (p. 69).

The absence of self-regulation skills: 98% of the master learners evidence a lack of strategies for learning to learn, they require self-regulation skills that allow them to set goals, plan time and evaluate progress. Some students lack these skills and find it difficult to organize their learning effectively. Therefore, as Leon (2023) asserts, one of the tasks of teachers is to identify the needs of students and determine whether they are able to actively participate in the learning process.

Lack of resources and support: Autonomous learning may require access to adequate resources and support, such as libraries, study materials and guidance, aspects to which 98% of students do not have access, which hinders their ability to learn autonomously.

Difficulty in self-diagnosing knowledge: Learning to learn implies the ability to evaluate and diagnose one's own knowledge. 97% of graduate students in virtual modality demonstrate difficulties in accurately assessing their level of understanding and identifying the areas in which they need improvement.

Lack of previous experience in autonomous learning: 95% of master's students are accustomed to traditional and behaviorist educational processes in which the teacher provides the information and students uncritically receive the information. Learning to learn requires a change in the mentality and predisposition to apply study strategies that enhance self-learning.

Lack of development of reading, research and text comprehension skills: This is another problem present in 98% of students in virtual master's degree programs. In addition, the lack of knowledge of learning methods, techniques and strategies, present in 95% of the students referred to, is another problem.

3. Results

As results of the research, there are some contributions of the strategies for self-learning of students in virtual modality. In order to carry out self-learning processes, the student in virtual mode requires knowledge and application of strategies for learning to learn such as those explained below:

- The search and effective use of digital resources: in virtual education, there are a large number of resources available online, such as e-books, articles, videos and tutorials. It is necessary that the student learns to search and select the most relevant and reliable resources for study. With heutagogy, the teacher can also be "critically incorporated into the informational horizons and the use of technology" (Morales and Amaya, 2019, p. 563).
- Independent research processes: studies in virtual modality require students to learn to use tools and resources that allow them to search, identify, select and process relevant and reliable information; current times demand the development

of competencies on the management of electronic books, academic articles and specialized databases.

- Online courses: online courses and programs are an opportunity to strengthen the development of competencies, they adapt in a flexible way to the requirements, contexts and schedules of the student, for example, the use of virtual platforms such as: Coursera, edX and Udemy that offer a wide variety of courses in different areas of study.
- Search for online videos and tutorials: this activity allows understanding and incorporating new content, including an important categorical corpus through the use of platforms such as YouTube and Khan Academy that offer a diversified educational content.
- Use of interactive multimedia resources such as videos, simulations or interactive games to facilitate learning, as these resources allow students to explore, experiment actively and develop different skills and abilities.
- Participation: although learning in virtual environments can be mostly individual, participation in discussion forums, study groups and online collaborative activities related to the area of study also contribute to the development of heutagogical competencies, allowing the sharing of ideas, resolving doubts and enriching learning through online exchange with other students.
- Collaborative online interaction involves the creation of online work groups with classmates in which students can discuss, resolve doubts, collaborate and share knowledge to solve problems or carry out projects; through interaction with others, communication skills, teamwork, understanding of concepts and critical thinking are developed.
- Organization and planning: these are necessary in virtual studies, and can be carried out through the creation of schedules, the establishment of realistic goals, subdividing activities, reorganizing dates for the completion of tasks, etc. In this regard, Valle et al. (1998) agree that "learning involves an active process of integration and organization of information, construction of meanings and control of understanding" (p. 61).).
- Recording or taking notes and summaries: these are valuable strategies that should be executed before, during and after a virtual class to the extent that these techniques promote the development of fundamental cognitive skills in human beings. The elaboration of content summaries, synthesis, analysis, underlining, structuring graphic organizers and the use of other techniques allow processing and remembering information, and are effective to consolidate learning. These activities help to identify, process and systematize information.
- The self-assessment process understood as self-monitoring and self-regulation: Another significant aspect in the learning to learn process is the practice exercises for self-assessment of progress and understanding of the content through feedback activities. Self-assessment allows to identify strengths and weaknesses, focus on improving in the required areas and adjust the study approach. The use of strategies such as self-assessment, reflection and constant feedback allows monitoring learning and making the necessary adjustments for improvement.
- Self-care as an essential mechanism to care for physical and mental well-being, respect for rest time, exercise, nutrition and medically recommended sleep as requirements for effective learning.

- Establishment of short and long term goals and rewards as an effective way to maintain motivation insofar as self-compensation constitutes a key element for self-learning.
- Use of the strategy of reflective learning in order to achieve metacognition and the development of their skills and abilities.
- Application of problem-based learning (PBL): this strategy consists of presenting students with a challenging problem or situation related to the topic of study. Students must investigate, analyze and propose solutions, thus fostering their autonomy and capacity for self-directed learning.
- Application of project-based learning (PBL): in this strategy, students work on research or creative projects that allow them to apply the knowledge acquired in real situations. Students must plan, research, design and present their projects, which promotes their autonomy and capacity for self-directed learning.

These strategies should be adapted to the needs and characteristics of virtual mode students, and it is important to provide them with the necessary support and guidance so that they can develop their abilities to achieve effective self-learning, making true that "education consists of getting a person to do by himself what he should do, to develop skills and abilities that allow him to represent and understand the world; to interpret existence and to undertake in life itself,..." (Aguilar, 2008, p. 44).

The implementation of strategies for learning to learn autonomously in virtual mode requires discipline, responsibility and commitment. In virtual university education, there are several methods, techniques and strategies that can be used for self-learning. These strategies are useful for students to acquire knowledge autonomously, taking advantage of their learning styles and experiences in virtual environments. Self-learning in virtual education requires discipline and commitment, and the adequate use of learning strategies contributes to the strengthening of the necessary capacities of the human being for individual and social transformation.

4. Conclusions

Learning strategies based on heutagogy promote autonomous and meaningful learning in university students, contribute to the strengthening of heutagogical skills that promote the improvement of students' ability to learn independently and adapt to changing environments, however, the implementation of heutagogical strategies requires a change in the role of the teacher, who must act as a facilitator and guide instead of being the center of the teaching process.

Learning strategies play a fundamental role in virtual education, as they help students acquire and apply knowledge effectively; promote self-management and self-direction skills; facilitate the organization and structuring of information in a meaningful way, an aspect that helps them understand and retain information more effectively; encourage active participation in the learning process, by using techniques such as collaborative learning, online discussion and problem solving, students can interact with their peers and build knowledge together; improve motivation and engagement in virtual education by using techniques such as gamification, challenges and rewards, a more engaging and stimulating learning environment can be created; develop critical, reflective and creative thinking skills by employing techniques such as case analysis, problem solving and information evaluation, learners can develop their ability to analyze, evaluate and make informed decisions.

Learning strategies are fundamental for self-learning in virtual education, as they help students become more autonomous, organized, participative, motivated and critical in their learning process.

In addition, by fostering autonomy and responsibility in their educational process, students are better prepared for lifelong learning, a crucial skill for today's work environment. Likewise, the development of metacognitive skills improves understanding of the learning process and leads to deeper and more meaningful learning. Heutagogy is an educational approach that focuses on self-directed learning and learner autonomy. In the virtual education of university students, heutagogy can be of great importance because it fosters learner autonomy; active learning where students actively participate in the search for and construction of knowledge; promotes the ability to adapt to different learning environments and situations; fosters students' intrinsic motivation by allowing them to choose and direct their own learning.

4.1 Challenges

Teachers' lack of familiarity with and understanding of heutagogy can hinder its effective implementation.
Adapting curricular content and traditional assessment to heutagogical approaches is a challenge.
Resistance to change on the part of students and teachers may hinder the adoption of strategies for self-learning.
The use of teaching methods that encourage student participation.
Openness to opportunities for students to work on collaborative projects.
The use of technological tools that support autonomous learning.

4.2 Challenges:

The training of teachers in the use of heutagogical strategies.

The creation of flexible and collaborative learning environments that foster student autonomy and self-regulation.

Heutagogy-based learning assessment requires the development of new assessment approaches and tools that go beyond traditional tests.

In conclusion, heutagogy-based learning strategies can be an effective way to strengthen the autonomous learning capabilities of university students in virtual study mode.

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Relevance and prospective study of the chemical professional in the national, regional and current world scenario

Estudio de pertinencia y prospectivo del profesional químico en el escenario nacional, regional y mundo actual

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Abstract

This research aimed to highlight the importance of chemical professionals at national, regional and global levels; for this, a systematic review was conducted to demonstrate the capabilities of chemical professionals who are closely linked to regulations set by the Ecuadorian Institute of Standardization (INEN), Codex Alimentarius, among others that govern the operations of companies to research and develop products of various economic sectors with quality. Regarding the linkage of chemical professionals in a global context, the literature review made it possible to align the profile of the chemical professional with the Sustainable Development Goals (SDGs), providing the basis for curriculum design or professional training content. On the other hand, surveys were conducted to representatives of companies in the industrial sector related to chemistry to consult cleaner production activities in the framework of the SDGs, where waste recycling stood out with 30.43%. To deepen the responses, focus groups were conducted, where company representatives expressed a clear interest in closer ties with academic institutions to access updated knowledge, continuous training and advice. In addition, they highlighted the need for chemical professionals to possess leadership, teamwork and effective communication skills. These findings show the need to strengthen collaboration between industry and academia to improve the implementation of sustainable practices in companies where chemical professionals have a relevant role in solving environmental challenges and promoting sustainable practices in various economic sectors.

Keywords

Curriculum design, relevance study, Sustainable Development Goals, chemical professionals.

Resumen

La presente investigación tuvo como objetivo destacar la importancia de los profesionales químicos a nivel nacional, regional y global; para esto, se realizó una revisión sistemática para evidenciar las capacidades de los profesionales químicos que están estrechamente vinculados a normativas señaladas por el Instituto Ecuatoriano de Normalización (INEN), Codex Alimentarius, entre otras que rigen las operaciones de empresas para investigar y desarrollar productos de diversos sectores económicos con calidad. Respecto a la vinculación de los profesionales químicos en un contexto global, la revisión bibliográfica permitió alinear el perfil del profesional químico con los Objetivos de Desarrollo Sostenible (ODS), proporcionando la base para el diseño curricular o contenidos de formación profesional. Por otra parte, se realizaron encuestas a representantes de empresas del sector industrial afines a la química para consultar actividades de producción más limpia en el marco de los ODS, donde el reciclaje de residuos destacó con un 30.43%. Para profundizar en las respuestas se realizaron grupos focales, donde los representantes de empresas expresaron un claro interés en estrechar lazos con las instituciones académicas para acceder a conocimientos actualizados, capacitación continua y asesoramiento. Además, resaltaron la necesidad de que los profesionales químicos posean habilidades de liderazgo, trabajo en equipo y comunicación efectiva. Estos hallazgos evidencian la necesidad de fortalecer la colaboración entre industria y academia para mejorar la implementación de prácticas sostenibles en las empresas donde los profesionales químicos tienen un rol relevante en la resolución de desafíos ambientales y en la promoción de prácticas sostenibles en diversos sectores económicos.

Palabras clave

Diseño curricular, estudio de pertinencia, Objetivos Desarrollo Sostenible, profesionales químicos.

1. Introduction

Higher education denotes an important responsibility in the face of emerging challenges such as climate change, globalization and technology in society. The problem in higher education in terms of professional training relevant to social needs lies in a disconnection between the academic curriculum and the changing demands of society. Therefore, the relevance of the careers should be reviewed and updated on an ongoing basis, and thus ensure that academic programs are aligned with reality and that they are executed around theories and pedagogical models relevant to reality and the social environment.

The analysis of the role of the chemical professional in the current context takes into account macro guiding documents such as the Sustainable Development Goals (SDGs), Constitution of the Republic of Ecuador, National Development Plan for the New Ecuador 2024-2025, among others. In the local context, the Development and Land Management Plan 2019-2023 of the Prefecture of Pichincha, an area of geographic influence due to the location of the Faculty of Chemical Sciences of the Central University of Ecuador, is considered. On September 25, 2015, world leaders agreed on the "Sustainable Development Goals (SDGs) to be achieved by 2030, these global goals are directly linked to eradicating poverty, protecting the planet and ensuring prosperity for all" (UN, 2023, p. 21). In this sense, "scientific research and investment in new technologies, in strategic industrial sectors generate an environment of competitiveness, sustainable economic development that promotes poverty eradication" (Haro-Sarango et al., 2023, p. 12). In addition, the chemical professional can promote innovation and the implementation of sustainable technologies, such as clean production, recycling of materials and efficient resource management, and the implementation of environmentally friendly practices in various industrial sectors.

Particularly, when analyzing the SDGs in accordance with the main industries of the country, where the chemical professional would have influence, his contribution is linked to sectors such as Agroindustrial (Agriculture, livestock, forestry and fishing), mining and quarrying and manufacturing industries, and therefore, directly with economic growth (SDG8), which in parallel correlates with the SDGs such as end of poverty (SDG1), zero hunger (SDG2), industry - innovation and infrastructure (SDG9).

The chemical professional plays an essential role in protecting the planet, specifically in critical areas such as clean water and sanitation (SDG6), where their expertise in wastewater treatment and water purification contributes to ensuring access to safe drinking water for communities. With regard to climate action (SDG13), chemists work on developing renewable energy technologies and reducing emissions, thus addressing the challenges of climate change. Furthermore, in the area of affordable and clean energy (SDG7), chemical professionals are involved in the research and application of methods to produce energy sustainably and efficiently. In the preservation of underwater life and terrestrial ecosystems (SDG14 and SDG15), chemists play a key role in pollution management, the development of biodegradable materials and the conservation of biodiversity, contributing to protecting life in the oceans and on land (UN, 2023).

Therefore, the objective of this research focuses on highlighting the importance of chemical professionals at national, regional and global levels based on the requirements of the employer sector.

As for the content of the manuscript, the methodological procedures applied to fulfill the purpose of the research are presented, followed by the main results of the focus groups and the survey applied to representatives of the industrial sector of incidence of the chemical professional and possible labor niches, to finally establish the conclusions of the study.

1.1 Methodology

1.2 Approach

The study is aligned with the theoretical assumptions that govern the sociocritical paradigm, according to the articulation of qualitative and quantitative data, to better interpret the context and requirements of the chemical professional in the current local and national scenario. The research level is descriptive-cross-sectional.

It was based on the bibliographic analysis of relevant normative and regulatory elements, such as the declaration of SDGs, Constitution of the Republic of Ecuador, Development and Land Management Plan 2019-2023 of the Prefecture of Pichincha, Development Plan for the New Ecuador 2024-2025 among others, to determine the gaps or dilemmas of the profession that require addressing from higher education and clarify the structuring cores for the formation of the chemistry professional and conclude with the relevance of the Chemistry Career.

These results were complemented with the application of questionnaires on the challenges for the pertinent and adequate training for the needs of the employer sector. The questionnaire was structured according to the study variables: industrial sector in relation to the objectives of sustainable development and the role of the chemical professional, these variables were derived in dimensions and their corresponding indicators that guided the content of the data collection instrument. Once structured, the questionnaire was validated by the judgment of three experts who reviewed and observed the correspondence of the data collection instrument with the research objective, variables and dimensions, as well as the appropriate use of language and response scale.

Subsequently, focus groups were held, in which criteria were obtained from the representatives of the national industry on the current and expected role of the chemical professional. These elements allowed the situational analysis or diagnosis regarding the potential participation of the chemical professional in terms of the tensions or social requirements determined in the current regulations and proposals made by the business sector linked to the work environment of the chemist.

1.2 Sample

The sample was made up of representatives of the national industry linked to the field of chemistry. The sampling was non-probabilistic and intentional, since it was aimed at people linked to the chemical industry, who could provide the best criteria on the sector's requirements and who gave their informed consent to participate. In the first instance, in order to apply a questionnaire through the Microsoft Forms platform, representatives of the industrial sector of the areas related to chemistry in the city of Quito were called by e-mail and direct message, with the collaboration of the Quito Chamber of Commerce and the Association of Chemists of Ecuador. Subsequently, in order to deepen the responses

provided, with a qualitative analysis, the 51 respondents were invited by e-mail and direct message to participate in a focus group, of which 17 people agreed to contribute anonymously.

1.2 Data processing

To establish the content of the questionnaire, the study variables were operationalized according to the instructions in Table 1.

Variable	Dimensiones	Indicators
Industrial sector vis-à-vis relevant sustainable development objectives	Challenges	Degree of implementation of cleaner production processes in the company.
	Alliances with universities	Degree of interest in receiving training from universities.
	Skills of the chemical professional	Level of skills demanded by the industrial sector

Table 1. Operationalization matrix for variables

The responses to the questionnaire were tabulated, organized, filtered and presented with graphs to obtain orderly and comprehensible information. The statistical treatment of the results was approached through the use of descriptive statistical tools (bar and pie charts). Relative frequencies corresponding to the response options of the questions that formed part of the questionnaires were established. In addition, a series of filters were established to set contexts in obtaining more specific frequencies and graphs for a given variable (questionnaire question).

The graphs were obtained with the help of Power BI Desktop software which is a free application from Microsoft and aims to centralize large volumes of data to produce impact graphs to aid decision-making. Regarding the qualitative analysis, the focus group was conducted on two different dates, in 2023, through the Zoom platform, where groups were generated depending on the area in which the participants worked; food and beverages for human consumption, food and supplies for animal consumption, construction and/or metallurgy, plastics, leather and textiles, agrochemicals and environmental. The groups were led by professionals related to each area. Subsequently, open questions were asked, validated by experts, related to the field and spheres of action of the chemical professional.

The focus group questions were derived from the categorization matrix, which served as a basis for the semi-structured interview with the following categories:

- Interest in receiving training from the Universidad Central del Ecuador
- Interest in solving problems presented by companies
- Cleaner production alternatives in the workplace.

The results obtained were transcribed and analyzed to determine points of agreement and disagreement, which allowed for a more holistic analysis of the importance of the role of the chemist in the industrial scenario.

2. Results and discussions

The results are presented on the basis of three methodological procedures followed:

1. Bibliographic review of regulations and legal basis to establish the relevance of the professional in terms of these regulations and legal basis.
2. Results of the questionnaire.
3. Results of focus groups.

1.2 Contributions of the chemical professional in the national, regional and current world scenario.

Table 2 shows the contribution of chemical professionals in three important productive sectors in Latin America and the Caribbean, for example, with their scientific knowledge in instrumental chemistry the quality of the soil is determined, promoting productivity in the agricultural and livestock sector, therefore, chemical professionals can contribute to SDG 1 (End Poverty), SDG 2 (Zero Hunger). "More than 700 million people in the world live in extreme poverty, where its main causes are: unemployment, social exclusion and the high vulnerability of some populations to disasters, diseases and other phenomena that prevent them from being productive" (UN, 2023, para. 10). Chemical professionals contribute to poverty eradication (SDG 1), because, through their scientific knowledge, they enable industrial development (SDG 9) leading to economic growth and employment generation (SDG 8).

To illustrate the above, Table 2 highlights the importance of chemical parameters to determine the quality of manufactured products such as flour. The manufacturing sector has a higher percentage of annual growth rate (8.6) with respect to other productive sectors, this is mainly due to innovation and development of new products (SDG 9), where chemical professionals can contribute with their knowledge. In addition, strengthening industrial development generates economic growth (SDG 8), which results in job creation and poverty reduction (SDG 1).

Production sector	Millions of dollars	Annual growth rate (Percentage))	Role of the professional chemist
Agriculture, livestock, hunting, forestry, and fishing	259 972.2	1.5	AGRICULTURE: NTE INEN-ISO 10382 indicates that soil quality is determined through the quantification of organochlorine pesticides and polychloride biphenols by gas chromatography with electronic capture detection (INEN, 20114).
Mining and quarrying	190 449.0	4.4	The essential chemical element for battery production is lithium, where Latin America accounts for 52% of world reserves, located in Chile (41%) and Argentina (10%) (ECLAC, 2023b)..
Manufacturing industries	678 046.5	8.6	The Codex Alimentarius states that edible cassava flours must comply with several quality parameters such as: crude fiber (max. 2.0%), ash (max. 3.0%), food additives and certain particle size if it is considered fine or coarse flour (CODEX ALIMENTARIUS, 2019).

On the other hand, lithium has been considered an important resource in Latin America, however, its extraction requires abundant water; therefore, chemical professionals can contribute with scientific knowledge to develop research focused on a circular economy in the mining sector, as ECLAC has already done in its expert workshop "From traditional mining to sustainable mining: a comprehensive approach" (ECLAC, 2023a). In this context, the National Survey of Employment, Unemployment and Underemployment (ENEMDU) reports that in April 2023 there was 4.0% unemployment in Ecuador (INEN, 2023). In this aspect, the chemistry career would have a significant contribution because the objectives and contents of the subjects seek to train professionals with knowledge to implement new businesses in the chemical area, which results in increasing and promoting employment.

A similar alternative is mentioned in objective 5 of the economic axis of the Development Plan for the New Ecuador 2024-2025, which consists of promoting production in a sustainable manner, improving productivity levels to reduce unemployment and improve the quality of life of Ecuadorians (SENPLADES, 2024).

Considering the local level; according to results from the Central Bank of Ecuador, poverty in the province of Pichincha for 2019 was 13% (Pichincha, 2019). Table 3 shows the role of chemical professionals in the development of different economic activities that contribute to the sustainable development objectives: food, metallurgy, chemical products, plastics, textiles and leather.

Economic activity	Thousands of dollars	Role of the chemist
Meat processing and preservation	754.085	To preserve the health of consumers, meat products should not contain residues of pesticides or their metabolites and residues of veterinary drugs; for example, the maximum limit of benzylpenicillin in beef is 50ug/Kg (CODEX ALIMENTARIUS, 2021a). For the quantification of these residues, instrumental methods are required that can be carried out by chemical professionals. In addition, chemical professionals can conduct research for the development of new methods that are economical and environmentally friendly, e.g., biosensors (Prado et al., 2015).
Processing of vegetable and animal oils and fats	452.762	The Codex Alimentarius establishes maximum limits for iron and copper in different types of oils, using the atomic absorption method in a graphite furnace (CODEX ALIMENTARIUS, 2021b). This method can only be performed by professional chemists.
Dairy product processing	583.883	The NTE INEN-ISO 1740:2013 standard details the procedure for determining the acidity of milk fat and its derivatives through titration with tetra-n-butylammonium hydroxide (INEN, 2013c).
Processing of milling, bakery	906.885	The NTE INEN-ISO 20483:2013 standard indicates the Kjeldahl procedure to determine the nitrogen and crude protein content in cereals and legumes. The

and noodle products		development of these procedures requires professionals with extensive knowledge in analytical chemistry and industrial safety. (INEN, 2013b)
Sugar processing	4.616	The Codex Alimentarius has determined several physicochemical parameters to determine the quality of sugar; for example, conductivity, inversion by polarized light, pH, color. In addition to parameters involving starch quantification (CODEX ALIMENTARIUS, 2022).
Cocoa, chocolate and confectionery processing	653.985	Codex Alimentarius determines the analytical methods for the quantification of cocoa butter, fat-free dry extract of cocoa and milk (CODEX ALIMENTARIUS, 2016).
Processing of other food products	554.304	The Codex Alimentarius indicates that the nutritional value of a food must be reported on the label, the amount of energy, protein, carbohydrates, fat, specific nutrients per 100 grams of food; the result is obtained through bromatological tests (CODEX ALIMENTARIUS, 2009).
Manufacture of beverages and tobacco products	666.559	NTE INEN 1081:1984, indicates that the quantification of caffeine in carbonated beverages is done through the spectrophotometric method (INEN, 2013a).
Manufacture of textile products, garments; manufacture of leather and leather articles	897.620	The NTE INEN-ISO 17234-1 Standard prohibits the use of certain azo dyes that form toxic amines upon degradation (INEN, 2014d). Therefore, in order to protect human and environmental life, professional chemists are required.
Manufacture of paper and paper products	287.445	NTE INEN-ISO 11480, indicates that the determination of total chlorine and chlorine bound to organic compounds in paper or cardboard, is performed through microcoulombimetry (INEN, 2014g).
Manufacture of chemical substances and products	917.120	Article 51 of the Regulations for the Control and Administration of Scheduled Substances Subject to Control establishes that "aqueous dilutions of acids, bases and oxidants, in concentrations less than or equal to 6 Normal (6N) shall be described on the labels of the containers and shall not be controlled" (REGISTRO OFICIAL, 2020).
Manufacture of rubber and plastic products	490.121	The NTE INEN-ISO 1269 Standard indicates that volatile matter (including water) in plastic materials, resins and homopolymers, are determined by gravimetry (INEN, 2014f).
Manufacture of other non-metallic mineral products	231.962	NTE INEN-ISO 10545-15, indicates that the determination of lead and cadmium emission in glazed ceramic tiles, is performed by atomic absorption spectrophotometry (INEN, 2014a).

Manufacture of base metals and metal products	1.238.246	The NTE INEN 2 492:2009 Standard indicates that high-strength steel sheets are achieved through microalloys with elements such as niobium, titanium and molybdenum (INEN, 2009). The NTE INEN-ISO 15096 Standard establishes that the method for the quantification of silver in jewelry is inductively coupled plasma optical emission spectroscopy (INEN, 2014e).
Mining and quarrying	133.718	The second provision of the Environmental Regulations for mining activities establishes that "The physicochemical, heavy metal, bacteriological and biological laboratory analyses required to comply with the provisions of these regulations, both in environmental impact studies and in environmental monitoring, control and follow-up work, shall be carried out only by laboratories accredited by the Ecuadorian Accreditation Body (OAE)" (REGISTRO OFICIAL, 2011).

Table 3. Role of the professional chemist in the different productive sectors of the Province of Pichincha (BCE, 2020)

8.9% of the world's population suffers from hunger (690 million people) due to human-caused conflicts, climate change and economic downturns, for which the following has been set as a target:

> By 2030, end hunger and ensure access by all people, in particular the poor and those in vulnerable situations, including infants, to safe, nutritious and sufficient food all year round (ONU, 2023, para. 1).

For the development of all types of foods, especially nutritious foods, a multidisciplinary group of professionals is required; in which chemical professionals determine the quality of foods through the quantification of different chemical parameters established by the Codex Alimentarius standards; in addition, chemical professionals have the knowledge to innovate and develop functional foods (SDG 9). According to Bhattarai, food adulteration consists of the elimination of nutrients from food, addition of hazardous substances and contamination with microbial agents; which diminish the quality of the food, causing different diseases in consumers. Therefore, for the development of SDG 2 (Zero Hunger) it is necessary to develop analytical techniques to detect food hazards (Bhattarai et al., 2022).

The United Nations indicates that 13% of food is lost in harvesting, transportation, storage and processing. Therefore, it is necessary to innovate in new technologies (SDG 9) to avoid food waste, such as, for example, ultrasound drying that increases the shelf life of fruits and thus can reach distant places avoiding product loss; in addition, fruit drying facilitates and lowers transportation costs by having a lower weight compared to fresh fruit (Fernandes and Rodrigues, 2023). Chemical professionals have high capacities to develop research in the search for new technologies in food drying.

On the other hand, agricultural production worldwide exceeds 3 billion tons, requiring 187 million tons of fertilizers. However, more than 50% of NPK (nitrogen, phosphorus, potassium) is lost through leaching, photodegradation, chemical hydrolysis and microbial degradation, generating economic and environmental problems. Therefore, it is necessary to seek new technologies (SDG 9) that favor the absorption of nutrients such as

nanofertilizers, which have shown an increase in agricultural production of 30% compared to conventional fertilizers (Rahman et al., 2021). For the development of this modern agriculture such as the use of nanofertilizers, chemical professionals with the knowledge and skills to study and manipulate matter on an atomic scale are required. Hence: "Industry in general plays an important role in the development of the world economy. On the other hand, it is the largest consumer of natural resources and one of the largest global polluters. (Montes-Valencia, 2015, p.75).

ECLAC indicates that the war between Russia and Ukraine has increased the price of fertilizers and has made it difficult to import them to Latin America and the Caribbean, since Russia is the world's largest exporter of nitrogen fertilizers, the second largest supplier of potassium and the third largest exporter of phosphate fertilizers (ECLAC, 2022). Therefore, there is a need for chemical professionals with the capacity to increase regional production and the development of new technologies such as nanofertilizers.

Considering SDG 3 (Health and well-being) the National Agency for Regulation, Control and Sanitary Surveillance establishes as the seventh requirement for obtaining the sanitary registration of medicines: Description of analytical methods for the quantification of active ingredients (ARCSA, 2022); an activity that specifically requires chemical professionals with knowledge in the validation of analytical methods to ensure the quality of pharmaceutical products.

Similarly, chemical professionals, having knowledge of organic and inorganic molecule synthesis, development of new bulk materials and nanotechnologies, can contribute significantly to the research and development of innovative pharmaceutical products (ARCSA, 2022).

3.2 Contributions of the professional chemist in the environmental sector

The "chemical professional has a relevant degree of influence for the detection and quantification of pollutants in the various ecosystems, access to clean water and the development of new materials to ensure affordable and non-polluting energy" (Martínez et al., 2023, p. 21). With respect to SDG 13 (Climate Action), the current Development Plan for the New Ecuador 2024-2025 proposes to promote circular models that contribute to the reduction of pollution of natural and water resources (SENPLADES, 2024). The implementation of these sustainable models would be possible with chemical professionals who have the knowledge to transform matter, i.e., from waste, generate innovative products for reuse. To this end, the educational approach should not be limited to the transmission of technical knowledge on sustainability and chemistry, but should also foster critical awareness in professionals, so that they question and transform existing structures that perpetuate exploitation and environmental degradation.

Similarly, in order to contribute to waste reduction, chemical professionals are able to implement projects that replace toxic and hazardous substances with environmentally friendly substances, through the discipline known as green chemistry (Raj et al., 2022). These professionals must have the capacity to innovate in the reuse of waste and the creation of products that promote a circular economy, thus contributing to a structural change in the relationship between society and nature.

The data reported in Technical Bulletin No 04-2020-Municipal ADGs, on Drinking Water and Sanitation Management, is related to SDG 6 (Clean Water and Sanitation); in which it is reported that 90% of municipalities have one or more water treatment systems and 83.3% of municipalities declare compliance with INEN Standard 1108 that determines water

quality (INEC, 2021). Therefore, to complete the deficit of municipalities without access to water in Ecuador, there is a need for professional chemists who know the processes of potabilization and determination of water quality, through analytical methods reported in the aforementioned regulations.

In this sense, as shown in Table 4, the professional chemist has an important responsibility, due to the physicochemical analysis of parameters such as ions, heavy metals, total soluble solids, chemical oxygen demand, as parameters of drinking water quality, as well as the detection of traditional contaminants such as heavy metals and emerging ones such as plastics and antibiotics.

Regarding SDG 7 (Affordable and clean energy), SDG 14 (Underwater life) and SDG 15 (Life of terrestrial ecosystems), the state of diverse and deep contamination in all ecosystems of the planet requires emerging attention of specialized professionals, who investigate various pollutants, generate proposals for change and positively influence public policies that seek to mitigate global warming and the pollution and destruction of ecosystems. The chemical professional has the necessary training and knowledge to develop specific research projects, such as pollutant detection and generation of new materials to collaborate in the evaluation of ecosystem pollution and generate biodegradable and non-polluting materials. Table 4 describes several examples that relate the chemical professional to the various Sustainable Development Goals.

Sustainable Development Goals	Role of the professional chemist
CLEAN WATER AND SANITATION	The NTE INEN-ISO 10304-3 Standard indicates that the determination of anions (iodide, thiocyanate, thiosulfate, sulfite and chromate) dissolved in water are determined by liquid phase ion chromatography (INEN, 2014b).
AFFORDABLE AND NON-POLLUTING ENERGY	Biofuels are a renewable energy source that can replace petroleum. For example, biofuel obtained from microalgae has been used for air transportation, showing several advantages compared to alkanes (Jayakumar et al., 2023)
CLIMATE ACTION	Raw material production from CO_2 photocatalysis as a reduction strategy to reduce greenhouse gas emissions (Guo et al., 2023).)
UNDERWATER LIFE	The NTE Standard indicates that the determination of ions (Li^+, Na^+, NH_4^+, K^+, Mn^{2+}, Ca^{2+}, Mg^{2+}, Sr^{2+} and Ba^{2+} in wastewater is determined by ion chromatography (INEN, 2014c)
LIFE OF TERRESTRIAL ECOSYSTEMS	The development of alternative materials to wood, such as composites from waste such as expanded polystyrene, rice husk, sawdust, which have better physical-mechanical properties compared to commercial composites (Bollakayala et al., 2023).

Table 4. Sustainable Development Goals associated with the role of the chemical professional. Own elaboration.

3.3 New challenges for the Ecuadorian industry in chemical processes, facing the relevant SDGs

In this section, the results of the survey and the focus group were analyzed simultaneously, since the findings found quantitatively in the survey of the 51 chemical professionals were analyzed in greater depth qualitatively with the 17 participants of the focus group.

For the focus group, the participants were subdivided according to their area of expertise, which was beneficial in facilitating understanding among the members of each group by using a common language when communicating. However, the results did not differ, which is why a joint analysis of the data collected was made.

In the survey conducted, the challenges of the industry regarding cleaner production in the companies where the respondents work became evident. Where, waste recycling with 30.43% followed by efficient production methods with 19.13% are the most implemented processes (Figure 1). Results that seem to respond to the legislation established in the country but not necessarily to a genuine interest in seeking a greener industry, added to the lack of knowledge on how to approach or implement a less polluting production according to the considerations analyzed with the participants of the focus group, a fact that has been expressed in other investigations that reflect the limitations of the Ecuadorian industry (Anchatipán Bastidas and Flores Tapia, 2023). Therefore, the teaching of chemistry should be directed to promote skills tending to the "study of substances and their transformations should contribute to the formation of the scientific conception of the world by revealing causal relationships and interdependence"(Caballero, 2017, p.5).
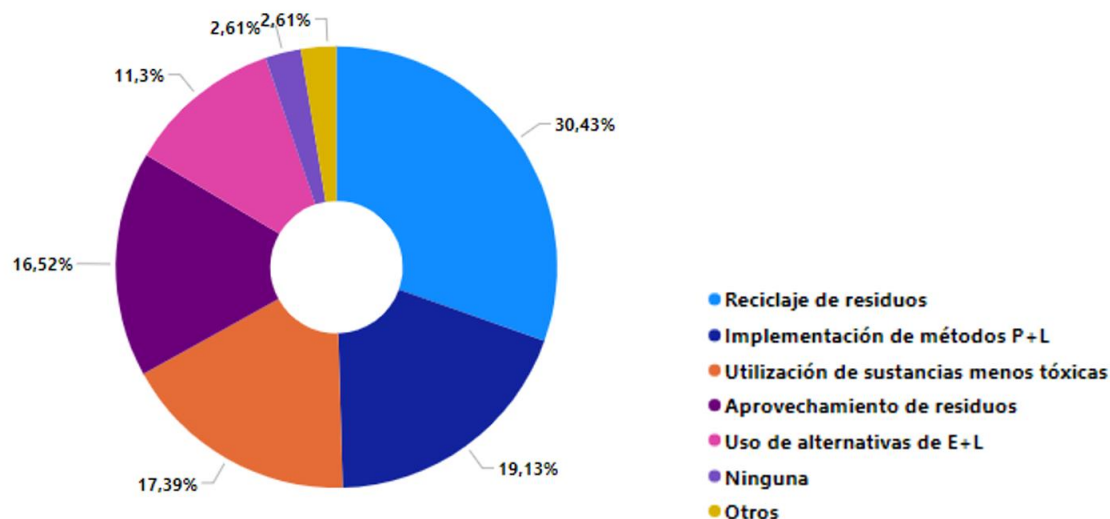
Figure 1. Selection of cleaner production processes applied in the surveyed companies

Note: CP, cleaner production; CP, cleaner energy.

Source: own elaboration

In addition, as shown in Figure 2, the survey provided useful information on the level of interest of chemical professionals and the companies they represent in addressing problems related to the following issues:

- Production: optimization, formulation, innovation, among others.
- Waste management.
- Quality of finished products: analysis, shelf life, among others.
- Raw materials: conservation, high costs, shortages, among others.
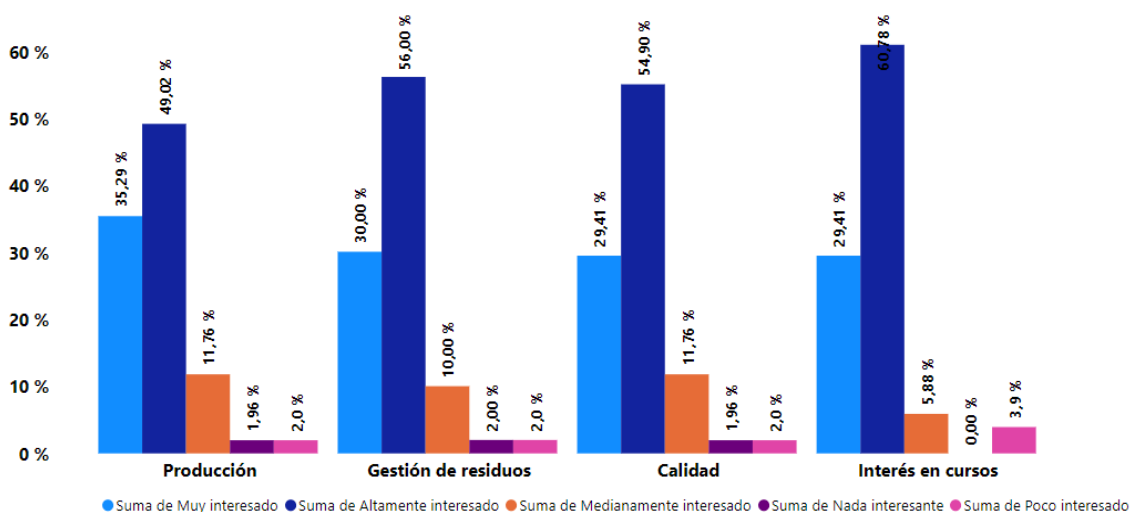
Figure 2. Level of interest of chemical professionals and the companies they represent

Figure 2 shows that there is a high level of interest in employing corrective actions in response to the problems presented, exceeding 40% in all the established parameters. However, economy plays a significant role in all these procedures, as highlighted in the focus group. This criterion goes hand in hand with 60.78 % of the respondents, highly interested in receiving training from academia to improve industrial processes (Figure 3). When delving deeper into the topic within the focus group, it was evident the inherent need for training in addition to expressing the importance of a constant rapprochement between industry and academia. Given that academia provides the fundamentals and innovation while industry provides the funding and market knowledge, collaboration between the two is crucial (Guachi, 2019).
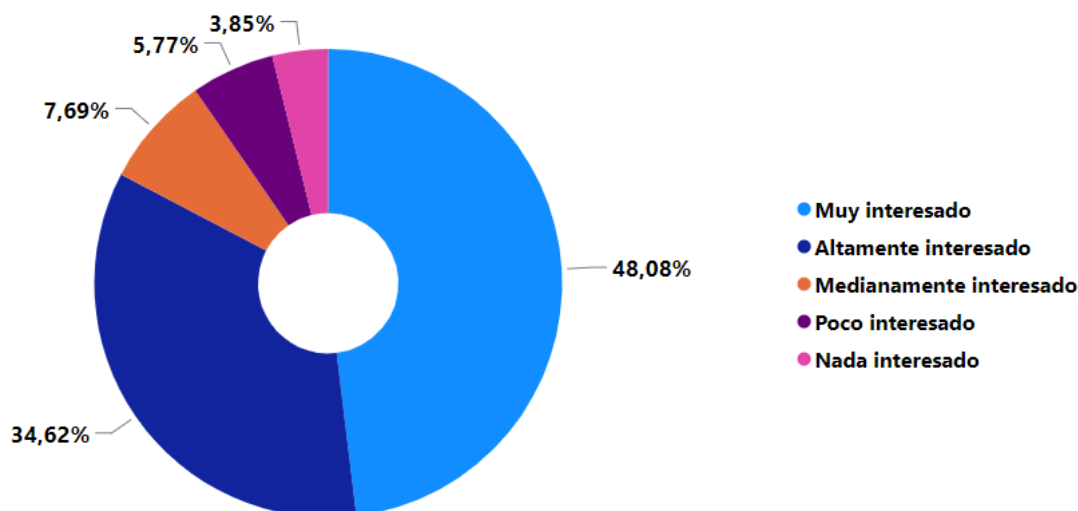
Figure 3. Degree of Interest in University Training Courses to Improve Business Production: A Respondent Perspective

4. Conclusions

The results obtained through focus groups indicate that the implementation of cleaner production practices in companies is insufficient. Most of the participants mentioned that they have focused mainly on efforts related to waste recycling. Regarding collaborations with academic institutions, interviewees noted that interaction with academia is limited in terms of addressing and solving the challenges associated with waste generation in various industrial processes. Therefore, the educational model should be oriented to the early interaction of the student with its sphere of potential performance, in order to achieve a solvent training and development of knowledge and skills, this is feasible through the development of a system of relevant and contextualized pre-professional practices.

In this scenario, the representatives of the companies interviewed expressed a clear interest in establishing closer links with academic institutions. They seek access to knowledge updates, continuous training and advice on processes that are aligned with the competencies that a chemical professional can provide. Regarding the literature review on the Sustainable Development Goals (SDGs) and the relevant regulatory frameworks for the creation of a professional chemist profile in line with the current context, several key elements were identified. The SDGs, as an international framework, the Constitution of the Republic of Ecuador, Development Plan for the New Ecuador 2024-2025 and the Development and Territorial Planning Plan 2019-2023 of the Prefecture of Pichincha, establish the political and normative bases that serve as a starting point for the development of a relevant curriculum for chemical professionals.

In particular, the bibliographic analysis revealed that the opportunities and relevance of chemical professionals are linked to national and international regulations that companies and industries in the country's productive sector must comply with. These regulations include standards such as the INEN regulations and the Codex Alimentarius. Chemical professionals can play a crucial role in the development of technical solutions, as well as in the creation of experimental bases for innovation and development.

These professional competencies, together with their theoretical and technical knowledge, translate into the ability to develop relevant learning content in the current context. In addition, these regulations have been directly linked to the productive sectors of greatest economic influence in the country, such as the manufacture of metals and derived products, the production of chemical substances, the manufacture of textile and leather products, and the elaboration of milling, bakery and noodle products. Therefore, it is essential to take these sectors into account when designing the curriculum for chemical professionals and to promote their positive influence in these economic areas.

The environmental field is currently a highly relevant field of influence for chemical professionals. In a context of widespread pollution of ecosystems and global warming, the participation of chemical professionals offers the opportunity to identify and characterize pollutants of organic and inorganic nature. In addition, they can contribute to innovation in biodegradable materials that help mitigate pollution and contamination problems, as well as generate solutions to counteract climate change.

The pertinent and adequate training of a chemical professional implies the adoption of an educational posture that allows their training in the ethical, scientific, research and society linking fields requires a comprehensive approach that consolidates knowledge, skills and values. It is essential to provide a solid foundation in the chemical sciences, ensuring that students understand the fundamental principles and advanced applications of chemistry. This is achieved through a rigorous curriculum that includes the development of experimental laboratory practices, research projects and the integration of emerging technologies. However, professional education must be accompanied by ethics education that addresses the social and environmental implications of chemical practice. This implies the inclusion of professional ethics courses, where real cases are discussed and the impact of chemical decisions on society and the environment is reflected upon. In addition, it is crucial to foster critical thinking that allows future professionals to question established practices and seek innovative and sustainable solutions. In this way, education not only trains a competent technician, but also a committed citizen, capable of contributing ethically and with critical thinking to the positive transformation of society and the care of the planet.

The interlearning theories adopted for the formation of the chemical professional should guide the practice of participatory and collaborative methodologies with the support of information and communication technologies and, based on the development of problem-based learning, inverted classroom, augmented reality and interdisciplinary projects that link chemistry with various areas of knowledge.

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and on the functionalization of natural polymers through chemical reactions to obtain new biodegradable biomaterials that can be used as packaging materials for fruits and vegetables.

Statement of Authorship-CRediT

DENNYS ALMACHI-VILLALBA: Conceptualization, data curation, formal analysis, research, methodology, project management, resources, supervision, validation, visualization-preparation, writing - original draft, writing-revising and editing.

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Measurement of the appropriation of learning achievements in physics in virtual and blended modalities

Medición de la apropiación de logros de aprehendizaje en física en modalidades virtual y semipresencial

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Abstract

The aim of this study was to evaluate the impact of the covid-19 pandemic on the acquisition of learning achievements in Physics in students of the Lev Vygotsky Educational Unit in the city of Quito-Ecuador through the statistical analysis of standardized assessments. An evaluation matrix was designed to record the learning achievement to be evaluated, together with the corresponding code for its identification, level and type of achievement. The instrument consisted of 20 multiple-choice questions with four options, covering elementary, basic and advanced levels. The questions were grouped by topic and structured to demonstrate the applicability of knowledge. Assessments were cumulative and included all content covered during the first quarter of the 2021-2022 school year. Data were collected through assessments validated by the institution's mediators and analysed to identify significant differences between virtual and blended learning modes. The results of mean comparison by means of the t-test indicated that there is no significant difference in the appropriation of learning achievements between students who attended blended and virtual classes. This study highlights the importance of effective pedagogical practices in the appropriation of students' learning achievements regardless of the mode of study.

Keywords

Resumen

El objetivo de este estudio fue evaluar el impacto de la pandemia por covid-19 en la adquisición de logros de aprehendizaje en Física en estudiantes de la Unidad Educativa Lev Vygotsky de la ciudad de Quito-Ecuador a través del análisis estadístico de evaluaciones estandarizadas. Se diseñó una matriz de evaluación para registrar el logro de aprehendizaje a evaluar, junto con el código correspondiente para su identificación, el nivel y el tipo de logro. El instrumento consistió en 20 preguntas de opción múltiple con cuatro opciones, cubriendo niveles elemental, básico y avanzado. Las preguntas se agruparon por temas y se estructuraron para demostrar la aplicabilidad del conocimiento. Las evaluaciones fueron acumulativas e incluyeron todo el contenido cubierto durante el primer quimestre del año escolar 2021-2022. Los datos se recopilaron a través de evaluaciones validadas por los mediadores de la institución y se analizaron para identificar diferencias significativas entre los modos de enseñanza virtual y semipresencial. Los resultados de comparación de medias por medio de la prueba t indicaron que no existe diferencia significativa en la apropiación de los logros de aprehendizaje entre los estudiantes que asistieron a clases semipresenciales y los que asistieron a clases virtuales. Este estudio resalta la importancia de prácticas pedagógicas efectivas en la apropiación de los logros de aprehendizaje de los estudiantes sin importar la modalidad de estudio

Palabras clave

1. Introduction

The covid-19 pandemic has generated significant transformations in education around the world, forcing educational institutions to adapt to non-traditional teaching methods. One of the main adaptations has been the transition to virtual or blended learning modalities to avoid the spread of the virus. With this, the need arises to evaluate learning in these modalities, especially in high school students.

From this arises the need to investigate and contrast the appropriation of learning achievements among students who attended blended and virtual classes. The purpose of the study was to obtain valuable information for decision making in the educational field. This paper shows the results of a study that compares the learning achievements of the students of the Lev Vygotsky Educational Unit, in both modalities during the school year 2021 - 2022.

Although virtual education has gained ground in recent years, the pandemic has accelerated its massive implementation. This raises doubts about its effectiveness compared to face-to-face or blended learning. Consequently, it is necessary to evaluate learning in both modalities to determine which is more effective during the pandemic and how educational practices can be improved in this new context, leading to the following research question:

What are the effects of the covid-19 pandemic on the appropriation of learning achievements in the subject of Physics by the students of the Lev Vygotsky Educational Unit

during the first quarter of the 2021-2022 school year? This is the central question addressed in this paper, with the aim of ensuring quality education in the post-pandemic period. For this purpose, the learning achievement assessments will be statistically analyzed in order to implement effective pedagogical practices. In order to achieve this approach, the following specific objectives have been defined:

- To design standardized instruments for the evaluation of learning achievements in the subject of Physics through a process of validation by experts.
- To measure the appropriation of learning achievements in the subject of Physics through the application of validated evaluations by experts to identify significant differences between the virtual and blended learning modalities.

The hypothesis put forward for this study suggests that academic performance in the assessment of learning achievement in the subject of Physics will be higher among students who participated in blended classes compared to those who attended virtual classes during the pandemic. It is expected that, direct interaction between students and teachers, together with access to resources and materials in the classroom, will contribute to an improvement in learning and, consequently, in academic performance, in contrast to those who participated in virtual classes and might face distractions in the home environment during virtual sessions.

In this study, we intend to demonstrate that one of the two educational modalities, either blended or virtual, is more effective for students' learning. Through the evaluation of cognitive and praxeutic[1] learning achievements in Physics of students in both modalities, we seek to determine which of them allows a greater understanding and retention of the contents, especially in the context of the pandemic and the need to adapt to new forms of teaching. This research is also expected to provide recommendations to educational authorities on the most appropriate modality to ensure effective learning in times of pandemic.

The topic of learning assessment in different educational modalities in times of pandemic and post-pandemic is of great interest due to the need to find effective solutions to guarantee student learning in a context of uncertainty and constant change. The pandemic has forced educational institutions to adapt quickly to new teaching and learning modalities, which has generated a debate about the most effective pedagogical modality and strategies for student learning. Therefore, it is essential to conduct studies to determine the best way to ensure learning in post-pandemic times.

This manuscript is organized into six main sections. In the introduction, the general context of the topic is presented and the problem addressed in this study is stated. Then, the general objective and specific objectives, the hypothesis and the idea to be defended are established. The generalities of Conceptual Pedagogy and the design of Learning Achievement are addressed, as well as the guidelines for the creation of standardized tests. In the methodology section, the sample is described, as well as the way in which data collection was carried out and the statistical analysis used. In the results section, the findings of the study are presented, accompanied by tables and figures for a better understanding of the

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[1] Praxeitive system is understood as the set of skills and abilities essential to process knowledge and apply it in different contexts, therefore, it indicates what the student is able to do. Lev Vygotsky Educational Unit (2018, p. 20).

findings. The discussion section focuses on the interpretation of the results and their comparison with previous studies in the literature. Finally, the conclusions section summarizes the main findings and offers recommendations for future research on the subject.

2. Literature review

In this research we sought to analyze the effectiveness of two educational modalities during the pandemic, so it is important to review previous studies conducted in this field and to know the relevant theories and approaches for the analysis of the results. This theoretical framework addresses the pedagogical approach governing the Lev Vygotsky Educational Unit and online and blended learning education, as well as previous studies that have evaluated the effectiveness of these educational modalities.

2.1 Conceptual Pedagogy

According to José Brito (2013), a pedagogical model is "a schematic representation of reality, which guides decision-making in the design and development of the curriculum and is an indicator of educational quality" (p. 7). Therefore, it is the set of features of an educational institution that differentiates it from others.

At the Lev Vygotsky Educational Unit, the Conceptual Pedagogy model predominates, which stems from the reflections of Miguel and Julián De Zubiría Samper on "what to teach" and "how to teach" (De Zubiría and De Zubiría, 1995) based on the contributions of Vygotsky, Piaget, Wallon, Luria, Merani, among others. The fundamental purpose of conceptual pedagogy, being an ultramodern pedagogical model, is to form symbolic, loving, ethical, talented, creative and affectively competent symbolic analysts. This model is supported by a theoretical compendium on mentefacts, exceptional minds, instruments of knowledge, intellectual operations, theory of the six readings and psychological minds (Lev Vygotsky Educational Unit [LEV], 2020, pp. 45-49).

Figure 1 shows the conceptual mentefact of Conceptual Pedagogy in which Structural Pedagogy is visualized as its supra ordinate, together with the essential characteristics that differentiate it from Active Learning and Teaching for Understanding, and the applications according to its subtheories.
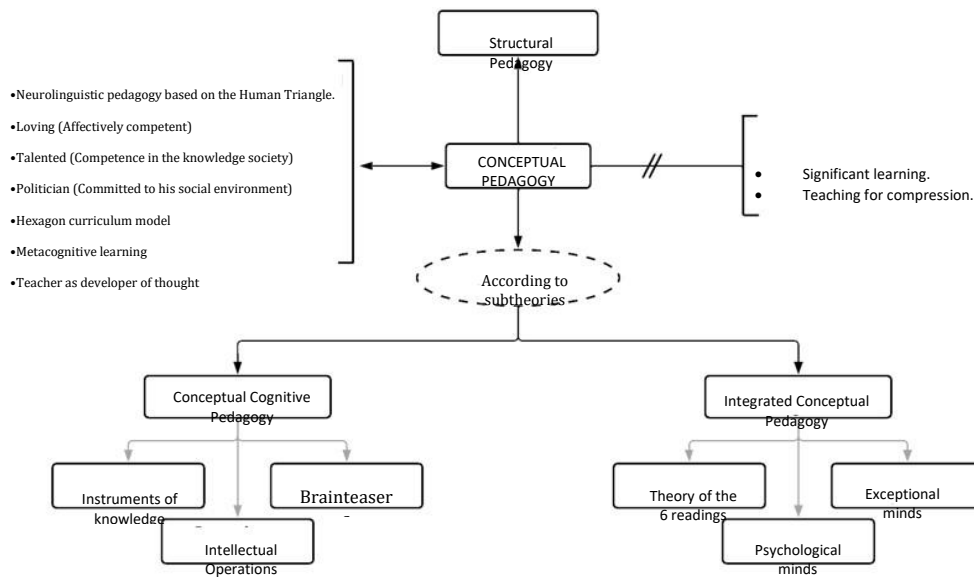
Figure 1. Mind-set [[Conceptual Pedagogy]] Adapted: De Zubiría et al., 2019, Lev Vygotsky Educational Unit, 2020

To achieve the objective of Conceptual Pedagogy, the Hexagon Model is used, which is a technology of Curricular and Didactic Design where the pedagogical elements are defined, that is, the elements that guide the educational process. The how of the process is also determined, that is, the didactic elements. In the postulate, the didactic elements are subordinated to the pedagogical ones. When referring to the pedagogical elements, it is mentioned that the learning achievements (purposes), the indicators of success in learning (evaluation) and the learning contents (teachings), become the purpose of the process, since they express in a consequential way what is sought in the student, as shown in Figure 2.
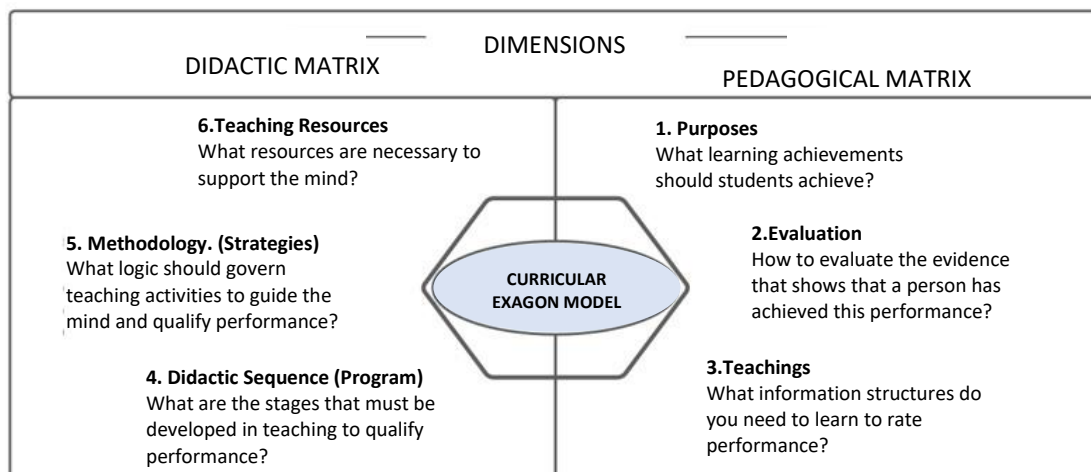
Figure 2. Model of the curricular hexagon. Adapted from Castro, 2017

Semantic memory is not designed for the processing of large amounts of data and information, "these can be memorized and retained as long as they are functional; then they are discarded as 'cortical garbage' when this memory is full, so the retention time is short"

(Brito Albuja, 2013, pp. 7-51; De Zubiría, 2000, pp. 14-39). For such reason, learning is developed through instruments of knowledge and intellectual operations. "An instrument of knowledge is a generalized learning that allows the comprehension of the world around us; it abstracts reality into a complex mental tool that helps us to interpret situations and to apprehend" (LEV, 2020, p. 42).

Intellectual operations allow the processing, utilization, exercise and application of the instruments of knowledge. These intellectual operations are mental abilities that potentiate each of the levels of thought for the creation of new structures and semantic relations, as shown in Table 1. For this reason, it is necessary to teach simultaneously the intellectual operations together with the instrument of knowledge to be taught.

Conceptual Pedagogy offers an important contribution regarding the teaching of knowledge instruments by means of mentefacts. These focus on three fundamental areas: 1) cognitive, which allows the understanding of the world through sciences; 2) affective, which refers to the attitudes, affections and emotions necessary for human formation and motivations; and 3) praxeitive, which focuses on the skills and abilities necessary to process knowledge and apply it.

Age	Level of thinking	Instrument of knowledge	Intellectual Operations
2 - 6 years	Notional	Notion	Introjection, Projection, Nomination and De-nomination
6 – 12 years	Propositional	Proposition	Encoding, Decoding, Propositionalization and Exemplification
12 – 14 years	Formal	Chain of reasoning	Induction, Deduction, Transduction and Hypothesizing
14 – 16 years	Argumental	Argument	Tesification, Argumentation (Counterargumentation), Derivation and Definition
16 – 18 years	Conceptual	Concept	Supraordination, Exclusion, Isoordination and Infraordination

Table 1. Relationship between levels of thinking, instruments of knowledge and intellectual operations. Adapted from: (Unidad Educativa Lev Vygotsky, 2020)

Each of these areas is related to the human triangle and are hierarchized according to the level of thinking to be developed. The great advantage of mentefacts is that they allow the development of thinking from an early age, organizing and categorizing the objects and notions of the Popperian Three Worlds and transforming information into real knowledge. In addition, they are a very useful didactic tool for transcending from particular information to instruments of knowledge and generalizations that allow understanding the world. Figure 3 shows the conceptualization of the mentefact.

2.2 Learning Achievements

According to José Brito (2019) "a learning achievement is the action (ability) and, sometimes, the operation (skill), which is manifested in its execution, realization or performance" (p. 1) as a direct consequence of a teaching-learning process for the acquisition of a competence. On the other hand, Kennedy (2007) states that "learning achievements anticipate what students will be able to do with the learning, under what conditions they will do it, and suggest evaluation criteria" (p. 19). These achievements guide the choice of the evaluation system, the selection of teaching content, teaching and learning strategies and activities, as well as the selection and use of resources.

For the Ministry of Education of Ecuador (2019) the learning achievements.

> They are those that identify the capacities associated with the areas of knowledge, practices and experiences of the area and/or subject in the corresponding sublevel; they constitute the previous steps towards the achievement of the general objectives of the area. The objectives of the area by sub-level cover the set of learning of each area in the corresponding sub-level. (p. 21)
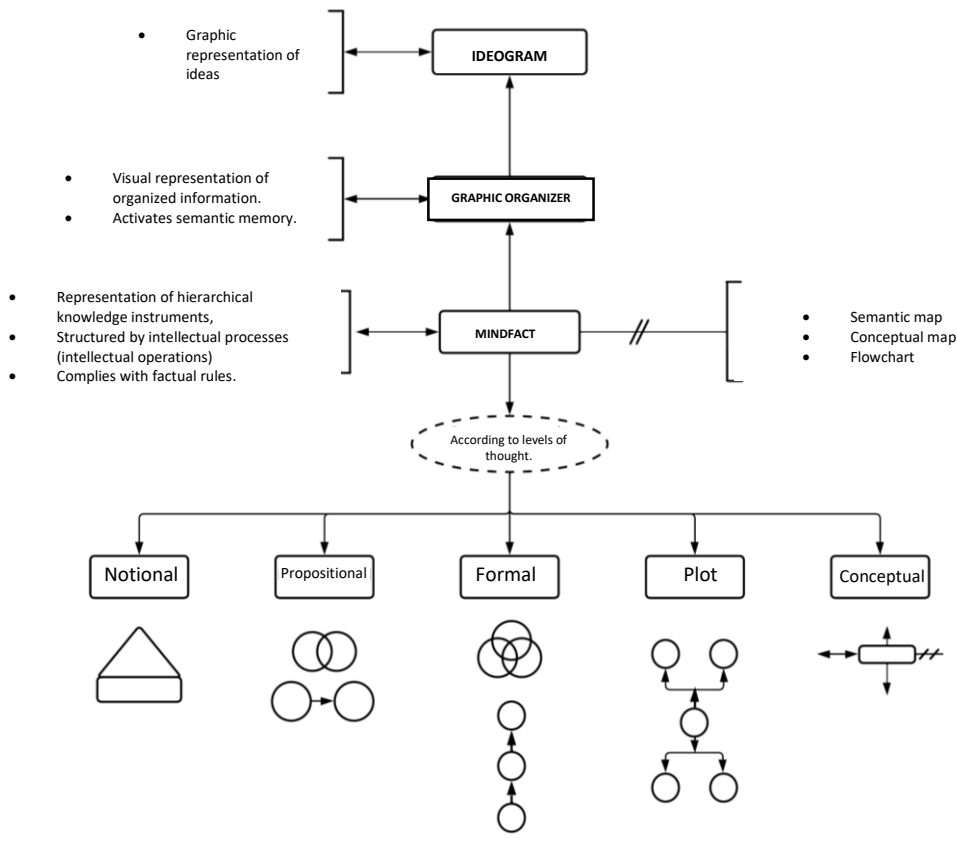
Figure 3. Conceptualization of mentefact. Adapted from: De Zubiría et al., 2019

In the case of Conceptual Pedagogy, curricular characteristics are defined by learning achievements, which include the acquisition of knowledge, skills and formative competencies. This pedagogical model is context-focused and interdisciplinary. In addition, it focuses on the needs of the labor market, unlike the traditional curriculum that focuses

only on the knowledge to be transmitted to students. Moreover, according to the European Center for the Development of Vocational Education and Training (2011) "the definition of learning achievements promotes teaching and learning practices in different places and through different strategies, always learner-centered" (pp. 3-4).

For learning achievements to become the "generic outcome statements of what a learner is expected to have achieved at the end of a level of learning" (Moon, 2004, p. 3), emphasis should be placed on the learner's ability to perform an action, expressing it in terms of the human dimensions: affectivity, cognition and praxis. Each outcome should include a single action verb, followed by its complement and a context sentence. Precision in the wording implies avoiding ambiguous terms such as knowing, comprehending, learning or understanding; being related to the competencies selected and adapted to the educational level. In addition, they should be stated in such a way that the degree of acquisition by the students can be checked. According to Royo (2010) "to formulate them, it is necessary to include a verb that indicates the action, one or several terms for the object of the action, and others to express the level of detail, character or context of the execution" (p. 20).

2.3   Learning assessment

Evaluation is a key element that indicates the level of achievement of the established purposes, the effectiveness of teaching, students' progress and the effectiveness of the didactic resources used. In addition, it allows reflection on the planning and development of the educational process (De Zubiría et al., 2019). According to Julian De Zubiría (2015)

> evaluation must contemplate the three human dimensions. In this sense, a description and explanation of the current level of development is required, taking into account the context and the personal, social and family history of the person being evaluated. In addition, it is important to prioritize the assessment of modifiability and to recognize that assessment is necessarily an intersubjective process. The quality of the assessment is based on the proposed objectives having appropriate criteria and instruments, so that the diagnosis allows the selection of the most appropriate option (pp. 233-241).

Experts in educational assessment assign three purposes: to diagnose, to form and to add up.Standardized tests are considered a valuable tool for assessment, as they have been used and maintained according to educational and social needs for content standardization. According to George-Reyes (2020) "these tests are used to verify the learning achieved by students, as well as to obtain indicators to compare the educational systems of different regions or even countries" (p. 420).

For the design of standardized assessments, a methodological framework is defined to make the assessment operational and to provide precise guidelines for structuring the instrument. This methodological framework contains information on the types of assessment, items, instruments, scoring rule, cut-off points and assessment time, as shown in Table 2. (INEVAL, 2021, pp. 11-14).

Component	Property
Target population	Characterization of the subjects to whom the evaluation will be applied, considering age group and referential number of the target population.
Type of assessment	Identification of the purpose of the evaluation according to the evaluating agent, the use of results or the moment of application.
Type of items	Selection of the type of item, number of plausible answers and number of correct answer options.
Number of items	Determination of the number of items proposed.
Type of instrument	Establishment of the type of instrument to be used in the evaluation.
Time of assessment	Specification of the duration of the evaluation based on data from past evaluations or pilot evaluations.
Cognitive levels	Specification of the cognitive levels of the taxonomy or theory to be used, as reflected in the instrument.
Calculation of cut-off points and scoring rule	Indication of the minimum cut-off point above which the subject will be considered to pass or fail the evaluation, including the qualification rule.
Evaluating agent	Definition of the person or institution that will apply the evaluation instrument; in case there are different roles, the function of each participant is described.
Application considerations	Establishment of the necessary regulations to guarantee adequate levels of reliability in the application of the evaluation according to the population and the modality of application of the instrument.

Table 2. Components of the methodological framework for a standardized assessment. Adapted from: (INEVAL, 2021, pp. 11-14)

2.4 Pandemic Education

The covid-19 health crisis forced governments to implement control measures to reduce the spread of the virus, such as social isolation (Fong et al., 2020, p. 977), suspension of economic activities (Rahman et al., 2020, p. 2), mandatory use of masks, border closures (Lau et al., 2020, p.8), reduction of transportation services (Tirachini and Cats, 2020, p. 15) and, of course, discontinuation of face-to-face mode in educational institutions (Crawford, 2020, p. 20).

Despite this, educational institutions have implemented strategies to continue academic programs through virtual education. However, this modality presents problems such as the lack of technological resources on the part of students, reflecting the economic limitations they face and restricting their access to connectivity and digital media at home. In addition, for Sánchez-Almeida et al (2021) "mandatory social isolation as a preventive measure also affects the performance of students in virtual environments, as well as in the emotional sphere and in the family environment" (p. 695).

Thus, this opens the debate on the possible benefits and risks of excessive exposure of students to technologies due to online education. Torres-Toukoumidis et al. (2021) highlights "the lack of dynamics and practical interactions and admits that this modality does not provide a safe environment to develop thinking and comprehension skills" (p. 3).

Compared to more conventional pedagogical approaches, where teaching is done unilaterally from teacher to student (implying passivity), virtual or blended environments encourage more interactive communication between both parties. However, to achieve this, active techniques that promote more participatory learning must be applied, otherwise the potential offered by ICTs would be wasted. The construction of knowledge in these virtual environments highlights the importance of collaboration and mutual support among members of the educational community, which contributes positively to teaching and learning, as well as to the intellectual enrichment of all those involved. In fact, Hinojo & Rodríguez Fernández (2012) state that many of the new educational strategies are based on cooperation in learning, such as group learning, peer tutoring or collaborative learning (p. 162).

3. Methods and instruments

3.1 Research design

The present research used a transectional non-experimental quantitative approach. This was because no variables or study categories were manipulated and a single measurement was made through the application of the Assessments of Appropriation of Apprehension Achievement in the subject of Physics. In addition, a correlational-causal approach was used to define the relationships between the modality of study and the level of appropriation of learning achievement at a single point in time, establishing causal explanations (Álvarez, 2020; Huaire, 2019).

3.2 Population

The group of participants in this study were students from Eighth Grade of General Basic Education (EGB) to Third Grade of General Unified Baccalaureate (BGU), legally enrolled, and 442 students took the assessments of Appropriation of Learning Achievement in the subject of Physics, whose distribution by level and modality is shown in Table 3.

Grade	Students in Semi attendance	Students in Virtuality	Total
Eighth Grade EGB	29	50	79
Ninth EGB	43	44	87
Tenth EGB	42	44	86
First BGU	48	24	72
Second BGU	21	47	68
Third BGU	30	20	50
Total	213	229	442

Table 3. Population distribution

One student was excluded from this group, who has curricular adaptations of level III, because he has medical conditions related to Refractory Epilepsy with Intelligence Quotient (IQ) of 73.

3.3 Data Collection Techniques and Instruments

For this research, the Assessments of Appropriation of Learning Achievement were used as the main instrument. The Lev Vygotsky Educational Unit carried out a face-to-face evaluation of the basic subjects with the objective of analyzing the impact of the blended and virtual classes on the students. The results of the evaluation made it possible to establish comparisons on the academic performance of both populations and conclusions were reached that have been useful for the design and development of an Institutional Educational Quality Improvement Plan. The evaluations sought to verify the levels of appropriation of the knowledge instruments developed in the subjects, but this research focuses on the results obtained in the subject of Physics during the first quarter of the 2021-2022 school year.

3.4 Procedure

The instrument was designed according to *the Learning Achievement Appropriation Assessment Plan Matrix*. The mediators recorded the learning achievement to be evaluated, together with the corresponding code for its identification, the level (Elementary, Basic and/or Advanced) and the type of achievement (Praxeutic or Cognitive), as well as the wording of the question and the response options. Each instrument consisted of 20 multiple-choice questions with 4 response options, only one of which was true. The questions were grouped by themes, covering several levels and distributed as follows: 10 items on elementary level apprehension achievement, 7 items on basic level apprehension achievement, and 3 items on advanced level apprehension achievement.

The items were structured with the objective of demonstrating students' appropriation and applicability of knowledge, avoiding focusing only on the application of formulas or memorization without reasoning. In addition, cumulative evaluations were carried out, which included all the contents addressed during the first quarter of the 2021-2022 school year.

Once the Planning Matrices were elaborated, the teachers sent to the assistant principals of each level to perform a first review and correction on the structure of the questions. Each reviewer analyzed whether the question was related to the topic proposed in the Pre-Learning Triangle, the Pre-Learning Achievement Matrix, the contents developed in the Pre-Learning Notebook and the measurement of applicability of the Intellectual Operations and/or Knowledge Instruments taught in class. In order to carry out this review, the Matrix to evaluate Instruments was used.

Once the planning was approved, the mediators created the evaluation instrument based on a template provided. Other mediators from the same field and teaching at other levels reviewed these documents. At this stage, it was verified that each question had only one answer and that it was related to the learning objectives set by the area for each level.

3.5 Data processing

For the treatment of the data collected in this research, the statistical software R was used, which is a language and environment for computational statistics (R Core Team, 2022). Several statistical tests were applied to compare the results of the evaluations between students who attended blended classes and students who attended virtual classes. First, the Kolmogorov-Smirnov test for two samples was used to verify whether the distribution of the data in both modalities was normal. Subsequently, Levene's test for homogeneity of variances with center at the median was applied to assume equality of variances between samples. Finally, the T-test for two independent samples was used to determine if there

were significant differences between the results of both modalities, establishing a significance level of 0.05.

The data obtained were presented in tables and graphs to facilitate their understanding and analysis. In addition, descriptive analyses were carried out to calculate measures such as the mean, median and standard deviation of the results obtained in the evaluations. All statistical analysis was performed in accordance with the specific objectives and hypothesis stated in this research.

4. Results

After the application of the instrument, the database was organized in order to analyze the scores and create tables and graphs with the help of R software.

Figure 4 shows the results obtained in the evaluation of cognitive and praxical achievement, divided into 6 parts corresponding to the three levels of educational achievement evaluated. Each part of the graph represents the concentration of the number of successes according to the blended or virtual modality in each of the levels. In general, a similar trend can be noted between both modalities, where the number of correct scores in the basic and elementary cognitive achievement levels are quite similar; however, the blended mode presents a slight advantage in the basic and advanced achievement levels.
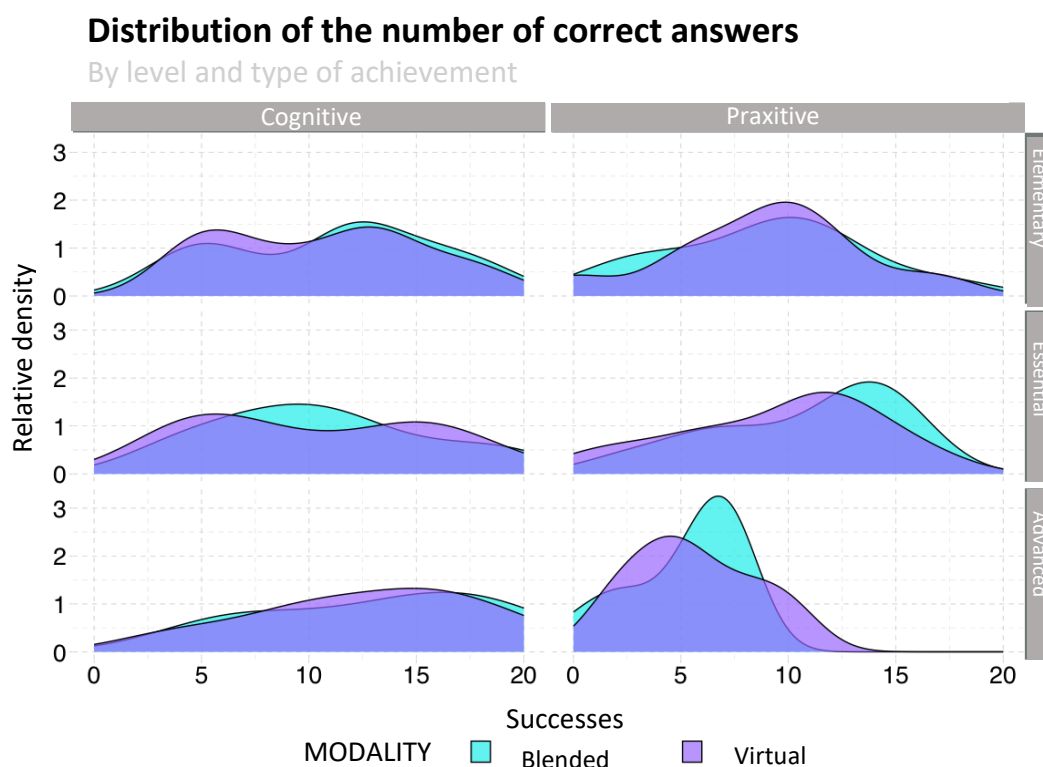
Figure 4. Percentage of successes according to modality, type and level of learning achievement

Figure 5 presents a comparison between the blended and virtual teaching modalities, in terms of the level of student learning achievement in the levels of Upper Basic and High School. In Upper Basic, a similar distribution can be observed in elementary and basic achievement, but with a slight advantage for the blended learning modality as of 10

successes. As for advanced achievement, the virtual modality stands out with a prevalence in this category.

At the baccalaureate level, there is an uneven distribution in advanced achievement, but a higher proportion of correct answers is observed in the virtual modality. However, for elementary and basic level achievement, the distribution is more balanced between the two modalities.
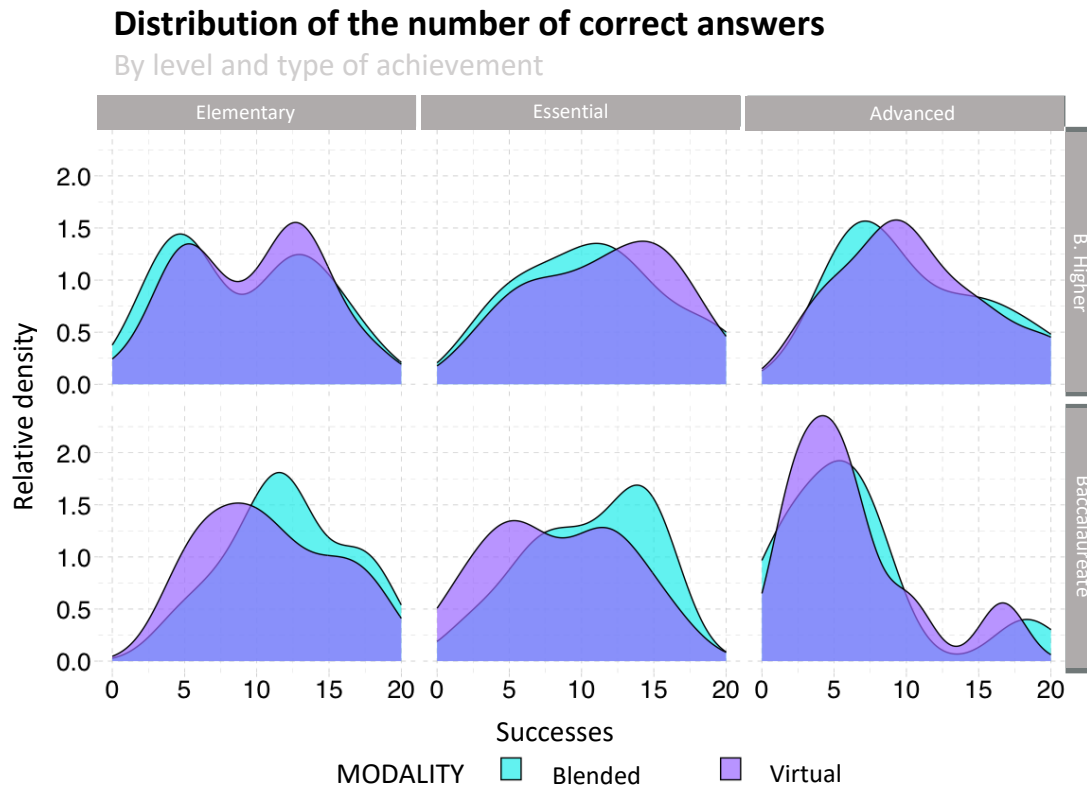
Figure 5. Percentage of successes according to modality, level of achievement and educational level

Figure 6 shows a graph divided into 12 parts, showing the results of students from different educational grades in relation to the levels of learning achievement. In Tenth grade, there is no significant difference between both modalities, but this distribution changes for the lower grades according to achievement level. In Bachillerato, the blended learning modality presents better results in most achievement levels, presenting very marked concentrations of successes.

Distribution of the number of correct answers

By level and type of achievement
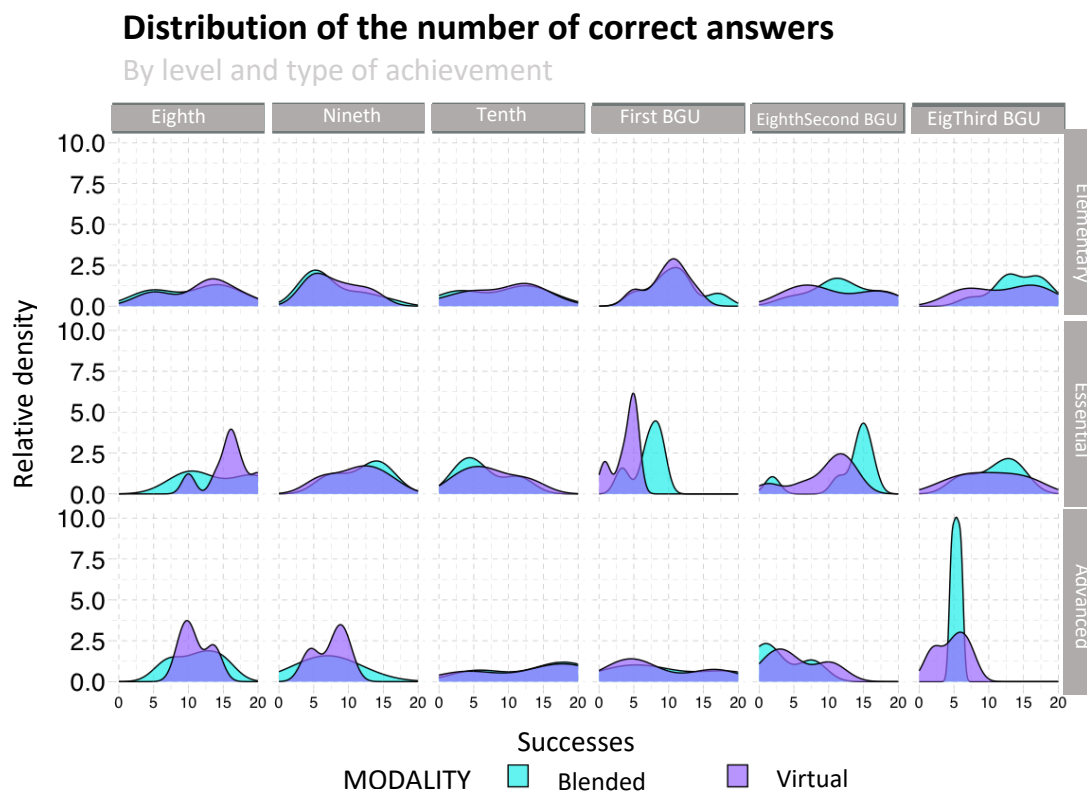
Figure 6. Percentage of successes according to modality, grade and level of learning achievement

Table 4 presents the results of three statistical tests carried out to evaluate the differences between the teaching modalities in terms of the hits obtained by the students. The purpose of these tests was to determine the normality of the sample distribution, as well as the differences in the variances and means of the scores according to the study modality.

Test	Objective	Value	p-value
Kolmogorov-Smirnov test for two samples	Compare the observed cumulative distribution function of hits by mode with a theoretical normal distribution.	D = 0.10833	0.482 < 0.05
Levene's test for homogeneity of variances with center at median	Calculate the equality of variances for the modality-dependent hits.	F = 4.3025	0.03913 < 0.05
T-test for two independent samples	Test whether the means of the modality-dependent hits are equal or not.	t = -0.5486	0.5838* > 0.05

Table 4. Statistical tests employed. (* presents a confidence interval of [-3.4814; 1.9647])

5. Discussion

In this section, the results obtained through the analysis of the data collected in the study were discussed. The differences found between the teaching modalities in terms of cognitive and praxetive achievement were examined, and the possible reasons behind these differences were explored. In addition, the implications of these findings for online and face-to-face education were discussed, as well as recommendations for improving the quality of teaching in both modalities.

The perception of the blended modality as more effective relative to the virtual modality may be based on the fact that the in-person interaction and support provided in this modality may have a positive impact on student performance compared to the virtual modality. In addition, feedback is given in a better way in the blended mode, since the teacher can interact more directly with the student and provide a more personalized and effective response. However, it is important to keep in mind that the effectiveness of each modality may vary depending on factors such as the quality of the educational material and the teacher's ability to adapt to the online platform.

The results of the statistical tests indicate that the value of: $D = 0.10833$ and that, p-value = $0.482 > 0.05$, suggesting that the distribution is normal for Kolmogorov-Smirnov tests. Furthermore, for Levene's test that evaluates the homogeneity of variances between the two apprehension modalities, using the median as the center; the results showed that: $F = 4.3025$ and that, p-value = $0.03913 < 0.05$, suggesting that it can be assumed that the samples are homocedastic.

Through the t-test for two independent samples, it is evaluated whether there is a significant difference in the hits obtained according to the study modality. The t-value obtained in the test was -0.5486, indicating that the difference between the means of the two groups is not significant. Furthermore, p-value = $0.5838 > 0.05$, which means that, there is not enough evidence to reject the null hypothesis: the means of the hits are equal for both modalities. That is to say, no significant differences were found between the successes obtained by the students in the blended and virtual modalities in terms of their mean.

According to the results obtained in the evaluation of appropriation of learning achievements in both study modalities, there is no significant difference in the appropriation of these achievements by the students. It is important to emphasize that this similarity in the results is not due to differences in the environment or resources, but rather to the importance of the learning achievements as a guide for teaching. In this sense, the implementation of Conceptual Pedagogy, which emphasizes the clarity of learning objectives and their follow-up, may have contributed to the homogeneity of the results obtained in both study modalities.

The present investigation demonstrates that the study modality does not have a significant effect on the acquisition of learning. However, it is important to reflect on the importance of the didactic components that influence educational success. In this sense, a change in the current perspective is proposed, emphasizing the importance of teaching objectives or purposes, in order to then design pedagogical activities and strategies to achieve these objectives. Finally, special attention should be paid to the evaluation process, considering that it not only allows measuring the learning acquired, but also provides valuable information to provide feedback to the teaching process and adjust the objectives and strategies in a timely manner. In this way, the success of education can be guaranteed, regardless of the study modality used.

In education, it is essential that students acquire knowledge, not just information. Knowledge refers to the deep and meaningful understanding of concepts, while information is simply the accumulation of data. The results obtained in learning depend on the development of the instruments of knowledge through mentefacts, that is, cognitive tools that allow the construction and understanding of complex knowledge. Therefore, it is important that teachers teach students how to structure information to consolidate knowledge and its applicability.

6. Conclusions

1. The covid-19 pandemic did not significantly affect the appropriation of learning achievements in the students of Higher Basic and Baccalaureate of the Lev Vygotsky Educational Unit in the subject of Physics, during the 2021-2022 school year.
2. The instruments designed and validated by experts are reliable and valid for the evaluation of learning achievements in the subject of Physics.
3. No significant differences were found in the appropriation of learning achievements between the virtual and blended learning modalities, with respect to the mean number of correct answers.
4. The hypothesis is partially accepted, since a slight advantage was found in the academic achievement of students who attended blended classes compared to those who attended virtual classes in basic and advanced achievement levels. However, no significant differences were found in the appropriation of learning achievements between the two modalities.

Among the limitations encountered, it should be noted that the assignment of students to the study modalities (virtual and blended learning) was not random but depends on factors such as the availability of technological resources or geographic location determined by the context of each student. On the other hand, the emotional situation of the students was not taken into account as an intervening variable, and it is possible that it influenced the results obtained and were not controlled in the study.

Based on the results and findings of this study, future research can be proposed taking into account a longitudinal study, in which the sample of students at different educational levels and in different areas of study is expanded, in order to evaluate whether the results obtained in this study are applicable to other subjects and educational levels. Likewise, the evaluation of the quality of virtual education can be deepened by means of a study that relates it to the factors that can influence its effectiveness, such as course design, interaction with the teacher, among others.

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Pedagogic practice in a hospital environment

Práctica pedagógica en un ambiente hospitalario

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Abstract

The article analyzes the importance of pedagogical actions in hospital environments, considering the educational inclusion of children and young people in situations of illness and hospitalization. The main problem is the lack of attention from educational and health administrations, and the lack of knowledge of processes that lead to a continuity of the school curriculum; to this is added feelings of anguish and anxiety about the academic aspect, since the absence of the patient in the classroom causes delay and desertion in their studies. The purpose of the research is to investigate experiences and results of research related to this study. It is an exploratory qualitative approach research, it analyzes a problem from different perceptions; it considers the inductive-deductive method and the empirical method as the immediate experience of the undergraduate students of the Pedagogy of Experimental Sciences, Mathematics and Physics of the Faculty of Philosophy, Letters and Education Sciences of the Central University of Ecuador who participated in the pedagogical practice in a hospital environment. The results obtained from the analysis of the interview script indicate that, in addition to the teaching that should be provided through playful and didactic activities, emotional support is important. Finally, the study proposes different pedagogical actions and teaching strategies adapted to the special educational needs derived from the disease and hospitalization.

Keywords

Hospital environment, educational inclusion, pedagogical practice, academic mentoring.

Resumen

El artículo analiza la importancia de las actuaciones pedagógicas en ambientes hospitalarios, se considera la inclusión educativa de niños y jóvenes en situaciones de enfermedad y hospitalización. Se plantea como problema fundamental la escasa atención de administraciones educativas, sanitarias, y el desconocimiento de procesos que conlleven a una continuidad del currículo escolar; a esto se suma sentimientos de angustia y ansiedad por el aspecto académico, pues, la ausencia del paciente en las aulas provoca retraso y deserción en sus estudios. El propósito de la investigación es indagar experiencias y resultados de investigaciones relacionadas con este estudio. Es una investigación de enfoque cualitativo exploratorio, analiza un problema desde diferentes percepciones; considera el método inductivo-deductivo y el método empírico como la experiencia inmediata de los estudiantes de pregrado de la carrera de Pedagogía de las Ciencias Experimentales Matemática y Física de la Facultad de Filosofía, Letras y Ciencias de la Educación de la Universidad Central del Ecuador que participaron en la práctica pedagógica en ambiente hospitalario. Los resultados obtenidos a partir del análisis del guion de la entrevista señalan que, además de la enseñanza que se debe brindar a través de actividades lúdicas y didácticas es importante el apoyo emocional. El estudio, finalmente, propone actuaciones pedagógicas diferentes y estrategias de enseñanza adaptadas a las necesidades educativas especiales derivadas de la enfermedad y la hospitalización.

Palabras clave

1. Introduction

Pedagogical practice in hospital environments means contributing to an educational normalization of the convalescent child or young person that responds to specific educational needs. The analysis of these needs and possible responses depends on a large number of factors such as: the training of professionals who accompany the student-patient, the methodology used to design an intervention through academic tutoring and public policy that promotes an appropriate pedagogy according to the specific needs. Hence, these factors are essential to legally standardize an efficient pedagogical performance.

The most common problems faced by children and young people who are hospitalized are related to disinterest, indifference on the part of educational and health administrations, and the lack of knowledge of an agile process to provide continuity to a school curriculum. It is also observed that in most Latin American countries there is no specialty in hospital teaching; to this is added the indifference of society in general.

The present study proposes to determine the advantages of hospital education. The pedagogical performance implies a systematic review of how the training of teachers who teach in hospitals is treated. The main findings of this research are the study of teaching strategies adapted to the special educational needs derived from illness and hospitalization.

Regarding the methodology, the research has used an exploratory qualitative approach, since it analyzes a problem from different perceptions. The technique used was the interview with the interview script instrument. The interview was directed to 32 students/trainers of the Mathematics and Physics Department of the Philosophy Faculty of the Universidad Central del Ecuador who applied the Hospital Classrooms project to 136 children hospitalized in the pediatric area of the Carlos Andrade Marín Hospital in the city

of Quito-Ecuador. The study is based on an inductive-deductive method because it is based on the observation of facts in order to establish teaching strategies adapted to special educational needs.

Regarding the structure and content of the article, section 2 presents the studies related to the research. In section 3, the concepts related to the research topic are presented. Section 4 details the methodology used to develop this research. Section 5 shows the results of the interview script. In section 6, conclusions are drawn according to the results obtained.

2. Related studies

In 2020, a research entitled La formación docente en la modalidad hospitalaria domiciliaria en argentina: un desafío del porvenir gives an account of their teaching practices in hospitals. Regarding the training of professionals, this research does not show a curricular support that guarantees the academic development of the teaching staff. In terms of policy, Law No. 26,206 created in 2006 establishes Home and Hospital Education as one of the modalities of the Argentine Education System; in its Article 60, it guarantees home and hospital education at all educational levels (initial, primary and secondary) and establishes the right to education of students who, for health reasons, are unable to attend an institution on a regular basis. Methodologically, the authors of this project indicate that their practice was based on the metaphor of the kaleidoscope (a self-evaluative return of their individual and group construction process, necessary to be objectied), Cuidarse para Cuidar that addresses the importance of life and its sustainability with quality of life both for those who stay and for those who leave, the Hospitacuentos and a thousand and one places to play (Vitarelli and Margall, 2020).

In the year 2023, the Ministry of Education of the Plurinational State of Bolivia points out general norms for educational management. Regarding teacher training, Art. 62 states that the Specialized Unit for Continuing Education (UNEFCO) develops refresher courses for teachers, with emphasis on theory and practice in classrooms other than regular education. In the political sphere, education and health are established as universal rights with community support, with their own cosmovisions. In public policy, pedagogical action is based on the constitution of the Plurinational State of Bolivia 2022, considering the international human rights policy (Ministry of Education of the Plurinational State of Bolivia, 2023). Methodologically, curricular planning responds to a Pluricultural Bolivian State, emphasizes the implementation of hospital support classrooms, develops competencies on knowing how to be, knowing how to do, knowing how to know and knowing how to live together (Ministry of Education, 2019).

In 2017, a research entitled El abordaje de la pedagogía hospitalaria en el contexto venezolano describes the experiences of different programs developed in hospitals. In the training of professionals, there is no investment in higher education with respect to teachers in hospital environments. In terms of policy, its hospital pedagogical performance responds to the special education modality implemented since 1970 through the Department of Exceptional Children, which depended on Preschool Education. In the Public policy since 1976, specifically, in the 1st document of Conceptualization and Policies of Special Education and in 2003 in the Report of the Special Education Modality: they raise in their mission and vision, respect for diversity, access to comprehensive education, heterogeneity as a natural fact of the school for all, and the social integration program (Serradas-Fonseca, 2017). Methodologically, the aim is to develop therapies with educational sense (Romero and Alonso, 2007).

In 2017, a research entitled La pedagogía clínica-hospitalaria en el Perú. A challenge and challenge for the education and health sector points out the characteristics of a hospital pedagogy based on three strategic lines: support for educational intervention, attention to the patient's family and hospital pedagogical research. Regarding the training of professionals, there is no specific and officially recognized university education in hospital pedagogy in this research. Public policy is based on the General Law of Education, its Regulation of Special Education guarantees a hospital education (Mendoza-Carrasco, 2017). Methodologically, the existing program has been adjusted to the particularities of the Peruvian context, considering that the children served come from different regions of the country, with varied educational levels and even different languages (Chaves-Bellido, 2012).

In 2018, in a program entitled *Libros de Educa Hoy llegan a escuela del Hospital Bloom* gives an account of the existence of an educational center, whose facilities are on the upper floors of the Hospital Bloom, it is the only one of its kind at the level of Central America and the Caribbean; in addition, it has served as an example and model for implementation in countries such as Chile. As for the training of professionals, there is no mention of education for hospital teachers; the educational center is staffed by teachers who work in regular or special education schools. The public policy establishes legal norms that regulate the function of this hospital classroom, based on Decree No. 917; the General Education Law of December 12, 1996; the Law of Equal Opportunities for Persons with Disabilities 2000 and its regulations; and the Law of Integral Protection of Children and Adolescents 2000. Methodologically, it focuses on the plastic arts through this resource affective and academic contents are taught (Martínez, 2018).

In 2020, in a research entitled *Aulas hospitalarias en Paraguay* points out that since 2009 the Ministry of Education and Science through an agreement carried out procedures for the habilitation of hospital classrooms as proposed solutions for children suffering from any disease. In the training of professionals, they point out that no specific competences are developed to attend to the student-patient; this is done as a practice of continuous training. The public policy is framed in Law No. 6749 on Hospital Pedagogy, whose objective is to guarantee the right to education of hospitalized or ill children and young people. Methodologically, the classroom is organized by modalities: hospital classroom; hospital ward and home care (García-Tatera and Sánchez-Bobadilla, 2020).

In 2019, through the page of the Costa Rican Ministry of Education, it was indicated that the high school educational service for hospitalized adolescents at the San Juan de Dios Hospital had been inaugurated. Regarding the training of professionals, there is no specific educational program for hospital pedagogy; however, it is complemented with courses, workshops and seminars on hospital pedagogy. In public policy, hospital care is supported by Article 21 of Law 7600 on Equal Opportunities for Persons with Disabilities and its Regulations; the Code for Children and Adolescents and the National Policy for Children and Adolescents 2009. The learning methods and strategies have an inclusive approach and are oriented to the development of competencies (Díaz, 2019). The Methodology used is flexible and adapts to the needs of each student, it is noted that they work one hour a week and the lessons are divided into moments of beginning, development and closing with individual or group work sessions (Ardón et al., 2017).

In 2008, a research entitled Pedagogía Hospitalaria Chile - España - Centro América (Hospital Pedagogy Chile - Spain - Central America) describes the history of hospital classrooms in Chile. In professional training, it is observed that undergraduate education is

limited to specific actions associated with practical cases, while postgraduate training offers diplomas in specific areas, but not in hospital pedagogy. In public policy, pedagogical action is based on the Declaration of the Rights of Hospitalized Children and Young People. On the other hand, it contemplates the 2015 Framework Law on Hospital Pedagogy in Latin America. Methodologically, it is based on the continuity model of the educational process and prioritizes the recovery of health, and then focuses on the objectives of education (Garcés, 2008).

In 2024, a study entitled *Anteproyecto de Ley 197*. Derecho a la educación de los niños, niñas y jóvenes hospitalizados o en situación de enfermedad en Panamá raises some perspectives for hospital education. As for the professional training of teachers, there is no specific curriculum on hospital pedagogy in the country. In public policy, pedagogical action is protected by the Political Constitution of the Republic of Panama, Chapter 5, Art. 91, 92, right to education, Convention on the Rights of the Child 1989, Art. 28 and 29, specifically on the right to education of children and young people in a situation of illness. In terms of methodology, it is indicated that the priority is to give continuity to education, and for this purpose it has been divided into three care modalities: hospital classroom, hospital ward and home care; all modalities have as methodology the continuity of their studies (Center for Latin American Studies on Inclusive Education |CELEI|, 2024).

3.   Related concepts

3.1.1   Inclusive education

Inclusive education is understood as any political attitude, collective commitment or educational trend that seeks to integrate individual differences and needs. In this regard, UNESCO (2001) states that educational inclusion "is seen as the process of identifying and responding to the diversity of needs of all students through greater participation in learning, cultures and communities, and reducing exclusion in education" (p. 15). With this appreciation, inclusion is perceived not only as integration, but also as adaptation. Adaptation to different learning styles and needs; learning difficulties are various, and if illness and hospitalization are added to this, the situation of school continuity is further aggravated. Inclusive education projects the access of children and young people to formal education. In this sense, the presence of pedagogical action in the hospital environment is imperative.

3.1.2   Hospital education

The teaching process can be developed in the hospital classroom (physical space determined to receive classes), in the room (mobile classroom) or at home depending on the specific needs of each patient. The Ministry of Education of Ecuador (2016) increased the National Model of Hospital and Home Education Management and Care, the program states that "hospital education is the teaching service provided to children and young people who are in periods of illness and hospitalization"(p. 8). The situation of illness and the hospital environment is an unfamiliar and, in some cases, discouraging place for children, young people and their families. In this sense, the educator plays a fundamental role, since the strategies and methodologies used should promote school activities that strengthen the continuity of the curriculum, an environment of well-being and resilience for patients and their families.

3.1.3 Pedagogical practice

The development of inclusive pedagogical practices focuses on the organization and planning of all the resources used in the classroom, this action is a consequence of the joint reflection of all educational actors, López-Machín (2000) expresses "in any pedagogical project, the soul is the teacher. He is the architect par excellence of the development of the work with the students, and of carving the human soul, which is the most important part of the educational work" (p. 2). Hence, the pedagogical performance must be supported by a curriculum that trains the hospital teacher.

In Ecuador, this practice is legally based on the Constitution of the Republic of Ecuador (2008), since in Title II, Chapter One, Section Five, Art. 27 states that "Education (...); will stimulate the critical sense, art and physical culture, individual and community initiative, and the development of skills and abilities to create and work (...)" (p. 33). Similarly, in Title VII, Chapter One, Section One, Art. 343 refers to the fact that "the national education system (...) will have as its center the subject who learns, and will function in a flexible and dynamic, inclusive, effective and efficient manner (...)" (p. 160).

It should be noted that the Organic Law of Intercultural Education (LOEI) framed in the Constitution, in force since 2011 and updated in 2016, also constitutes a legal basis that supports inclusion. In Art. 2 referring to the Educational Principles, literal (b) points out that "education constitutes an instrument for the transformation of society; (...)" (p. 9), while literal (s) refers to the flexibility of education, while literal (ll) mentions that "students are guaranteed an education that responds to the needs of their social, natural and cultural environment at the local, national and global levels" (p.13). However, in Ecuador there is no third level academic offer in hospital pedagogy. Methodologically, it is observed that students/teachers attending hospitals are based on value criteria and on the recognition of people as holistic, integral and diverse human beings.

3.1.4 Academic tutoring

The purpose of tutorial action is to help and guide the student in the learning process. According to Álvarez (1995)

> is a systematic process of assistance, addressed to all people in their formative period, professional performance and leisure time, with the aim of developing in them those vocational behaviors that prepare them for adult life, through a continuous and technical intervention, based on the principles of prevention, development and social intervention, with the involvement of educational and socio-professional agents (p. 12).

Thus, tutoring as a substantial element of the educational process presents as a characteristic a continuous, systematic and coherent curricular planning to the students' learning, considering their specific circumstances. In this process, it is also important for the tutor-counselor to develop empathy, emotional stability, confidence and leadership skills; but, above all, to possess learning strategies and participative methodologies such as help among students, the joint action of two teachers in the classroom, the formation of interactive groups, cooperative learning, dialogues, personalized tutoring, diversified teaching, meaningful learning, and the use of information technologies, among others.

For this reason, the curriculum should be made more flexible, curricular programs should be proposed that make possible different learning contexts, committing to overcoming

barriers of access, participation and commitment to meet diversity. In this sense, pedagogical practices in hospital environments have been conceived as a service that brings educational benefits to a process of educational inclusion in which the social reality and the contextual situation of each child and young person are combined with the psychosocial and educational needs. One of the first principles of these educational support units is that of comprehensive globalized education, integrating the context and the subject, here plays an important role the didactic resource and motivation.

Well-used didactic resources, in my personal opinion, make the teaching process more concrete, the class becomes attractive, fun, and knowledge becomes meaningful. The task of education according to Simbaña-Gallardo et al. (2017) "must allow living a constant process of interaction, that the person discovers and cultivates individualities and at the same time strengthens coexistence in collectivity, that manages to achieve corporate objectives through the cultivation of the spirit, morals, values" (p.93). Hence, academic tutoring in hospital environments must be based on values such as respect, empathy and good treatment of the student-patient; the tutor must develop good human relations with the patient's family, colleagues, hospital staff, etc.

Thus, the tutor anticipates what the student needs; love is paramount in this context, the teacher must attend in a loving and humane way to the student, but without being dragged by the pain. The task in the hospital environment is to ensure school learning, but also to help to understand the disease and the hospital environment, offering emotional and affective support to students and their families. For this reason, teaching-learning activities are only effective if they are carried out in an interpersonal way, but, in addition, the factors involved in the activity are directly related to the notion of care to the extent that hospitalized students require comprehensive care that promotes humanism, health and quality of life with due consideration of individual differences.

The principle of teaching responsibility, as well as the principles of justice and equality of educational care, are not marked by the prescriptions of duty, but consist in the recognition of students in their individual being. Simbaña-Gallardo et al. (2017) also indicate that in this task it should not be forgotten that "in society there are forms of social organization, and it will be up to education to articulate various social, economic, political, ideological and cultural scenarios that converge in the educational system" (p. 96). The educational curriculum responds to study plans or programs, but in practice it does not manifest unified criteria, it does not respond to social needs of interdisciplinarity and multidisciplinarity of knowledge; the educational curriculum then implies teaching from the problems encountered, from the comprehensiveness and complexity in a given context.

4. Methods and materials

The research has an exploratory qualitative approach and applies the empirical method based on experience. The following is a description of the steps developed:

1. Location of the study area. The research focused on the pediatric area of the Carlos Andrade Marín Hospital.
2. Selection of the sample. Thirty-two trainers from the Mathematics and Physics Department of the Philosophy Faculty of the Universidad Central del Ecuador applied the Hospital Classrooms project to 136 children hospitalized in the pediatric area of the Carlos Andrade Marín Hospital in the city of Quito-Ecuador.

3. Design and application of the research instruments. The technique applied to collect information was the semi-structured interview, this instrument was validated by experts in the area of Pedagogy of Experimental Sciences, Mathematics and Physics and experts in the area of Psychopedagogy of the Faculty of Philosophy, Letters and Education Sciences of the Central University of Ecuador. The interview was directed to 32 students of the Pedagogy of Experimental Sciences, Mathematics and Physics, who were the trainers of the project. The interview questions were related to the following dimensions: teaching experience in the context of hospital classrooms, beneficiary situation (children hospitalized in the pediatric area of the Carlos Andrade Marín Hospital), and academic tutoring in the context of hospital classrooms. To identify the participants, coding [ENT] was applied, assigning the number according to the order of intervention.

4. Data processing. Once the research instruments were applied, the interview was transcribed. Subsequently, the codes were created and the respective quotes were selected using the Atlas ti program. With the help of the Atlas ti program, the codes and quotes were recorded in a matrix, and a semantic network was elaborated for each dimension, in which the type of relationship between the codes was established.

5. Analysis and discussion of results. On the basis of the matrix of relevant codes and quotations, together with the semantic networks, the results were theorized and discussed. Finally, the conclusions of the study were drawn.

5. Results

Table 1 shows a summary of the categories: teacher perception, situation of the beneficiaries and academic tutoring in the context of hospital classrooms with their respective codes and frequency of rooting. Subsequently, through the formation of semantic networks, the most relevant aspects for the aforementioned categories are described.

Category	Codes	Freq	Relevant quotations	Identificator
Teaching experience	Rewarding experience	23	"one of the most rewarding experiences I've ever had."	ENT-5:1
			"A good experience"	ENT-6:1
			"really wonderful experience"	ENT-8:1
			"very pleasant experience due to the fact that we shared with wonderful children".	ENT-9:1
			"I liked this work very much, I got very attached to it".	ENT-10:2
			"The experience at the hospital was very gratifying"	ENT-11:1
			"it was a very gratifying experience for the spirit".	ENT-12:1
			"it was a very nice experience because of the sharing of knowledge".	ENT-15:2
			"the experience was very nice and pleasant".	ENT-16:5

		"It was one of the most unforgettable experiences that we as students and human beings can have.	ENT-18:1
		"it was very pleasant since this intercultural education project".	ENT-19:1
		"hospitalarias has been very satisfactory"	ENT-23:1
		"one of the most gratifying experiences that we could have".	ENT-28:1
		"it was a very gratifying experience"	ENT-29:1
		"it was an unrepeatable experience".	ENT-31:1
		"it was a rewarding experience".	ENT-32:1
Promoting inclusive education	10	"teachers are obliged to offer our service to those social groups that are excluded" "I would like us to continue in this way".	ENT-11:6
		"I would like us to continue with this social work that changes our lives and above all fills us with joy.	ENT-17:5
		"to change their mentality to achieve true inclusion".	ENT-27:3
		"helps you to transform as a person and find the human side".	ENT-31:2
		"I learned in a practical way what "INCLUSIVE EDUCATION" means".	
		"it was very enriching to be able to learn from them, the most defenseless".	
Inclusive education learning in the professional field	4	"it helps me to gain experience for my working life".	ENT-8:2
		"There is learning that is not taught in the classroom when you are training in a profession".	ENT-18:2
		"to forget for a while the situation in which they were in".	ENT-19:5
		"We were able to get a little bit out of the environment full of doctors and nurses.	ENT-20:3
Helps you forget about your problems	3	"but finally I was able to distract myself, smile and learn how beautiful this subject is".	ENT-1:9
		"right to a quality and warm education".	ENT-14:5
		"We teachers have the obligation to offer our service to those social groups that are excluded.	ENT-27:2
To provide a quality and warm education.	3	"We must educate for life, to love it and respect its diversity.	ENT-8:3
		"support that they give to each other".	ENT-11:6
		"learn to understand what kindness, companionship and most importantly empathy are".	ENT-20:4
Teaches empathy	2	"to see the other reality that is not observed in a normal classroom".	ENT-4:4

		2	"We learn values such as perseverance and perseverance.	ENT-15:4
	Learning a reality different from the classroom	1	"equal opportunities to learn and be included in society".	ENT-14:2
	Learning in values	1	"I would like us to continue with this social work that changes our lives and above all fills us with joy.	ENT-3:3
	Providing equal opportunities	1	"Many times they are excluded because of their disability.	ENT-8:4
	From	1	"to motivate them that life goes on and they have to keep on preparing themselves".	ENT-17:5
	Continue with hospital classrooms	1	"There is a lack of teachers to provide support in these areas.	ENT-28:2
	exclusion due to disability	1	"solidarity they have among themselves".	ENT-19:4
	Motivate students	1	"opportunity to work with children for the first time".	ENT-11:5
	Need for more teachers to support children	1	"anxious to be able to receive classes"	ENT-4:3
	Solidarity	1	"with their smiles on their faces"	ENT-4:1
Beneficiary status	Working with children	7	" enthusiasm with which the children were waiting for us"	ENT-1:7
			"The excitement of watching them learn"	ENT-2:2
			"she smiles and welcomes you with open arms"	ENT-3:2
			"she was waiting for me patiently and eager to learn"	ENT-7:2
			"they were excited when I came in".	ENT-12:2
			"patients with different types of illnesses"	ENT-20:1
			"girls with different illnesses that did not allow them to attend regular classes"	ENT-25:1
	Different diseases diseases	5	"illness depress them even more"	ENT-1:1
			"bedridden without access to their studies".	ENT-15:1
			"We encountered lucky and not so good situations.	ENT-16:3
			"And it was enough to arrive for the child to smile.	ENT-26:1
			"she waited patiently for me and was eager to learn".	ENT-27:1
		3	"They were excited when I came in".	ENT-17:4

	Joy in receiving classes		"children and adolescents who, due to life circumstances, had to postpone their studies momentarily".	ENT-20:1
			"girls with different illnesses that did not allow them to attend normal classes".	ENT-25:1
		3	"bedridden children without access to their studies".	ENT-14:3
	Postponing studies due to illness	3	"smiles and welcomes you with open arms".	ENT-15:1
		3	"they made the children very happy"	ENT-26:1
		3	"The affection that the children give us is unparalleled.	ENT-12:2
	They receive classes with joy	3	"they can't attend classes normally"	ENT-15:3
		3	"they can't attend classes normally"	ENT-29:2
		2	"They tend to be a little depressed.	ENT-1:3
	Do not attend classes normally	2	"they fight day by day to improve themselves and be better".	ENT-22:2
	Not attending classes normally	1	"bedridden, without access to their studies".	ENT-16:1
		1	"strive to learn and to be able to catch up".	ENT-6:3
	Depression	1	"not being with their families"	ENT-26:1
	Desire to improve	1	"miss their classmates"	ENT-1:10
	Difficulty in accessing studies	1	"remain alone most of the time".	ENT-16:4
	Efforts to learn	1	"miss classes"	ENT-16:2
	Missing family members	1	"constantly struggle day by day for their health "	ENT-1:6
	Missing peers	1	"vulnerable situation"	ENT-1:4
	Staying alone for long periods of time	1	"think about it, since it is a part of teaching that is not analyzed or taught to us".	ENT-1:2
	Missing classes	1	"it makes me reflect on life, on what we are doing today, on what you should improve or change".	ENT-32:2
Academic Tutoring	Health problems	12	"to improve in all aspects of my life to be someone better in the future".	ENT-5:2
			"It taught me that life does not have to be based only on seeking my well-being and in the future as a professional, only to teach.	ENT-6:2

			"It changes you and transforms you, making your way of thinking different.	ENT-6:4
			"I was able to acquire other qualities that we did not know yet".	ENT-7:1
			"It made us bring out our most human side and understand that life is harder with other people.	ENT-10:1
			"It was very enriching to be able to learn from them, the most defenseless ones.	ENT-11:2
			"There is learning that is not taught in the classroom when you are training in a profession".	ENT-13:2
			"there are more curricula like this".	ENT-18:2
			"To reflect that we always have to give our best whatever our problems are".	ENT-20:3
			"to analyze my life and to propose to myself to change, to strive daily for my ideals".	ENT-23:2
			"it was not only to teach the subject but also to accompany them".	ENT-26:2
			"We played games, I explained something they didn't understand.	ENT-30:1
Personalized Accompaniment	7		"We went to teach them what we are strong in Mathematics, Physics and Geometry, but not in an environment of boring them".	ENT-9:4
			"it does not imply just making the student learn".	ENT-17:1
			"giving them personalized tutoring"	ENT-19:2
			"accompanying them pedagogically"	ENT-20:2
			"We have to act wisely and quickly.	ENT-21:1
			"mathematics area but providing moral and emotional support."	ENT-29:3
			"the psychological part also requires it"	ENT-32:3
Emotional support	7		"to give them more than direct pedagogical support, it was emotional support".	ENT-1:5
			"mainly to support them and give them encouragement at all times so that they feel at ease".	ENT-11:4
			"if not that the presence of one of us was enough to make the child feel happy".	ENT-14:4
			"I carried out another type of didactics, familiarizing myself with the two children I had to teach.	ENT-17:2
			"They need emotional support".	ENT-17:3
			"In the area of mathematics, but by providing moral and emotional support.	ENT-19:3

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		"They learn mathematical knowledge from us.	ENT-22:4
Tutoring in the mathematics area	6	"They don't only need help in the academic area.	ENT-1:5
		"We go to teach them what is our forte, Mathematics, Physics and Geometry, but not in a way to bore them.	ENT-3:1
		"to teach them mathematics subjects".	ENT-11:3
		"to teach mathematics, to a very sweet and beautiful little girl".	ENT-19:2
		"methods to explain and to make them reason".	ENT-22:3
		"look for the most appropriate way to share by scrutinizing activities according to each situation".	ENT-24:2
Methodology-adapted to specific educational needs	5	"it helps me to gain experience for my working life".	ENT-4:5
		"there are more study plans like this one".	ENT-9:2
		"you have to act wisely and quickly".	ENT-19:5
		"to give them more than direct pedagogical support, it was an emotional support".	ENT-23:2
		"we go to teach them what we are strong in Mathematics, Physics and Geometry, but not in a way that bores them".	ENT-32:3
Pedagogical support	3	"to accompany them pedagogically"	ENT-14:4
		"activities according to each situation"	ENT-19:2
		"giving them personalized tutoring"	ENT-29:3
Customized activities	2	"a challenge to keep a child's attention".	ENT-9:3
		"look for the most appropriate way to share by scrutinizing activities according to each situation".	ENT-21:1
Adaptation of resources to maintain the child's attention	2	"return to their studies without any delay in their specific subject of mathematics".	ENT-4:2
		"When they leave the hospital and integrate into their daily life, there are no gaps in the educational field".	ENT-9:2
	2	"through games they are motivated to fight to get out of there".	ENT-26:3
		"we played, explained something they did not understand".	ENT-29:4
Teaching through games	2	"area of mathematics but providing moral and emotional support."	ENT-2:3
		"having a lot of understanding"	ENT-17:1

| Moral support | 1 | "doing some didactic activity" | ENT-1:5 |
| Understanding | 1 | "one of the most rewarding experiences I've ever had" | ENT-4:6 |

Table 1. summary of the categories: Teacher's perception, Beneficiaries' situation and Academic tutoring in the context of hospital classrooms

With respect to the category of teacher perception in the context of hospital classrooms, the most relevant aspects are as follows:

1. Rewarding experience: with a frequency of rootedness of 23, this code indicates that teachers find their work in hospital classrooms to be rewarding and meaningful.
2. Promoting inclusive education: with a frequency of rootedness of 10, this code clearly emphasizes that teachers see their experience in hospital classrooms as an opportunity to learn and promote inclusive education in a professional context.
3. Other codes, such as "helps to forget about their problems" and "provide quality and warm education," also have a frequency of rootedness of 3 or 4, indicating that teachers value aspects related to inclusion, emotional support, and quality of education in the hospital setting.
4. Some codes have a rootedness frequency of 1, suggesting that there is a need for more teachers to support children. A sense of solidarity is seen by teachers as indispensable but may not be as prominent in their overall perception of the hospital classroom experience.

In addition, in reference to the category teacher perception in the context of hospital classrooms, Figure 1 shows the semantic network with the most relevant codes analyzed above, through this analysis it was determined that teachers who performed their work in hospital classrooms found their experience rewarding and meaningful, demonstrating that they deeply value their work and commitment to learning inclusive education, taking advantage of this opportunity to develop these skills and knowledge.

Importantly, teachers value key aspects related to inclusion, emotional support and educational quality in hospital classrooms. This was reflected in the frequency of rootedness of codes such as "promote inclusive education", "help to forget about their problems" and "provide quality and warmth education". Another important aspect that emerges from this analysis is the need for more teachers to support children in this situation.
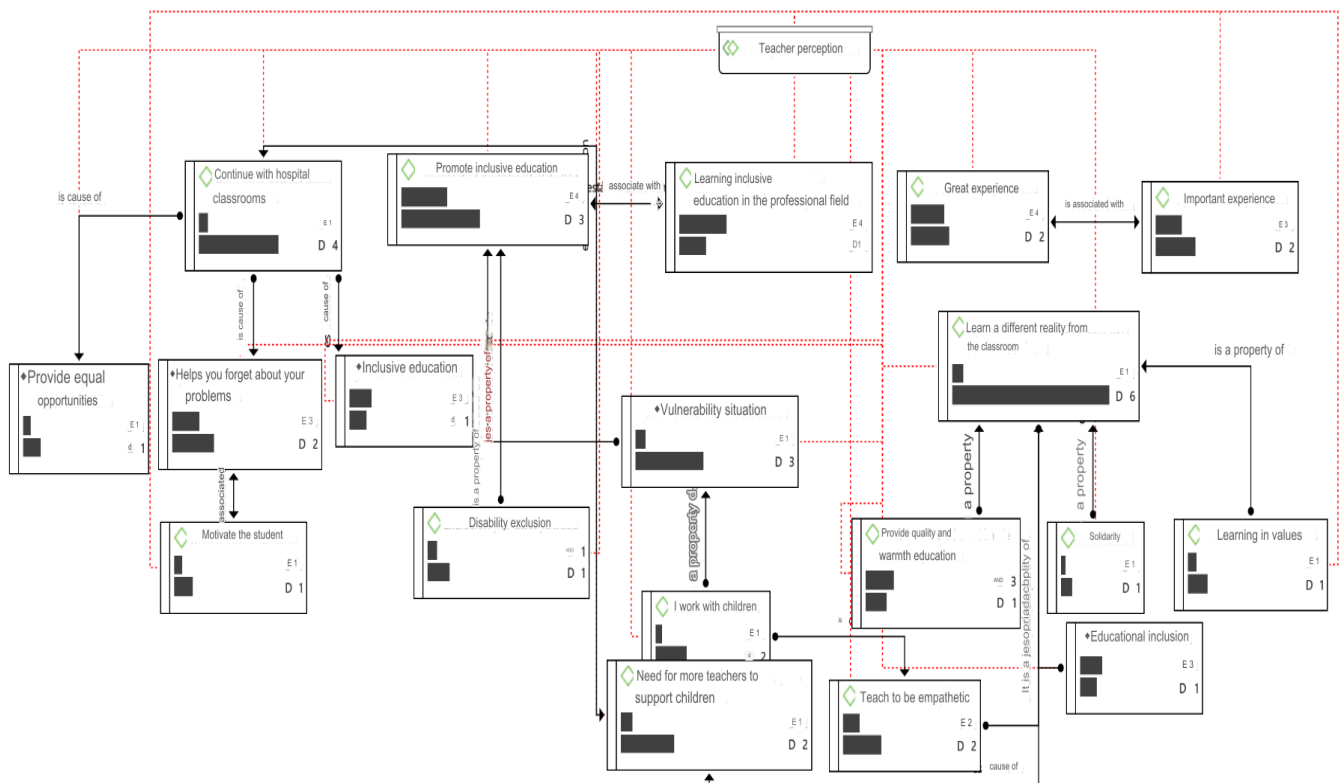
Figure 1. Semantic network category Teaching perception in the context of hospital classrooms

With reference to the category: situation of the beneficiaries in the context of the hospital classrooms, the most relevant aspects detected (see Table 1) are as follows:

1. Eager to receive classes: with a frequency of 7, this situation indicates that the beneficiaries of hospital classrooms have a strong desire to receive classes, despite their health conditions.
2. Other situations, such as "different illnesses" and "postponing studies due to illness" have a frequency of 5 and 3 respectively, suggesting that illnesses and the need to postpone studies are common challenges for these beneficiaries.
3. "Joy in receiving classes" and "receive classes with joy" have a frequency of 3 each, indicating that, despite difficulties, beneficiaries find happiness and satisfaction in participating in hospital classes.
4. "Do not attend classes normally" and "vulnerable situation" have a frequency of 2 and 1 respectively, suggesting that some beneficiaries face additional difficulties in accessing education due to their health conditions and personal situations.
5. Several other situations, such as "depression", "missing relatives" and "health problems", have a frequency of 1 each, indicating that these aspects are also relevant in the context of hospital classrooms, although less frequent compared to other challenges mentioned.

Similarly, Figure 2 shows the semantic network, with the most relevant codes analyzed in this category. This analysis revealed the different situations and challenges faced by children in hospital classrooms, such as health problems, loneliness, depression. However, despite these factors, their desire to learn, eagerness and joy to receive classes are

highlighted, and relevant aspects that teachers should develop such as the importance of providing adequate emotional and educational support in this context are detected.
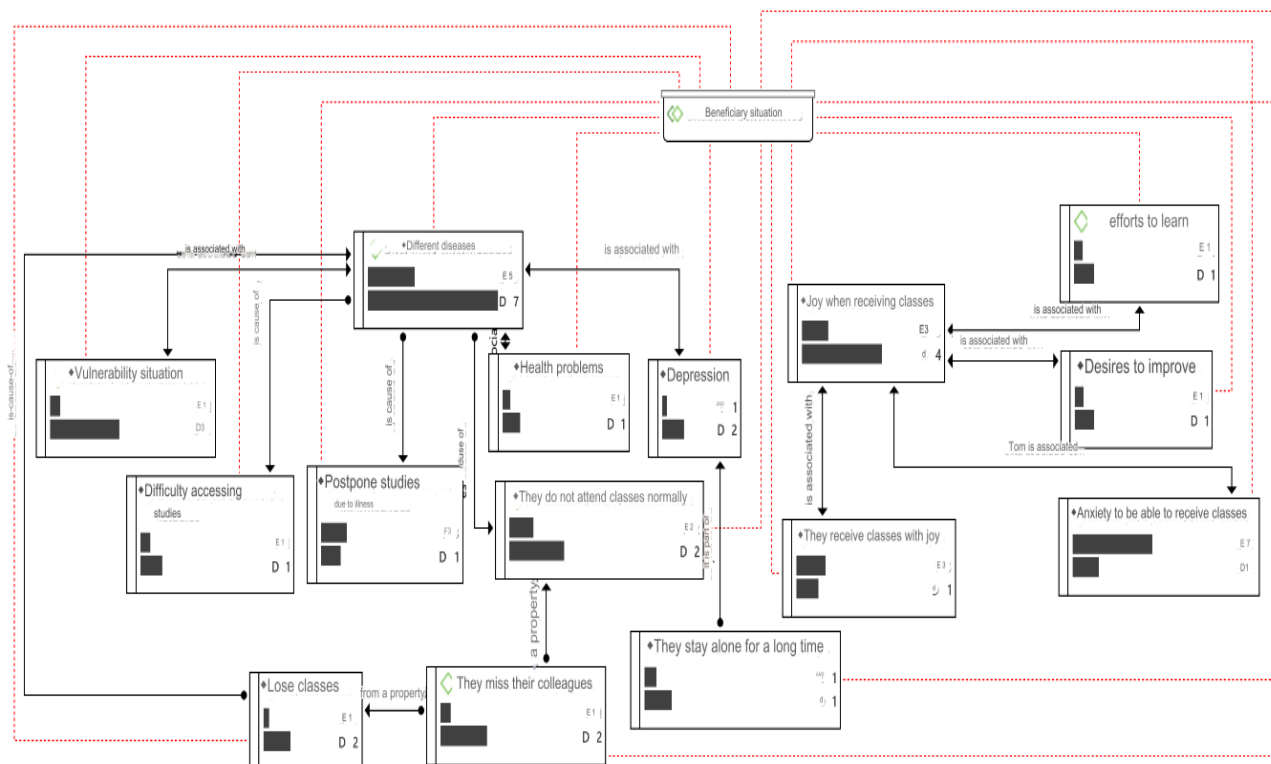
Figure 2. Semantic network category Situation of beneficiaries in the context of hospital classrooms

Finally, with respect to the Academic Tutoring category in the context of hospital classrooms, the most relevant significant aspects detected (see Table 1) are as follows:

1. Reflect on learning new methodologies: with a frequency of 12, this aspect indicates that teachers who carried out their professional practice in hospital classrooms are aware of the need to keep updated on new teaching methodologies, which suggests a willingness to continuously improve and adapt in order to provide quality education to hospitalized students.
2. Personalized accompaniment and emotional support: both aspects have a frequency of 7, which emphasizes the importance of teachers providing comprehensive individualized academic and emotional support to students in the hospital environment.
3. Tutoring in the area of mathematics: with a frequency of 6, this aspect indicates that tutoring in the area of mathematics is considered important by teachers, which reflects the attention given to the specific academic needs of students.
4. Methodologies adapted to specific educational needs: with a frequency of 5, this aspect highlights the importance of adapting the teaching process to meet the individual needs of students in the hospital environment.
5. Finally, other aspects such as adapting resources to maintain the child's attention, helping them to return without delay in their knowledge, teaching through games, moral support, understanding needs and carrying out didactic activities, have a lower frequency but are still considered important in the context of academic tutoring in hospital classrooms.

Likewise, Figure 3 shows the most relevant codes that make up this category through the formation of the semantic network, which allows us to establish that the teachers who worked in the hospital classrooms showed a strong commitment to learning new methodologies and creating personalized educational resources adapted to the specific needs of hospitalized children. This indicates a willingness to constantly improve and adapt in order to provide quality education to hospitalized students. It was also highlighted that personalized accompaniment and emotional support are fundamental aspects in the context of hospital classrooms, thus recognizing the importance of providing comprehensive support that addresses both the academic and emotional needs of the students.
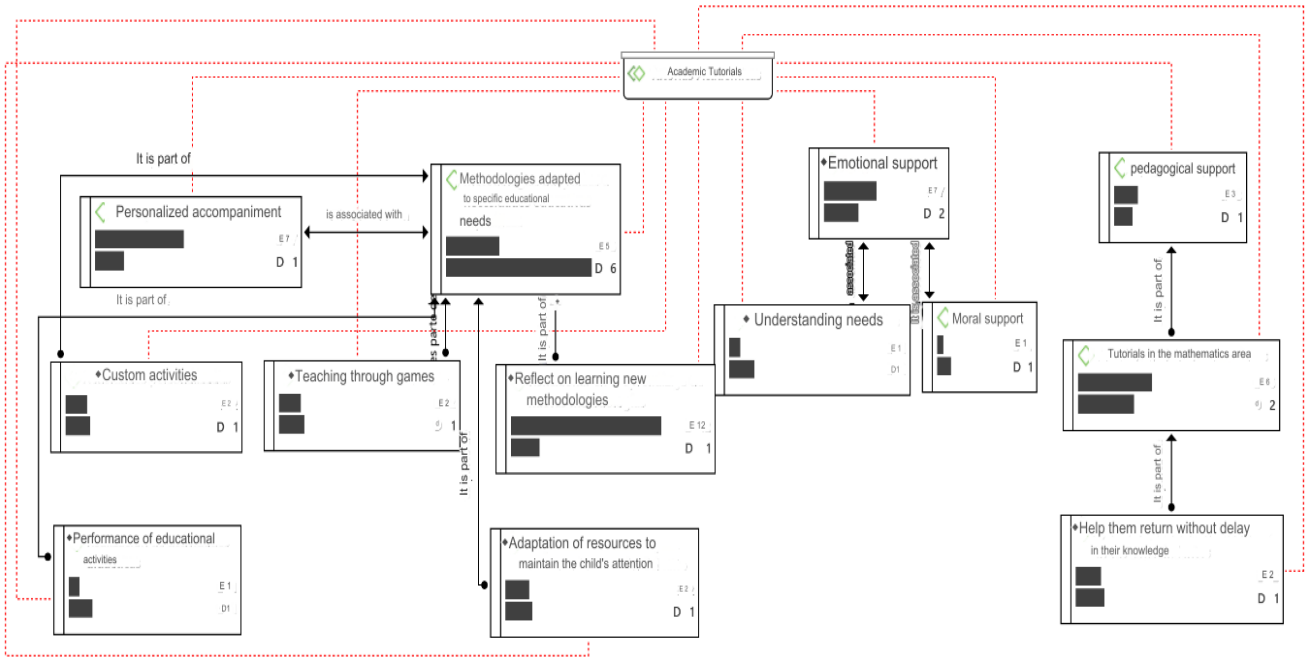

Figure 3. Semantic network category Academic tutoring in the context of hospital classrooms

6. Discussion and Conclusions

The teaching experience in hospital classrooms is truly gratifying, because through this noble work one experiences a deep learning about inclusive education in the professional field. Working in hospital classrooms allowed us to get to know a reality that goes beyond the conventional walls of the classroom, in this space teachers and children learn, both are enriched with their stories, their dreams and their challenges.

However, it is important to mention that this experience also confronts us with the harsh reality of exclusion due to illness and emphasizes the urgent need to provide equal opportunities for all children and young people, regardless of their health conditions or disabilities, everyone deserves access to quality education, regardless of their medical situation. In this sense, it is essential to continue with the hospital classrooms and strengthen support through the insertion of more committed teachers. On the other hand, the participation of Higher Education Institutions is indispensable, it is necessary that they commit themselves to the creation of careers in hospital pedagogy, training in new teaching methodologies, creation of personalized educational resources adapted to the specific needs of the student and forms of emotional support for children and young people in hospital classrooms.

It is essential to recognize and support the patient/student in their daily struggle to have a normal life, the tutor's support must be decisive to help them overcome different obstacles and provide access to quality education for their integral development. For this reason, it is emphasized that, in hospital classrooms, it is urgent to create and innovate new learning methodologies to guarantee quality education for children and young people in difficult medical situations. Therefore, it is necessary to focus on personalized accompaniment where emotional support is also provided, and the implementation of methodologies and educational resources adapted to the specific educational needs of each child and young person.

In this line, it is important to highlight that teaching through games was an effective strategy to make learning more fun and attractive for children in this environment. Through playful and didactic activities, active learning was promoted and creativity and participation were stimulated. The use of methodologies adapted to Information and Communication Technologies (ICT) can be an effective tutoring option, and this accompanied by a process of emotional support will provide efficient educational tools to continue growing, regardless of the challenges they face.

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Impact evaluation of the teaching and research process of the General Teaching Hospital of Calderón Quito-Ecuador

Evaluación de impacto del proceso de docencia e investigación en el Hospital General Docente de Calderón Quito-Ecuador

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Abstract

The Impact Evaluation Study of the teaching and research process of the Calderón General Teaching Hospital-HGDC in the city of Quito-Ecuador in the period 2016-2022, aims to measure the impact of the Teaching and Research process with respect to: (1) academic process and resources, (2) evaluation and research, (3) learning, training and knowledge transfer and (4) clinical-surgical practice and performance; through the design and application of the impact evaluation methodology with a focus on measurable results, Balanced Scorecard-BSC. The target group was identified as undergraduate students, rotating interns, postgraduate students, teachers and health care personnel of the Higher Education Institutions (HEI) that perform their health care and academic activities at the HGDC. It was developed in three phases: the first comprises the period 2016-2020, with a total population of 949 participants and an effective sample of 291 participants, served as a baseline for the construction of the follow-up and monitoring matrix-BSC. The second phase of 2021 has 382 participants and an effective sample of 165. The third phase of 2022 has a total population of 344 and an effective sample of 128 participants. The BSC monitoring matrix resulted that the average Global Effective Impact Evaluation of the HGDC Teaching and Research process in the period 2016-2022 reached 87.39% effectiveness, reflecting that the care and teaching activities are adequately fulfilled. The research provides conclusions and suggestions aimed at improving the care and teaching processes of the hospital, and allows it to be a model replicated for other institutions.

Keywords

teaching, education, evaluation, impact, indicators, research.

Resumen

El Estudio de Evaluación de impacto del proceso de docencia e investigación del Hospital General Docente de Calderón-HGDC de la ciudad de Quito-Ecuador en el periodo 2016-2022, tiene como finalidad medir el impacto del proceso de Docencia e Investigación respecto a: (1) proceso académico y recursos, (2) evaluación e investigación, (3) aprendizaje, capacitación y transferencia de conocimientos y (4) la práctica clínico-quirúrgica y desempeño; mediante el diseño y aplicación de la metodología de evaluación de impacto con orientación a resultados medibles, Balanced Scorecard-BSC. Se identificó como grupo objetivo a estudiantes de pregrado, internado rotativo, posgrado, docentes y personal asistencial de las Instituciones de Educación Superior-IES que realizan sus actividades asistenciales y académicas en el HGDC. Se desarrolló en tres fases: la primera comprende el periodo 2016-2020, con una población total de 949 participantes y una muestra efectiva de 291 participantes, sirvió de línea base para la construcción de la matriz de seguimiento y monitoreo-BSC. La segunda fase de 2021 cuenta con 382 participantes y una muestra efectiva de 165. La tercera del periodo 2022, tiene una población total de 344 y una muestra efectiva de 128 participantes. La matriz de monitoreo BSC dio como resultado que la Evaluación de Impacto Efectiva Global promedio del proceso de Docencia e Investigación del HGDC en el periodo 2016-2022 alcanzó 87.39% de efectividad, reflejando que las actividades asistenciales y docentes se cumplen de manera adecuada. La investigación aporta conclusiones y sugerencias orientadas a mejorar los procesos asistenciales y docentes del hospital, y permite ser un modelo replicado para otras instituciones.

Palabras clave

Docencia, educación, evaluación, impacto, indicadores, investigación.

1. Introduction

In order to improve the quality and effectiveness of management and teaching and healthcare activities, the Teaching and Research Unit of the HGDC promotes strategies to maintain an environment of study and activities in which theory and practice are interrelated in order to guarantee new health professionals with solid knowledge, altruism and solidarity. As a result, and considering that the quality of management must be anchored to continuous improvement, the question arises as to what has been the impact of the Teaching and Research process of the Calderón General Teaching Hospital in these eight years of management and to have a feedback from the perspective of students, teachers and assisting personnel who perform their daily work in this health center.

The impact evaluation study of the Teaching and Research process of the Calderón General Teaching Hospital-HGDC is aimed at evaluating the impact on the training of health professionals, scientific research, training and knowledge transmission, the improvement of clinical-surgical practice and the fulfillment of institutional objectives, through the design and application of a dynamic impact evaluation methodology whose results allow for the continuous improvement of the teaching-care process.

In this sense, a methodology has been proposed that presents a set of key concepts, practical orientations and guidelines for the application of evaluation in the different stages of the teaching-care process. Tools and mechanisms have been developed for the collection, analysis, monitoring and follow-up of the evaluation through previously defined indicators.

The applicability of the methodology involves several actors, on the one hand, the Higher Education Institutions (HEI) as training centers for professionals, on the other hand, the HGDC as the center where the future professional performs his internships and rotations. Finally, the student who is being trained and acquiring knowledge and new competencies to become a professional in the near future at the service of society.

The present study is a guide that has been structured on the basis of seven axes that address the topics that have been considered key in the elaboration process: 1. Generalities of the study, 2. Design of indicators and data collection instruments, 6. Sample and sample design, and 7. BSC monitoring matrix, based on the Organic Statute of Organizational Management by Processes of Hospitals of the Ministry of Public Health 2012, the Internal Regulations for Teaching and Research of the HGDC 2017, and the ILO Methodological Guide for Impact Evaluation 2011.

> Given that the Organic Statute of Organizational Management by Processes of the Hospitals of the Ministry of Public Health 2012 and the Functional Organic of the HGDC contemplates that the Teaching and Research Units as a mission should promote and coordinate the integration in health care of the training activities of health professionals and research, as tools for the transmission of knowledge, improvement of clinical-surgical practice and the motivation and involvement of health professionals, through programs, plans and projects aimed at improving the quality of Teaching and Research (MSP, 2012, p. 12).

Considering the above-mentioned background, the General Teaching Hospital of Calderón, through the Teaching and Research Unit, proposed to carry out a cross-sectional descriptive research, of quantitative type, supported by the application of a web-based questionnaire of its own elaboration addressed to teachers, assisting staff and undergraduate, graduate

and postgraduate students of the different HEIs, whose main objective was to measure the degree of impact of the Teaching and Research process in the period 2016-2022 as a first starting point for taking corrective actions of the teaching-assistance process. The results are translated into strategies to be implemented by the Teaching and Research Unit in order to improve the teaching-teaching training process of the students of the different careers that are trained at HGDC. The information gathering was carried out in three phases, one in 2020, a second in 2021 and a third in 2022.

The article consists of the following parts: an introduction with a brief description of the problem investigated, the justification on which the research is based, a description of the methods and materials used, describing the methodology, the scope, the determination of the sample, the tools for the collection of information and the indicators for the follow-up matrix Balance Score Card - BSC. The results and discussion reflect relevant interpretations of the quantitative cross-sectional descriptive study carried out. Finally, conclusions are presented with a synthesis of the most significant findings of the study.

1.1. Justification

The Calderón General Teaching Hospital is a second level and sixth level of complexity health center, one of its components is training and research. During its more than eight years of operation, it has incorporated several promotions of rotating interns in medicine, nursing, obstetrics and nutrition, prior to the draw for the rural health year. Additionally, it has added students from several undergraduate careers to perform their internships in the careers of Statistics, Psychology, Social Work, Pharmaceutical Chemistry, Clinical Chemistry, Clinical Laboratory, Physical Therapy, Environmental Engineering, Psychiatry, Nutrition, and Journalism, among others, with a total of 3,800 undergraduate students who have completed their internships. 800 undergraduate students who have completed their pre-professional practices or internship prior to obtaining their professional degree, and 1,192 fourth-level postgraduates from various universities in the capital, who have completed their graduate rotations at Calderón (UDI-HGDC, 2016-2022).

The Teaching and Research Management of the HGDC is in charge of generating research, studies, projects and the integration of teaching and care activities, which involve a series of processes that have not been previously measured or monitored. In this sense, it has been necessary to have an impact evaluation methodology that allows measuring, through management indicators, how is the process of Teaching and Research Management of the HGDC in the teaching, assistance, academic, research, learning, clinical-surgical practice and human talent training activities. This exercise shows the critical processes of the Teaching and Research Management and those processes that should be strengthened or redesigned in order to guarantee a high-quality teaching-care process, in constant monitoring and continuous improvement.

The impact evaluation methodology is intended to serve as a guide for application in other health units that manage teaching and research processes or are involved in training activities for health professionals.

2. Methods and materials

The study is descriptive, cross-sectional, quantitative and based on primary data collected through the application of a web-based questionnaire developed by the authors, which responds to the methodological criteria of the Training Impact Evaluation Guide issued by the International Labor Organization-ILO-CINTERFOR. The different questions developed for each axis are quantitative, and were measured through an ordinal scale and for their

tabulation they are parameterized through a Likert scale with the following options: 1=Bad, 2=Regular, 3=Good, 4=Very good and 5=Excellent; for their validation and reliability, Cronbach's Alpha was used, which reached a score of 0.926. The questionnaire was addressed to teachers, assisting personnel and undergraduate, rotating internship and postgraduate students of the different HEIs that carried out their academic and assisting activities at the Calderón General Teaching Hospital in the period 2016-2022. To determine the population and details of the sample size calculation, it was considered that the total population of teachers and students for the entire period was 1,675 participants, broken down as follows: in the period 2016-2020 with 949 participants, year 2021 with 382 participants and year 2022 with 344 participants (UDI-HGDC, 2016-2022). The sample calculation was based on the simple random probability sampling method and the finite population sampling formula, with a confidence level of 95% and an error level of 5% (Malhotra, 2004, p. 344-348), which determined an overall effective sample in the reference period of 584 participants, with 291 participants for the 2016-2020 period, 165 for the year 2021 and 128 for the year 2022.

For data collection, two anonymized web survey forms were designed under the methodological criteria of the Training Impact Evaluation Guide issued by the International Labor Organization-ILO-CINTERFOR (one for teachers and assisting staff and the other for students), whose links were sent to the e-mails registered in the databases of teachers and students of the reference period, which is under the custody of the Teaching and Research Unit of the HGDC.

Due to the scope of the study and the database, it was considered that the methodology that best fits the analysis requirements is quantitative, which seeks to establish the degree of causality between the precepts of the management of the Teaching and Research Unit of the HGDC and its impact on the teaching, assistance and research activities carried out by both teachers and students; this methodology has allowed for a more rigorous and accurate statistical analysis. The study inclusion criteria were: teachers, assisting staff and undergraduate, rotating internship and postgraduate students from the different higher education institutions that performed their teaching and assisting activities at HGDC in the reference period 2016-2022. In the exclusion criteria are students who do not have a registered email and who could not be feasibly located.

The data collected have been anonymized and were treated with strict confidentiality and only for research purposes. A presentation of the study was made to teachers, health care personnel and students in order to encourage the participation of all. Similarly, the introductory part of the questionnaire stipulates informed consent; if the participant accepts, the contents of the different sections of the questionnaire are displayed; if he/she does not accept, the questionnaire closes with a thank you. The results made it possible to determine the degree of impact of the Teaching and Research process of the HGDC on the teaching, assistance, academic, research and training activities of human talent in health of the sample mentioned above (584 participants).

In order to guarantee the results, for the validation of the reliability or trustworthiness of the questionnaire used for the research, it was performed through the "Cronbach's Alpha coefficient (α), which allows identifying the absence of measurement errors in a test, or as the precision of its measurement" (Ruiz, 2019, para. 2). Instruments with questions that have more than two answers can be evaluated with this test. "The Cronbach's α score is a number between 0 and 1. An acceptable reliability score is one that is equal to or greater than 0.7" (QuestionPro, 2019, para. 17).

As mentioned in previous lines, Cronbach's Alpha presents a high or acceptable reliability score of 0.926, evaluating 25 (quantitative variables) of the 33 items of the applied questionnaire. This result shows that the method, the instrument and the research sample selected were reliable and the results obtained are guaranteed.

Data tabulation and analysis was performed using the statistical software SPSS.25 and Excel 2019. Before entering into the analysis of the results, it is necessary to point out the proposed levels of impact evaluation and some key methodological components. For Baker (2000)

> Impact evaluation is the process of determining in general terms whether the program produced the desired effects on individuals, households and institutions and whether these effects are attributable to the program intervention. Impact evaluations also allow for the examination of unintended consequences on beneficiaries, whether positive or negative (p. 75).

Four levels have been identified to evaluate the impact of the actions of the Teaching and Research Process; these levels have been considered as a system, since there is a causal and sequential relationship between them.

- **Academic process and resources. -** Seeks to know the impact of the academic process by analyzing the academic planning, assignments, syllabus, time load and the digital platform used for teaching activities**.**

- **Evaluation and research. -** Seeks to know the impact of evaluation and research on professional training in students who perform their rotation at the HGDC.

- **Learning, training and knowledge transfer. -** Seeks to evaluate to what extent the education, learning, training and knowledge transfer are being applied by future health professionals in the units/areas in which they perform their rotation.

- **Clinical-surgical practice and performance. -** Seeks to evaluate how the Teaching and Research process contributes to improve clinical-surgical practice and performance in the units/areas in which they perform rotations.

It is also important to mention that an indicator is "a comparison between two or more types of data that serves to elaborate a quantitative measure or a qualitative observation. This comparison yields a value, a magnitude or a criterion, which has meaning for the person analyzing it" (Billorou et al., 2011. p. 38-40). The indicators and instruments are aimed at measuring the four levels of impact evaluation mentioned above. The methodological guidelines underpinning the construction of indicators, as cited by Billorou et al.:

- **Management indicators. -** They are used to monitor the processes, inputs and activities that are executed in order to achieve the specific outputs of a policy or program.

- **Outcome indicators. -** They relate to the goods and services generated by the training action; they result from the transformation activities of the inputs and generate an increase in the outputs applicable to training.

- **Effect indicators. -** They refer to the immediate consequences of training and development of competencies on individuals, companies and society. They represent the encounter of the training actions with the demand of the participants.

- **Impact indicators. -** They represent the expected change in the situation of the participants once the upgrading, knowledge transfer and training are carried out. They can usually be measured in medium or long term periods due to the fact that a period of time is required to observe the improvement of clinical-surgical practice, working conditions and work performance.

The indicators considered for the study were those of management, effect and impact. With regard to the data collection instruments, two surveys were used, which were designed via the web with an access link for students and teachers, respectively.

- **Outcome indicators. -** They relate to the goods and services generated by the training action; they result from the transformation activities of the inputs and generate an increase in the outputs applicable to training.
- **Effect indicators. -** They refer to the immediate consequences of training and development of competencies on individuals, companies and society. They represent the encounter of the training actions with the demand of the participants.
- **Impact indicators. -** They represent the expected change in the situation of the participants once the upgrading, knowledge transfer and training are carried out. They can usually be measured in medium- or long-term periods due to the fact that a period of time is required to observe the improvement of clinical-surgical practice, working conditions and work performance**.**

The indicators considered for the study were those of management, effect and impact. Regarding the data collection instruments, two surveys were used, which were designed via web with an access link for students and teachers, respectively, for teachers and assisting personnel who are part of the teaching, research and professional training process and who are responsible for the accompaniment, control and monitoring of the students who perform their rotation at HGDC in period.

- **Form C.1.-** Survey Management indicators. - They are used to monitor processes, inputs and activities that are executed in order to achieve the specific outputs of a policy or program.
- **Form C.2.-** Survey for students (undergraduate, rotating internship and postgraduate) who are part of the professional training and who are or were doing their rotation at the HGDC in the different areas/units assigned. A representative sample is made and they are randomly selected.

Finally, the use of the Balanced Scorecard-BSC tool (Kaplan & Norton, 1992) has been considered for monitoring the impact evaluation indicators; through this matrix, the continuous control of the impact evaluation indicators is carried out to determine whether or not the proposed objectives have been met and to make strategic decisions in order to guarantee a highly effective teaching and research process.
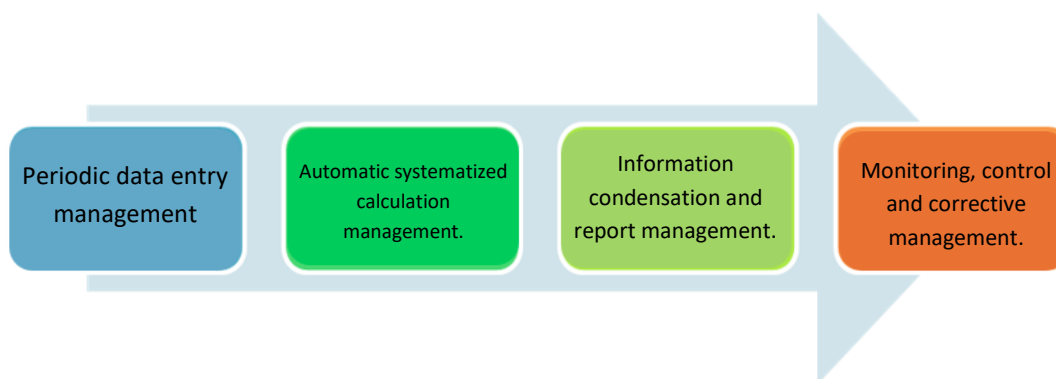
Figure 1. BSC Matrix assessment process

3. Presentation of results

The following are the results of the Impact Evaluation Study of the Teaching and Research Process of the Calderón General Teaching Hospital-HGDC for the period 2016-2022. It is important to indicate that the qualification and weighting was measured through an ordinal scale and for the tabulation it was parameterized through a Likert scale and each weight responds to the weighted weights method, which is used for the quantification of variables or alternatives through a numerical value. For the study, 5 measurement groups were determined as follows:

RATING VALUES
1=Bad (<= 30%)
2=Regular (> 30% y <= 50%)
3=Good (> 50% y <= 70%)
4=Very good (> 70% y <= 90%)
5=Excelent (> 90%)

Table 2. Rating values by variables

3.1 Analysis by levels

Of the sample under study in the reference period, 86. 30% of the participants were students (504) and 13. 70% were teachers and assistants (80).

3.1.1 Academic process

The level of impact of the academic process from the perspective of teachers and health care personnel reached an average impact of 76. 03%, equivalent to very good. From the results by subcomponents, 80. 36% of the participants expressed that the planning of academic activities was very good, 89. 09% considered that the teaching load was very good, 89. 07% stated that the tasks and academic material was very good, 69. 84% that the curricular design was good, 69. 62% considered that the curricular design was very good, 69.62% considered that the academic material was very good, 70.60% stated that the duration of the modules and the teaching load were very good, and 63.67% stated that university-teacher communication was good.

3.1.2 Training resources

The impact of the resources for training from the students' perspective reached an average impact of 63.32%, equivalent to good. Analyzing the subcomponents of this axis, 65.88% consider that the material resources have been good for their training, 64.12% that the

digital platform provided by the university for academic activities is good, 65.19% consider that the duration of the modules is good and 58.10% state that the organization of class schedules has been good.

It is important to note that the control of this axis is the responsibility of the HEI, however, the results reflect that the Teaching Management of the HGDC should put more emphasis on these parameters analyzed.

3.1.3   3.1.3 Evaluation and investigation

The impact of evaluation and research from the perspective of teachers and health care personnel reached an average impact of 86. 17%, equivalent to very good. Analyzing the subcomponents of this axis, student participation in the teaching assistance activities reached an average of 86.32%, equivalent to very good; the teaching assistance evaluation system applied to the student reached an average of 89. 76%, equivalent to very good; the scientific activities achieved an excellent average of 91. 28%; in reference to the motivation of the HGDC and teachers to work in the field of research, a very good level of achievement of 75. 60% is evidenced. Finally, regarding the capacity for synthesis, reasoning, reflection and criticism developed by the student, it reached an average of 87. 87%, equivalent to very good.

Continuing with the analysis of the impact of evaluation and research from the students' perspective, it reached an average impact of 80. 97%, equivalent to very good. Within this axis, the following results have been obtained: students consider that the teaching assistance evaluation system is very good, 85. 39% average; scientific activities achieved an average of 79. 74% equivalent to very good, in reference to the motivation by the HGDC and teachers to work in the field of research, a level of achievement of 71. 36% equivalent to very good is evidenced; at the level of the evaluation made by the teacher or tutor is considered very good with a level of achievement of 82. 42%. Finally, regarding the student's qualification on his participation in the teaching assistance activities, an average of 85. 95% was achieved, equivalent to very good.

3.1.4   Learning, training and transfer of knowledge

The impact of learning, training and knowledge transfer, from the perspective of teachers and healthcare personnel, reached an average impact of 80. 94%, equivalent to very good. It is highlighted that, at the level of knowledge of hospital regulations and norms, it is very good with an average impact of 79. 44%, the functionality of the hospital infrastructure for care and academic activities reached an average of 76. 17% equivalent to very good, the use of classrooms, residences and dining room reached an average of 80. 44% equivalent to very good. When inquiring about the level of knowledge and professionalism of the health care staff-teaching staff, an average score of 82. 80% was reached, equivalent to very good; the interpersonal relationships between teachers-health care staff-students reached a level of achievement of 85. 88%, significant to very good.

The impact analysis of the learning, training and knowledge transfer axis from the students' perspective reached an average impact of 80.38%, equivalent to very good. Within this axis, the following results are evident: knowledge of hospital regulations and norms is very good with an average impact of 73. 52%, the functionality of the hospital infrastructure for assistance and academic activities reached an average of 81. 23%, equivalent to very good, the use of classrooms, residences and dining room reached an average of 78. 29%, equivalent to very good. When asked about the level of knowledge and professionalism of the health care staff-teaching staff, this reached an average score of 80. 17%, equivalent to very good; the interpersonal relationships teacher-health care staff-student reached a level

of achievement of 85. 34%, significant to very good. Finally, in the transfer of knowledge from the teachers to the students, it reached an average of 83. 72%, equivalent to very good.

3.1.5   Clinical-surgical practice and performance

The results on the impact of the clinical-surgical practice and performance from the perspective of teachers and assisting personnel achieved an average impact of 80. 85%, equivalent to very good. When analyzing the subcomponents, the supervision of student practices reached a result of 85. 64%, equivalent to very good, and the teaching assistance process aimed at improving clinical-surgical practice reached an average of 75. 85%, equivalent to very good. When asked if the training process will allow the student to perform adequately in the functions or activities, it reached an average impact of 80.48%, equivalent to very good. Finally, when asked about the qualification of their teaching-assistance performance, this reached an average of 81. 43%, equivalent to very good.

Continuing with the analysis of results on the impact of clinical-surgical practice and performance from the students' perspective, this reached an average impact of 81. 32%, equivalent to very good. The following results stand out within this axis: on average, the supervision of practices performed on students at HGDDC reached an impact of 82. 92%, equivalent to very good; the process destined to clinical-surgical practice reached an average of 75. 16%, equivalent to very good. When asked if the training process will allow the student to perform adequately in the functions or activities, it reached an average impact of 81. 62%, equivalent to very good. Finally, when asked about the qualification of their general rotation at the HGDC, it reached an average of 85. 59%, equivalent to very good.

3.1.6 Overall weighted results

Under the Balanced Scorecard (BSC) philosophy, three weighting levels were identified: efficient >90%, precaution between 70% and 90%, and danger <70%. These values are detailed in section 3.2, with the traffic light scale. In Figure 2, the weighted results of the Impact Evaluation of the Teaching and Research process of the HGDC 2016-2022 under the BSC approach and from the perspective of teachers and assisting staff reached a weighted average of 81% which evidences that this axis has a caution alert, where the first evaluation axis on the academic process obtained a rating equivalent to 76. 03% with a caution alert, the second axis on evaluation and research reached a score equivalent to 86. 17% with a caution alert, the third axis on learning, training and knowledge transfer reached a score equivalent to 80. 94% with a caution alert. Finally, the fourth axis referring to clinical-surgical practice and performance achieved a score equivalent to 80. 85% with a caution alert.
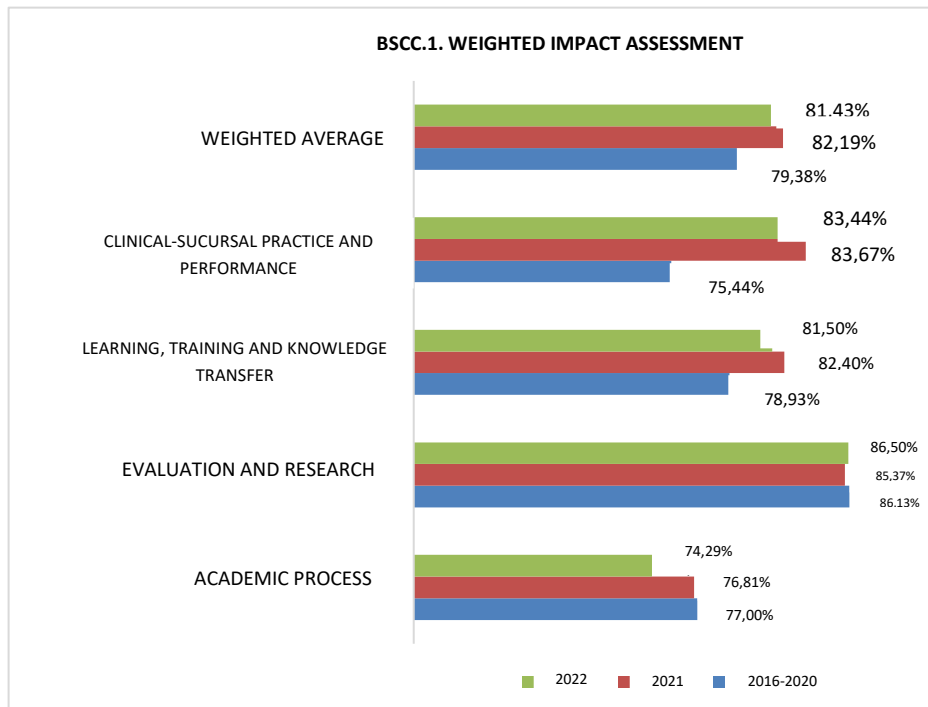
Figure 2. Weighted impact assessment, faculty and staff perspective, period 2016-2022, IDU-HGDC

In Figure 3, the weighted results of the Impact Evaluation from the students' perspective reached a weighted average of 76. 50% which shows that this axis has a caution alert, where the first evaluation axis on the resources used for training obtained a score equivalent to 63. 72% with a danger alert, the second axis on evaluation and research reached a score equivalent to 80. 97% with a caution alert, the third axis on learning, training and knowledge transfer reached a score equivalent to 80.38% with a caution alert. Finally, the fourth axis referring to clinical-surgical practice and performance achieved a score equivalent to 81. 32% with a caution alert.
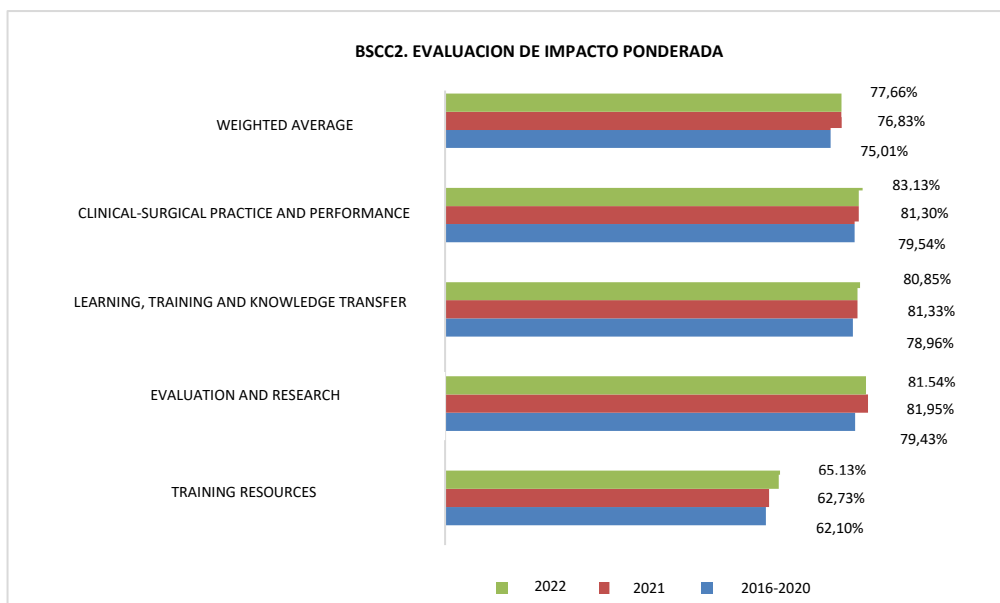

Figure 3. Weighted impact assessment, student perspective, period 2016-2022, UDI-HGDC

3.2 Impact Results by indicators, Balanced Scorecard matrix (BSC)

It should be noted that in the follow-up matrix, in the "Measurement" column, the results processed for each of the questions in Forms C.1 and C.2 are located. This column is marked with a traffic light and each selection of visual codes makes it possible to obtain differences between the goals and the effectiveness of the processes. Thus, in summary:

- **Green color:** The weighting is above the target value, depending on the case it can be good or it can be bad. For the study, efficient green color >90%.
- **Yellow color:** The weighting is within normal measurement parameters. Caution yellow color value between 90% and 70%.
- **Red color:** The weighting is below the quantitative target value to be reached and indicates that urgent corrective action is needed. Danger red color value <70%.

		MONITORING MATRIX			BASE LINE	MEASUREMENT 2	MEASUREMENT 3
LEVELS	INDICATOR	TYPE OF INDICATOR	FÓRMULA	VALUE TARGET	2016-2020	2021	2022
ACADEMIC PROCESS AND RESOURCES	EFFECTIVENESS OF THE PLANNING OF ACADEMIC ACTIVITIES	MANAGEMENT	$\dfrac{\text{Number of teachers who consider the planning of academic activities to be adequate activities is adequate}}{\text{Total number of participants surveyed}} \times 100$	90%	88.39%	67.69%	85.00%
	EFFECTIVENESS OF THE TEACHING LOAD	MANAGEMENT	$\dfrac{\text{Number of teachers who consider the teaching load to be adequate}}{\text{Total number of participants surveyed}} \times 100$	90%	87.74%	90.77%	88.75%
	EFFECTIVENESS OF ASSIGNMENTS AND ACADEMIC MATERIAL	MANAGEMENT	$\dfrac{\text{Number of teachers who consider the tasks and academic material to be adequate is adequate}}{\text{Total number of participants surveyed}} \times 100$	90%	86.45%	90.77%	90.01%
	EFFECTIVENESS OF SYLLABI AND GUIDE TEXTS	MANAGEMENT	$\dfrac{\text{Number of teachers who consider the syllabus and guide texts to be optimal}}{\text{Total number of participants surveyed}} \times 100$	90%	70.97%	72.31%	66.25%
	TECHNOLOGICAL PLATFORM EFFICIENCY	EFFECT	$\dfrac{\text{Number of teachers who consider that the technological platform platform used for teaching activities is adequate.}}{\text{Total number of participants surveyed}} \times 100$	90%	70.97%	75.38%	62.50%
	EFFECTIVENESS OF MODULES AND SCHEDULES	EFECT	$\dfrac{\text{Number of teachers who consider that the modules and class schedules are and class schedules are adequate}}{\text{Total number of participants surveyed}} \times 100$	90%	68.71%	73.08%	70.00%
	EFFECTIVENESS OF INTER-INSTITUTIONAL COMMUNICATION	MANAGEMENT	$\dfrac{\text{Number of teachers who consider that inter-institutional communication inter-institutional communication is efficient or excellent}}{\text{Total number of participants surveyed}} \times 100$	90%	65.81%	67.69%	57.50%
	EFFECTIVENESS OF TRAINING RESOURCES	EFECT	$\dfrac{\text{Number of students who consider that the syllabus, bibliography, guide texts and complementary materials are adequate, guide texts and complementary material are adequate}}{\text{Total number of participants surveyed}} \times 100$	90%	63.87%	66.27%	67.50%
		EFECT	$\dfrac{\text{Number of students who consider that the technological platform is platform is adequate}}{\text{Total number of participants surveyed}} \times 100$	90%	60.59%	63.73%	68.04%

Category	Indicator	Type	Description				
EVALUACIÓN E INVESTIGACIÓN		EFECT	Number of students who consider the duration of the modules to be adequate is adequate ____ x 100 Total number of participants surveyed	90%	64.62%	64.53%	66.43%
		EFECT	Number of students who consider the organization of class schedules to be of class schedules are adequate ____ x 100 Total number of participants surveyed	90%	59.33%	56.40%	58.57%
	EFICIENCIA DE PARTICIPACIÓN ACTIVIDADES ASISTENCIALES DOCENTES	EFECT	Number of faculty and support staff who believe that student participation in teaching support activities is the most effective way to ensure student participation in teaching support activities ____ x 100 Total number of participants surveyed	90%	84.89%	85.33%	88.75%
		EFECT	Number of students who consider their participation in teaching assistance activities to be participatory teaching assistance activities is participatory ____ x 100 Total number of participants surveyed	90%	83.95%	86.93%	86.6%
	EFICIENCIA DEL SISTEMA DE EVALUACIÓN ASISTENCIAL DOCENTE	IMPACT	Number of students who consider the teaching assistance evaluation system to be efficient the teaching assistance evaluation system is efficient ____ x 100 Total number of respondents	90%	83.03%	87.60%	85.54%
		IMPACT	Number of teachers and assistants who consider that the system for evaluating teachers and assistants is efficient the system of evaluation of teaching assistants is efficient ____ x 100 Total number of participants surveyed	90%	89.78%	92.00%	87.50%
		IMPACT	Number of students who consider that the evaluation by the teacher or tutor is permanent ____ x 100 Número total de encuestados	90%	81.51%	85.20%	80.54%
	EFICIENCIA DE ACTIVIDADES CIENTÍFICAS E INVESTIGACIÓN	EFECT	Number of students who consider that scientific and research activities are always carried out ____ x 100 Número total de participantes encuestados	90%	69.23%	68.09%	73.12%
		EFECT	Number of faculty and staff who believe that scientific and research activities are always carried out scientific and research activities are always carried out ____ x 100 Total number of participants surveyed	90%	84.43%	77.83%	77.26%
LEARNING, TRAINING AND KNOWLEDGE TRANSFER	EFICIENCIA DE REFLEXIÓN, RAZONAMINETO Y SÍNTESIS	EFECT	Number of teachers and assistants who consider that always teaching-assistance activities allow students to develop their reflection, reasoning and synthesis skills. ____ x 100 Total number of participants surveyed	90%	85.78%	85.33%	92.50%
	PERCENTAGE OF KNOWLEDGE OF HOSPITAL REGULATIONS	EFECT	Number of students who are aware of hospital regulations regulating academic-administrative activities ____ x 100 Total number of participants surveyed	90%	71.34%	73.87%	75.36%
		EFECT	Number of teachers and healthcare personnel familiar with hospital regulations governing academic-administrative activities ____ x 100 Total number of participants surveyed	90%	78.22%	81.33%	78.75%

		_____ x 100 Total number of participants surveyed				
EFFICIENCY OF INFRASTRUCTURE FUNCTIONALITY	EFECT	Number of students who consider that the hospital infrastructure allows for the optimal development of academic assistance activities.	90%	80.84%	82.13%	80.71%
	EFECT	_____ x 100 Total number of participants surveyed Number of teachers and healthcare personnel who consider that the hospital infrastructure allows for the optimal development of academic healthcare activities.	90%	76.00%	80.00%	72.50%
EFFICIENCY OF USE OF CLASSROOMS, RESIDENCE HALL AND DINING HALL	EFECT	_____ x 100 Total number of participants surveyed Number of students who consider that the classrooms, residence and dining room are used in an adequate manner and at the established times.	90%	76.13%	80.53%	78.21%
	EFECT	_____ x 100 Total number of participants surveyed Number of teachers and care staff who consider that the classrooms, residence and dining room are used adequately and at the pre-established times.	90%	78.67%	82.67%	80.00%
INTERPERSONAL RELATIONS EFFICIENCY INDEX	EFECT	_____ x 100 Total number of participants surveyed Number of students who consider hospital interpersonal interpersonal relationships is collaborative	90%	84.45%	86.93%	84.64%
	EFECT	_____ x 100 Número total de participantes encuestados Number of faculty and staff who consider hospital interpersonal relationships to be collaborative. hospital interpersonal relations are collaborative	90%	82.22%	86.67%	88.75%
LEVEL OF EXPERTISE AND PROFESSIONALISM	EFECT	_____ x 100 Total number of participants surveyed Number of students who consider the level of knowledge and professionalism knowledge and professionalism of the teaching and care staff.	90%	79.71%	80.00%	80.80%
	EFECT	_____ x 100 Total number of participants surveyed Number of faculty and support staff who rate the level of knowledge and professionalism of the support and support staff as excellent the level of knowledge and professionalism of the teaching and care personnel	90%	79,56%	81,33%	87,50%
EFFECTIVENESS OF KNOWLEDGE TRANSFER	IMPACT	_____ x 100 Total number of participants surveyed Number of students who consider that the transfer of knowledge has allowed them to knowledge has allowed them to put it into practice	90%	81.26%	84.53%	85.36%
EFFICIENCY SUPERVISION OF INTERNSHIPS	IMPACT	_____ x 100 Total number of participants surveyed Number of students who consider the supervision of internships to be adequate of internships are adequate	90%	78.99%	84.93%	84.82%
	IMPACT	_____ x 100 Total number of participants surveyed Number of faculty and staff who believe that supervision of student internships is efficient and ongoing supervision of students is efficient and permanent.	90%	81.33%	89.33%	86.25%
		_____ x 100 Total number of participants surveyed				

(Left vertical label: CLINICAL–SURGICAL PRACTICE AND PERFORMANCE)

EFFECTIVENESS OF CLINICAL-SURGICAL PRACTICE	IMPACT	Number of students who consider the clinical-surgical practice to be adequate or excellent practice is adequate or excellent _____ x 100 Total number of participants surveyed	90%	74.87 %	73.47%	77.14%
	IMPACT	Number of faculty and staff who consider the design of the clinical-surgical practice to be adequate or excellent. of the clinical-surgical practice is adequate or excellent. _____ x 100 Total number of participants surveyed	90%	70.22 %	77.33%	80.00%
STUDENT PERFORMANCE LEVEL	IMPACT	Number of students who consider that the training they have received and/or received allows them to perform adequately and/or given allows them to perform adequately _____ x 100 Total number of participants surveyed	90%	80.08 %	81.73%	83.04%
	IMPACT	Number of teachers and assisting personnel who consider that the training received and/or given to the students allows them to perform adequately _____ x 100 Total number of participants surveyed	90%	76.44 %	80.00%	85.00%
LEVEL OF SATISFACTION WITH THE ROTATION AT THE HEALTH CENTER PERCENTAGE OF TEACHING AND ASSISTANCE PERFORMANCE	EFECT	Number of students who are satisfied with the rotation performed at the assigned health performed in the assigned medical home _____ x 100 Total number of participants surveyed	90%	84.20 %	85.07%	87.50%
	IMPACT	Number of teachers and assistants who evaluate their teaching-attendance performance l _____ x 100 Total number of participants surveyed	90%	73.78 %	88.00%	82.50%

Table 2. HGDC Teaching and Research Process Impact Assessment BSC Monitoring and Indicator Matrix, period 2016-2022

4 Discussion

"Teaching presents a challenge when it comes to finding new dynamics and ways of transmitting knowledge to others, especially in times when information is almost immediate and the dynamics of socialization have changed" (CGFGlobal, 2016, para. 1). However, a large part of university students, have difficulties in their academic preparation on a regular basis. "Difficulties are expressed in lack of motivation for certain subjects or study programs; also due to inadequate school-family environments or spaces, disorganization of autonomous schedules, weakness in the management of study techniques, among others" (Barreno et al., 2022, p. 75-97).

According to Denegri, impact evaluation in higher education is a systematic process carried out to measure and evaluate the results of an intervention or educational program. The goal of impact evaluation is to determine whether educational programs or interventions are achieving the desired outcomes and whether they are having a positive impact on students, the university community, and society at large (Denegri, 2023, para. 1). Impact evaluation should be approached and managed as a management process that determines to what extent the initially stated purposes or objectives have been achieved. It consists of identifying, obtaining and providing useful and descriptive information on the value and merit of the goals, planning, implementation and impact of an intervention on a need or problem identified and intended to change its condition (Aponte and Pérez, 2021, p. 16-19).

The educational community, according to Bayona et al., as the main axis around which higher education institutions-IES revolve, should always be the main beneficiary of the interventions that are carried out in order to improve the scope of their mission and objectives. The better the quality of the HEI, the better the conditions it can offer to the entire educational community; if something benefits the institution, it will directly or indirectly benefit its members (Bayona et al., 2022, p. 18). Impact evaluations always have the intention of benefiting the participants; it is possible to say that the more a student is exposed to the different interventions developed by the HEI, the more benefits he/she can receive from them. Likewise, the more the impact of the interventions is evaluated, the more efficient they will be and, therefore, the benefits for the students will also be greater and greater (Cambridge Assessment International Education, 2019).

Commonly, the interventions proposed by an HEI according to Abdala are focused on implementing strategies that improve some identified aspect to turn it into a strength. By virtue of this, the efforts and resources allocated for their implementation and evaluation are usually focused on addressing the priority needs of students within the institutions (Abdala, 2004, p. 32). In general, the guiding bodies of HEIs, such as professors, managers, administrators, etc., propose interventions that, in spite of achieving their objectives, are not positively valued by their participants. It is important to emphasize that the deeper the analysis, the better the results and the greater the conclusions of the interventions carried out.

It is important to mention that the General Teaching Hospital of Calderón, since its creation, has had a formative and research focus, has incorporated several promotions of rotating interns in nursing, medicine, nutrition and obstetrics; in addition to this, students from several undergraduate careers perform pre-professional internships in careers such as: Statistics, Psychology, Social Work, Pharmaceutical Chemistry, Clinical Chemistry, Clinical Laboratory, Physical Therapy, Environmental Engineering, Psychiatry, Nutrition, Communication, Administrative Sciences, among others. Not to mention the fourth level students from several HEIs that perform the postgraduate rotation at the HGDC (UDI-HGDC, 2016-2022).

Under these considerations, the Global Effective Impact Evaluation of the Teaching and Research process of the HGDC in the period 2016-2022 reached a rating of 87. 39% of effectiveness, which indicates that the teaching-teaching activities are adequate and that certain specific aspects of the academic process need to be reviewed, which is the responsibility of the Higher Education Institutions-IES that work directly with the Calderón General Teaching Hospital.

The Global Effective Impact Evaluation from the perspective of teachers and health care personnel achieved an 89. 12% effectiveness rating, showing that the teaching and health care process has been very good during the study period. Among the aspects highlighted is the functionality of the infrastructure and classrooms that the HGDC has set aside for the training of students, the interpersonal relations between teachers, assistants and students is very good and the high level of collaboration and participation stands out. One of the areas for improvement is the academic process in general (planning of activities, timetable, syllabus, digital platform and university-faculty communication), which is a net competence of the HEIs.

The Global Effective Impact Evaluation from the students' perspective reached a rating of 85. 48% equivalént to very good, which reflects that students in the study period support the management of the Teaching and Research process. There are specific aspects to improve, such as academic resources for training, which is a competence of the HEIs. Internally, as HGDC will motivate teachers, assistants and students to develop research and the promotion of scientific activities to strengthen their knowledge.

The central idea behind the design and application of the impact evaluation methodology is that it should be an instrument that can be replicated in other health units where future health professionals rotate and do their internships. It is also important that once several evaluations have been carried out and a baseline has been established, the impact of the teaching and research process should continue to be evaluated periodically in order to compare the variations of the indicators and the actions for continuous improvement to be implemented. The forms designed for the collection of information can be applied both virtually and physically, which makes it possible to obtain highly reliable information.

In terms of methodology and applicability of the research, it is important to consider the limitation for the collection of information, in many cases the web surveys do not have the due acceptance due to the boom of information received by e-mail and social networks. As this was internal research of the Calderón General Teaching Hospital, a presentation of the study was made to teachers, assisting personnel and students to encourage the participation of all the participants.

5. Conclusions

In the axis on the academic process, it was evidenced that there is a need to improve: the communication system, the duration of modules and schedules, the digital platform and the curricular design, as a competence of the higher education institution-IES. Regarding the resources allocated for training, these are not totally efficient and it is pertinent to carry out an analysis so that students have academic resources that go hand in hand with their training.

The evaluation and research axis presented a high incidence in the students' training and the results reflect that the students have a good acceptance of the current evaluation system and that research is gaining more space. **In the learning, training and knowledge transfer axis**, the results show that this practice is very good and that what was learned in the internship and/or in the pre-professional practices have allowed the students to improve their performance in the units or services where they work. **The axis of clinical-surgical practice and performance** should be strengthened and the interaction between the teacher, the assisting staff and the student should be improved; associated to this, supplies, materials and equipment should be provided to enhance the clinical-surgical practice.

Finally, in order to guarantee accurate decision-making and continuous monitoring of the proposed impact evaluation indicators, the Teaching and Research Unit of the Calderón General Teaching Hospital should apply the Impact Evaluation Methodology once a year in order to compare the results in the indicator follow-up matrix, as well as the design and updating of the research, including the sample size.

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Kahoot in formative evaluation: teaching experience in Higher Basic General Education

Kahoot en la evaluación formativa: experiencia docente en la Educación General Básica Superior

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Abstract

The use of information and communication technologies (ICTs) has become widespread in today's society, covering various fields such as industry and communication. In the field of education, ICTs also play a fundamental role, since various multimedia tools and applications are used, such as videos, audio files, educational programs and didactic applications for pedagogical purposes. In this context, the use of Kahoot stands out as a teaching experience in Higher General Basic Education (EGB), specifically in formative assessment. The main objective of this research was to determine the impact of the application of Kahoot as a didactic strategy to assess knowledge in Natural Sciences. The research question was: Does the application of Kahoot have an impact on the learning of Natural Sciences? The methodology used in this study was quantitative, quasi-experimental, cross-sectional and descriptive. Two learning scenarios were considered: a traditional classroom (control group) and another in which the Kahoot evaluation tool was used (experimental group). The technique used to collect data was a survey applied to students through Google Forms. Among the main findings of this study, it is highlighted that the application of Kahoot as a didactic strategy for assessment significantly influences the levels of student participation in the learning of Natural Sciences.

Key words

Natural sciences, school environment, teaching experience, educational innovation, learning platform.

Resumen

El uso de las tecnologías de la información y comunicación (TIC) se ha extendido ampliamente en la sociedad actual, abarcando diversos campos como la industria y la comunicación. En el ámbito educativo, las TIC también desempeñan un papel fundamental, ya que se utilizan diversas herramientas y aplicaciones multimedia, como videos, archivos de audio, programas educativos y aplicaciones didácticas con fines pedagógicos. En este contexto, se destaca el uso de Kahoot como una experiencia docente en la Educación General Básica Superior (EGB), específicamente en la evaluación formativa. El objetivo principal de esta investigación fue determinar el impacto de la aplicación de Kahoot como estrategia didáctica para evaluar los conocimientos en Ciencias Naturales. La pregunta de investigación planteada fue ¿la aplicación de Kahoot tiene incidencia en el aprendizaje de las Ciencias Naturales? La metodología utilizada en este estudio fue de enfoque cuantitativo, cuasi experimental, transversal y descriptiva. Se consideraron dos escenarios de aprendizaje: una clase tradicional (grupo control) y otra en la que se empleó la herramienta de evaluación de Kahoot (grupo experimental). La técnica utilizada para recolectar los datos fue una encuesta aplicada a los estudiantes a través de los formularios de Google Forms. Entre los principales hallazgos de este estudio, se destaca que la aplicación de Kahoot como estrategia didáctica para la evaluación influye de manera significativa en los niveles de participación de los estudiantes en el aprendizaje de las Ciencias Naturales

Palabras clave

Ciencias Naturales, entorno escolar, experiencia docente, innovación educativa, plataforma de aprendizaje.

1. Introduction

In the current landscape of national education, Information and Communication Technologies (ICT) have acquired significant relevance. The constant technological growth and the need for connectivity in the social sphere have generated a demand to develop a variety of personal and professional activities. In this context, education stands out as a field that does not remain on the margin of this requirement, especially during extraordinary situations such as the pandemic, where ICT have allowed to advance in academic studies and to maintain the teaching task in force. This research focuses on exploring the use of the Kahoot tool in the summative evaluation of a natural science course. This approach arises from the recognition of the need to innovate in the educational field in order to face pedagogical, didactic and curricular challenges.

Based on the study conducted by Islas 2017 and Martínez 2017, it is evident that Kahoot, from its playful approach to learning and evaluation, is presented as a motivating and attractive factor to obtain objective information about students' knowledge, reducing the tension, stress and anxiety associated with traditional evaluation methods. In this context, the present research becomes relevant by offering teachers and the educational community in general the possibility of innovating the school environment through the pedagogical use of ICT, specifically through gamification with Kahoot, which leads to meaningful and lasting learning.

Regarding the structure of the article, section 2 presents the concepts related to the research. Section 3 details the methodology used to develop this research process. Section 4 shows the analysis and discussion of the results. In section 5, conclusions are drawn according to the results obtained.

2. Theoretical Reference

2.1 Changes in education

Educational institutions are undergoing change due to the needs and shortcomings present in the classroom. This drive to improve teaching leads to addressing current pedagogical and technological challenges, recognizing both teachers and students as central actors whose teaching and learning process deserves further exploration. Reinoso-Gonzales and Hechenleiter-Carvallo (2020) argue that, "a change in the role of the teacher in the teaching process minimizes direct instruction and content exposition, replacing them with classroom experiences that promote student protagonism" (p. 1).

In view of the above, new technologies have brought about many social and business developments, but they have also led to processes of profound change. The education sector is no stranger to this and is changing rapidly to try to adapt to the challenge presented by this new scenario. Traditional teaching methods give way to new ways of learning as new technologies transform the learning process, the role of the student and the teacher becomes more active and dynamic, so, technological limitations in schools must be covered and provide the necessary resources to observe if indeed the new cognitive experience points to effective transformations; only when this happens, it can be said that there is a pedagogical innovation.

Based on UNESCO's reading in 2017, at personal criteria, it can be pointed out that the adaptation of education to current changes implies the creation of new learning environments that incorporate innovative didactic materials, as well as new ideas, strategies and practices. This includes teaching-learning experiences that challenge

teachers to improve their skills and understand new approaches, which contributes to a transformative change in the educational process. The idea of integrating technology in the teaching exercise, if it is truly an improvement in the educational process, should also consider other elements that allow for greater knowledge regarding its operation and impact on the development of cognitive skills, that is, what happens in the brain of the learner to consolidate his new learning; the articulation of these factors leads to a true transformation of the teaching and learning process, the actions planned within education, with or without technology, must be consciously codified, with a goal set to be achieved. "The role of information technologies should be a means in the actions of teaching and learning, not an end" (Reinoso-Gonzales and Hechenleiter-Carvallo, 2020, p. 3). Thus, several studies point to

> an alternative teaching method based on active student learning and supported by the use of new technologies that allow redirecting learning through interactive interfaces that contributes to the development of students' intellectual and emotional skills and abilities (Martinez, 2017, p. 254).

It is worth mentioning that the use of information technologies in learning is a process that must be developed gradually, it offers the possibility of correcting errors, as well as obtaining experiences that will allow determining the main tools. The benefits of these tools must be applied for learning, in such a way that the achievement of educational objectives is guaranteed.

2.2 Importance of technological tools

According to Gallardo (2018) "from the organizational point of view it is necessary to complement the implementation of ICT with a global and integrative strategy that provides coherence between purely technological aspects and educational models, in order to achieve superior results" (p. 1) as can be observed current technological innovations evidence remarkable advances over time; ICT have transformed habits and lifestyle worldwide, including the educational field. They have revolutionized the way in which information is shared, which has generated a more interactive and dynamic environment for students. In this context, teachers face the challenge of adapting to the so-called new generation of digital natives within the educational system. ICTs are perceived in the school environment as tools that can improve the internal functioning, the services offered and the teaching provided to students.

ICT contribute to "a new understanding and vision of the contemporary school, which without forgetting the traditional pedagogical foundations incorporates these technologies into new ways of conceiving teaching and learning" (Granda et al., 2019, p. 2). In different contexts of society, the combination of ICT has transformed pedagogical activities in the educational process, including in terms of skills development both inside and outside the learning environment. In general, ICTs revolve around three basic media: computing, microelectronics and telecommunications; but they revolve, not only in isolation, but what is more significant in an interactive and inter-connected way, which makes it possible to achieve new communicative realities (Santana, 2019). According to Granda et al. ICT contribute to a new understanding and vision of the contemporary school, which without forgetting the traditional pedagogical foundations incorporates these technologies to the new ways of conceiving teaching and learning, are causing various attitudes and opinions regarding the use and exploitation to achieve optimal academic performance. In various social contexts, the combination of ICT has transformed pedagogical practices in the

educational environment, including in terms of skills development both inside and outside the learning environment (Granda et al., 2019).

Molina and Molina (2021) point out that "the phenomenon of globalization, scientific and technological transformation and communicational networks, have gradually eliminated geographical as well as cultural boundaries, thus promoting substantial changes in interaction and communication in academic contexts" (p. 3). Communication technologies have become fundamental tools in various sectors of society, where information and communication are stored, processed and transmitted freely and without restrictions. The importance of these technologies in education is evident; in recent years their need has become more evident, transforming and improving the field of teaching and learning. They have generated a wide range of capabilities that have eliminated the barriers in the transmission of communications and information, providing numerous advantages in several fields.

On the other hand, González and Martínez (2019) mention that "information and communication technologies in education represent the new learning environments and, because of their impact on education, they are developers of competencies necessary for learning and generators of life skills" (p. 4). In other words, it is necessary to identify the scientific and technological competencies that shape the citizens of the 21st century, so that people must acquire scientific and technological knowledge that will allow them to perform better in everyday life, and thus acquire broader knowledge according to the requirements of society and their environment. In the same way, Cañedo (2021) states that, "today science and technology are a powerful basis for the cultural, social, economic and public development of life in modern society" (p. 1). Their influence has reached such a point that life today requires their presence in all its aspects with the diffusion of products from one field to another, and their systematic use has become a growing condition in this historical period.

2.3 Gamification in education

Ortiz-Colón et al. (2018) point out that "the knowledge society and technology have brought with them a new map in which young people feel concerns that education has not always been able to satisfy" (p. 1). These changes generate a shift in students' interests, which requires teachers to seek new strategies and resources to increase their students' motivation and engagement. Liberio (2019) suggests that "play as knowledge construction requires committed teachers with different attitude, demands that they abandon traditional approaches, which worked at the time" (p. 1). Nowadays, it is crucial to impact the integral development of students. Play is one of the main ways in which children acquire knowledge and skills. Therefore, opportunities for fun and environments that encourage hands-on play, discovery, and learning are essential in effective early childhood education programs. Heinze et al. (2017) argue that "teacher quality and ongoing professional development is critical to achieving quality education" (p. 2). Through gamification in education, education, updating and training processes can be mediated. Prieto (2020) proposes:

> Gamification within learning consists of the use of game mechanics developed in non-game environments, a methodology that allows working on aspects such as motivation, effort and cooperation within the school environment, stimulating students in such a way that it leads to an expansion of their knowledge (p. 2).

These methodologies offer an effective approach to student-centered learning, promoting the development of skills and the acquisition of knowledge through situations created specifically for educational purposes. Prieto and Gómez (2022) argue that, "games that address the integral development of personality, cognitive, motor and socio-affective can have a positive impact on student motivation and participation" (p. 3).

Based on Islas' reading in 2017, at personal discretion, it can be considered that games involve engaging in pleasurable physical or mental activities to satisfy emotions, it is crucial to evaluate three essential characteristics: mechanics, dynamics, and emotions. This means that, in order to create a dynamic environment, it is necessary to plan activities that incorporate these elements, which will facilitate learning to be more relevant and effective in the acquisition of knowledge.

2.3.1 Games in the educational process

García et al. (2021) point out that, "the new educational framework requires an effort on the part of teachers to innovate and improve their teaching methodologies and tools, in order to guarantee student learning by competencies from the perspective of didactic innovation and effectiveness" (p. 1). In addition, Rojas et al., (2021) highlight that, "the strategy of implementing elements of games is used in different areas of knowledge that aim to motivate people to use a certain product, to participate in a campaign or as in this case to learn" (p. 5). Games, with basic components such as rules, objectives, players, playing field and rewards, offer dynamic learning that arouses students' interest.

On the other hand, Rojas et al. (2021) argue that, "the educational sector is one of the most affected and by not keeping pace with new advances in information and communication technologies, it is affected in the teaching-learning process" (p. 2). These technologies seek to provide answers from different didactic, communicative and social perspectives in the development of education, taking into account the different contexts in which they are applied. Jaramillo and Tene (2022) argue that, "technological didactic resources have become indispensable in today's life; however, their importance in the teaching-learning process lies in the pedagogical sense that teachers must incorporate" (p. 1).

According to Islas (2017) "ICTs represent for education a major element, from the infrastructure, the theories from which they are investigated, the competencies they have implied in the development of students and teachers or the learning environments they make possible" (p. 3). One specific area of interest is gamification in the classroom, which seeks to reconfigure educational methods to adapt to new needs. Gamification aims to influence behavior through game-generated experiences and feelings, fostering motivation and engagement to achieve specific objectives. It can be added then that gamification seeks to motivate behavior within the educational environment, stimulating the construction of learning through student participation, contributing to the creation of knowledge and making traditional education obsolete.

2.4 Innovation in education

González and Martínez (2019) point out that "the transformations and advances in science, technology and information we are living are originating a new social context in which citizens every day must assume the changes and challenges imposed by the information and knowledge society" (p. 5). On the other hand, Reinoso-Gonzales and Hechenleiter-Carvallo (2020) point out that, "the positive perception of students regarding methodological and evaluative innovation shows that flipped classroom is an adequate method to work with and that Kahoot constitutes an evaluation tool to evidence the achievement of learning" (p.

5). As can be seen, innovation in education and the concern for improving the skills and motivation of students in the classroom have been topics of continuous interest, in this sense, the education industry is dynamic and students express diverse needs and concerns over time. With new technologies, teachers have access to innovative and sophisticated tools that, when used for pedagogical purposes, can transform traditional learning systems.

Finally, Tapia et al., (2020) argue that "the exercise of pedagogy in university classrooms has made it necessary to implement new teaching-learning strategies; the current scenario of education must be aligned with technological trends" (p. 8). Thus, it can be seen that the trend of innovative educational models is to focus on solving games with a high ludic component, integrating devices such as tablets or smartphones in the classroom in a way that enhances motivation, interest and participation of students. These models can also develop basic cognitive skills and improve specific skills through game-facilitated interactions and interpersonal relationships. Consequently, pedagogical strategies linked to technology should ensure optimal development of students' academic competencies.

Ortiz-Colon et al. (2018) currently and as a result of the impact that technology has taken as a fundamental point during the academic process of students shows how it has highlighted the influential factor in the teaching-learning process, within the tools it can be mentioned that Kahoot is a free online educational platform that reinforces certain concepts through evaluation as part of the learning process, in a different way to the use of technical devices, especially cell phones. According to Garcia et al. (2021) the interactive platform

> kahoot allows educators to create relevant quizzes with clear and understandable questions on any topic they consider to reinforce it, students become active participants or actors and the way the tool impacts on the traditional method thus causes motivation in the teaching and learning process, where students have to attentively answer the questions from their technological devices, whether they are cell phones, tablets, laptops or computers (p. 4).

The use depends on the availability of resources such as a computer or a laboratory, as well as accessibility to the Internet, this at the time the activity is performed with the student, so that the student can interact quickly and earn points must consider all the elements of connectivity. The activities in the classroom are shown in a more attractive way, highlighting its interactive, dynamic and fun interface, that is, it has the form of a game. In this sense, Kahoot allows playing quizzes through questions in which the student is the most active protagonist in giving answers while the teacher becomes the coach or mediator of the process allowing him to connect with the student; it is a complete tool to be used in the teaching-learning process due to its multiple benefits. In the last five years, one of the most popular game-based digital learning resources in Spain is called Kahoot. It is free and easy to use, due to these aspects it has become a popular material for both teachers and students, it is valued as an element that enables the dynamization of classroom activities and contributes to the improvement of student participation, because it fosters positive group relations.

Thanks to new technologies and games, learning becomes easier, which helps to develop students' creativity, improve information management and collaboration with peers, improve problem-solving skills and critical thinking. These learning systems help reduce the fear of error, which is often one of the barriers to student participation in the classroom.

New technologies are then considered a trial-and-error process that allows rectifying mistakes. According to Rojas et al. (2021)

> if this concept is proposed for the use of Kahoot in the classroom, it means that the questions provided by this tool should be relevant to the student's level of knowledge, thus presenting achievable testing challenges, thus creating knowledge, skills and abilities (p. 3).

The tool is a digital educational resource that can be used for various purposes, for example, to diagnose knowledge on a topic, to find out highlights of a unit or test what has been learned, as well as to assess the level of understanding of a paragraph of reading or discussion on a particular topic. It is important to highlight that Kahoot was created by Professor Alf Inge Wang, who thought of a comfortable and fun educational environment. This game-based tool is more than a simple online test and has certain features that invite students to participate using any mobile device, in an accessible and easy-to-use way, both for teachers and students.

2.5 Teaching of Natural Sciences

Jaramillo (2019) argues that "teachers will know how to incorporate in the teaching of students knowledge that is related to updated science in order to rescue proven knowledge that enhances knowledge that helps to validate scientific truth and also to perform constructivist criticism" (p. 4). In this order of ideas, in relation to Jaramillo's reading in 2019 at the authors' criteria it can be stated that, teachers should integrate knowledge of modern sciences in teaching so that students acquire verified knowledge that enhance and validate scientific truth, in addition to facilitating a process of reflection to perform constructive criticism. According to the author, Natural Sciences are classified as real sciences due to their foundation in facts, empiricism and materialism, which leads them to work in the search for reality. Lozada (2017) argues that "games act as mediators in the teaching-learning processes, achieving in students a better understanding of theoretical concepts, thus, optimizing their competencies in academics" (p. 8). Thus, science education in the new millennium requires a profound transition from basic education to primary education, but not in an adaptive way, but in an innovative way so that it is the beginning of a process that guarantees the learning elements for the baccalaureate level of study. According to the author, the teacher should not limit himself to transmitting information, but should allow students to produce and construct knowledge, to feel happy and satisfied when they find it, and to use methods similar to the world in their daily work.

On the other hand, Arancibia et al. (2020) point out "the importance of creating a useful learning environment that promotes the generation of knowledge from a constructivist approach (p. 9). This is based on dialogue, collaborative learning and the application of knowledge to real problems with the help of technology. Méndez and Arteaga (2021) suggest that "the levels of experience of teachers in the natural sciences are closely related to the social management of the classroom" (p. 1). These levels represent the foundations on which the teacher bases his or her approach to teaching and learning in the natural sciences and specialized knowledge, adapting them to the characteristics of the professional environment in which the teacher has developed in practice.

Finally, Peña-Nivicela et al. (2019) emphasize that "science teaching should not only focus on learning concepts, but should also contribute to the development of competencies related to how to do and think about science" (p. 3). It is essential that the evaluation of topics such as river water pollution allows determining the acquisition of the knowledge

worked on during the class, providing the opportunity to correct or reinforce certain knowledge.

2.6 Articulating Natural Science learning with *kahoot*

Lozada (2017) states that "games act as mediators in the teaching-learning processes, achieving in students a better understanding of theoretical concepts, thus optimizing their skills in the academic field" (p. 8). In such a way that gamification becomes an activator of attention and an alternative to complement traditional educational programs with the integration of elements that enable sustainable learning over time. On the other hand, Mallitasig and Freire (2020) argue that "the study of natural sciences seeks to train students with a scientific attitude that allows understanding science as a systematic and logical investigation of reality" (p. 2). For this, the use of innovative, alternative, investigative, constructivist and resolutive didactic strategies is required, where the student is the main component, which implies changing the traditional paradigm of learning in the natural sciences. Riquelme (2021) emphasizes "the fundamental role of the teacher as an articulating agent of learning and highlights the importance of the methodological strategies used to achieve this change" (p. 4). Guayara et al. (2018) point out that "learning needs the participation of students in the construction of their knowledge, not being sufficient the simple personal reconstruction of knowledge previously elaborated by others" (p. 27). According to them, it is crucial that students create their own knowledge.

On the other hand, Lozada (2017) defines collaborative learning as methods that foster collaboration among individuals to understand, share, and expand information about a topic. This approach involves sharing data through real or virtual discussion rooms, where group members assume related and complementary roles to achieve a common goal. Lozada highlights the use of tools such as Kahoot to foster collaborative learning, facilitating immediate feedback from the teacher and promoting a more active attitude among students. Garcia et al. (2021) point out that research shows that the more a student is exposed to the information they are learning, the easier it is for them to remember the topic and the less they have to resort to memorization highlighting that Kahoot not only facilitates learning, but also allows students to learn in a variety of ways, turning them into creators of their own knowledge (Garcia et al.,2021).

Finally, Guevara et al. argue that education cannot be based solely on the transmission of knowledge from the figure of the teacher, especially considering the new scenarios and lifestyles faced by the various educational actors (Guevara et al., 2022). They highlight that online education, mediated with tools such as Kahoot, plays an important role in this transition, educational institutions have had to adopt changes to support the teaching and learning process. In addition, Vergara (2021) and Salazar (2020) point out that "the pedagogical intervention mediated with Kahoot contributes to improving students' academic performance in science learning" (p. 7).

3. Methods and instruments

In attention to the object of study, the quantitative approach was used, quasi-experimental type of research, cross-sectional and descriptive design where its purpose is to collect data at a single moment, to describe variables and the incidence of one variable on the other at a given moment. The study population was selected by means of a non-probabilistic sample by convenience, it was formed by 96 students; a parallel of 32 students intervened as the control group with the application of a traditional methodology and two parallels with a total of 64 students became the experimental group with whom the technological tool was

used; the research process had the consent approved by the legal representatives for the collection of the information, analysis and sharing of the results with the community of the Educational Institution.

The technique used for data collection consisted in the application of a survey to students. This methodology was selected due to its wide use in research, which guarantees its relevance. The data collection instrument included closed questions evaluated on a Likert scale, which ensures its validity and reliability; it was administered through Google Forms, which allowed the creation of a digitized questionnaire to facilitate the collection of responses and provide the research with an interactive, novel and innovative instrument. For the processing and analysis of the information collected, a statistical process will be used, supported by graphs that will facilitate the presentation and interpretation of the results obtained.

4. Discussion and results

The answer to the research question "Does the application of Kahoot have an impact on the learning of Natural Sciences? The evaluation of learning is an important indicator to determine the effectiveness of the Kahoot tool as a mediator of this process, where it is possible to verify if its use contributes to a better acquisition of knowledge, in such a way that the evaluation shows the following results.

	Question 1	Question 2	Question 3	Question 4	Question 5	Question 6	Question 7	Total students per group
Control group	75%	53,13%	53,13%	75,13%	43,75%	93,75%	31,25%	100%
Experimental group	100%	90,63%	96,88%	93,75%	84,38%	100%	98,44%	100%
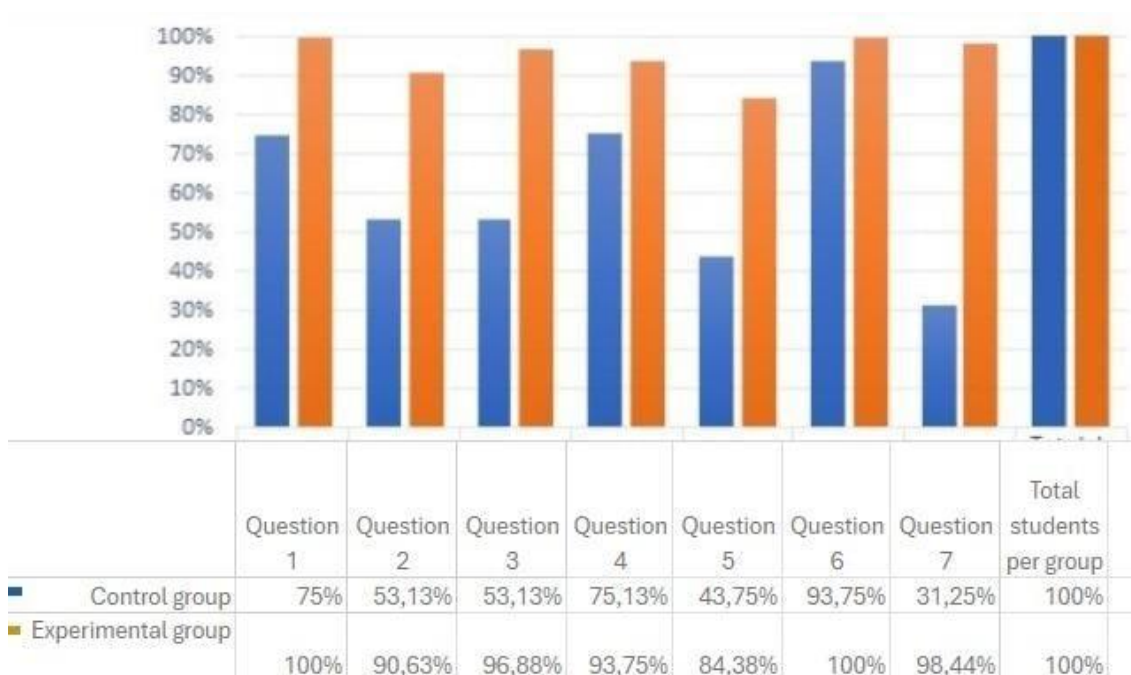
Figure 1. Learning assessment results of the control and experimental groups

For the evaluation of learning, seven knowledge questions were used as a reference, among which are: question 1, water pollution occurs when substances are added or physical changes are applied that alter its characteristics and quality; the students in the control group (CG) answered 75% correctly, while the students in the experimental group (EG) with whom the intervention was carried out answered correctly with 100%. Question 2, the

water does not have cleaning systems, so they are not carried out through the self-purification cycle; the control group answered this question with 53. 13% and the experimental group with 90. 63%. Question 3, water has a natural capacity to eliminate contaminants, but many times contamination exceeds the self-purification capacity of water, the response obtained by the CG was 53. 13% and for the SG 96.88%. Question 4, the cleaning capacity of water is not limited, since only biodegradable substances can be removed and in not excessive quantities, 75.13% of the CG students answered correctly, and with 93. 75% the GE. Question 5, wastewater from industries and mines contain toxic substances and solid materials that are difficult to decompose, 43. 75% of the CG students give an appropriate answer, while 84. 38% belonging to the GE answer in a timely manner. Question 6, What are the main water pollutant groups, the answers obtained for the CG are 93. 75% and for the SG 100%. Finally, question 7, what are the main water pollutants according to their origin? To this question, the CG responded with 31. 25%, while the SG responded with 98. 44%.

After administering the natural science knowledge assessment instrument through Google Forms to both the control and experimental groups, and observing the results presented in Figure 1, a significant difference is evident. In the control group, composed of a total of 32 students, the average correct answers to the seven questions established on the contribution to learning oscillate around 60%. In contrast, in the experimental group, these correct answers reached approximately 95%. This result highlights that the implementation of the tool has a significant impact on learning. It should be noted that the experimental group received a lesson plan based on the use of Kahoot as a means of knowledge assessment. The results obtained are in agreement with Malvasi and Recio (2022) who point out that:

> When planning playful didactic experiences in the school context it should be considered that such an approach does not have to be unique, but that the proposal can be enriched by adding other elements, such as the observation of the starting situation or the problem that contextualizes the experience, the story serves as a thread and scenario, an approach to various challenges that encourages action, collaboration and participation in problem solving can lead to great results with the intervention of digital platforms (p. 63).

In this sense, it can be pointed out that the use of the tool is beneficial for the teaching-learning process; students are more enthusiastic about the activities, getting involved in their learning and acquiring significant knowledge.
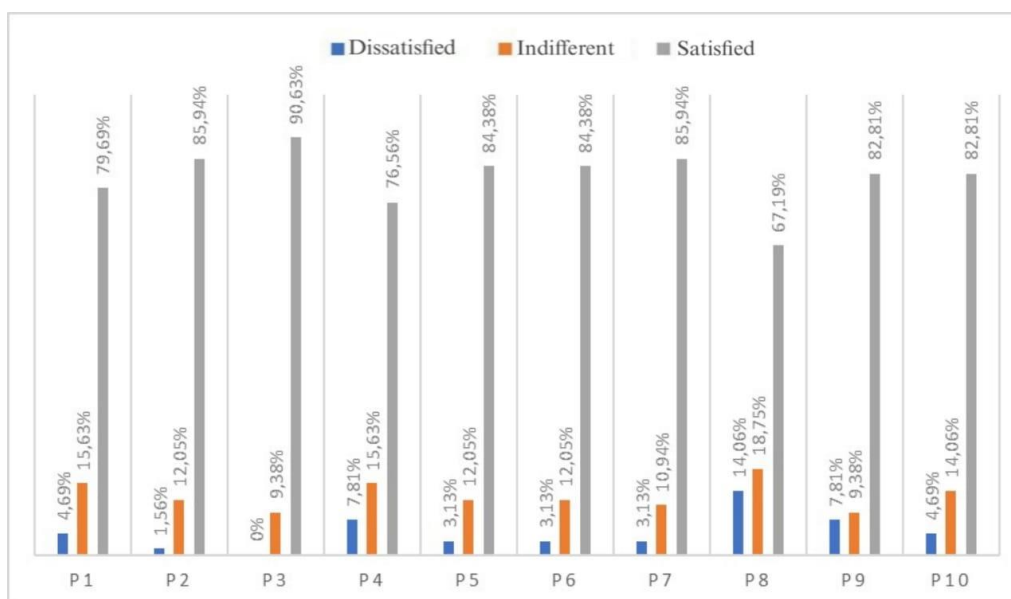
Figure 2. Learning assessment results of the control and experimental groups

Once the satisfaction evaluation instrument was applied using Google Forms to the experimental group, and according to the results presented in Figure 2, it can be observed that in the area of learning using the Kahoot tool, all the questions presented with the letter P reflect percentages higher than 50%. This indicates that students are satisfied with the usefulness of this tool to evaluate their academic progress through this medium.

These findings confirm that gamification emerges as an extremely popular educational methodology, as it increases the attractiveness of learning processes by fostering innovation, enjoyment, efficiency, concept retention and skill acquisition. In this way, the *Kahoot tool* contributes to the teaching-learning process by generating satisfaction among students, increasing their motivation to acquire new knowledge, and their dynamic and interactive participation goes hand in hand with interaction with the teacher.

Once the satisfaction evaluation instrument was applied through the *Google forms* to the experimental group, and according to the results presented in Figure 2, it can be seen that in the area of learning using the *Kahoot tool*, all the questions show percentages above 50%. This means that students claim to be satisfied with the usefulness of the tool to evaluate their learning through this medium.

With the above, it is ratified that gamification is positioned as a widely accepted educational methodology, since it enhances the attractiveness of learning processes, stimulates innovation, enjoyment, effectiveness, knowledge retention and skills acquisition. Consequently, the *Kahoot tool* contributes significantly to the teaching-learning process by reflecting student satisfaction, increasing their motivation to expand their knowledge, and their participation and interactivity in tune with the teacher.
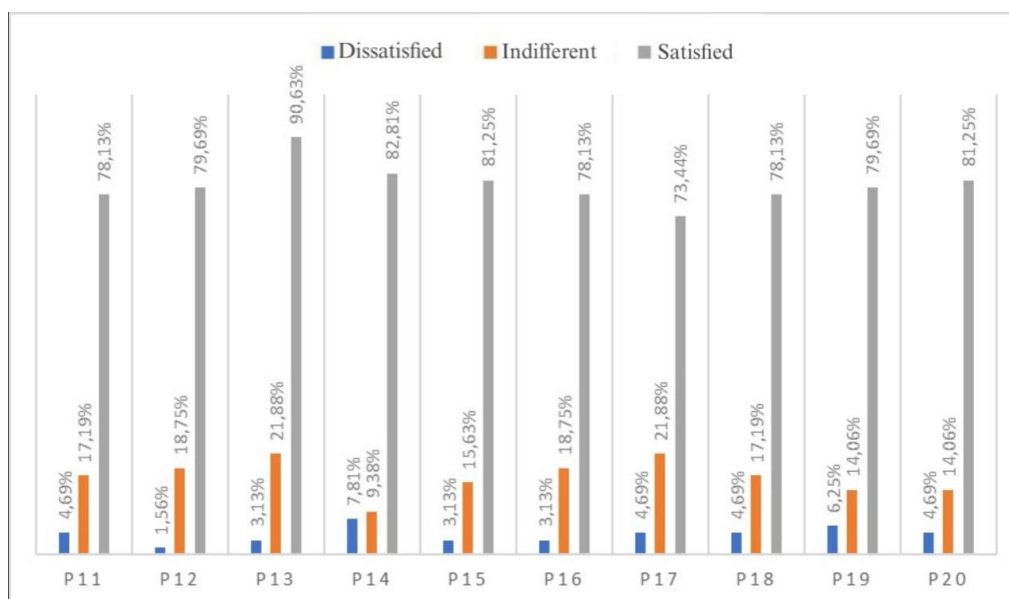
Figure 3. Results of satisfaction with the conceptual design dimension

Figure 3 presents the analysis of questions from eleven to twenty, the same are represented by the letter P, it is also observed that about 80% of students are satisfied with the conceptual design presented by the tool in their learning process in the area of conceptual design. According to Valero (2018) "these applications allow such everyday activities such as a written test or the completion of a classroom activity to become more dynamic and offer positive reinforcement to the students by the teacher" (p. 18). One of the most important keys to achieving this satisfaction is to give students full control over the dynamics of the game being used; it is critical that all activities are designed in a way that engages the learner in the game and allows them to move toward their goals. Depending on the specific dynamics, the teacher can employ various resources to achieve the established objectives.

The results obtained show that the conceptual design generated with the Kahoot tool has contributed to the achievement of the educational objectives established for the learning process. This confirms that the established standards have been met and that the achievements and rewards proposed by the program have been achieved.
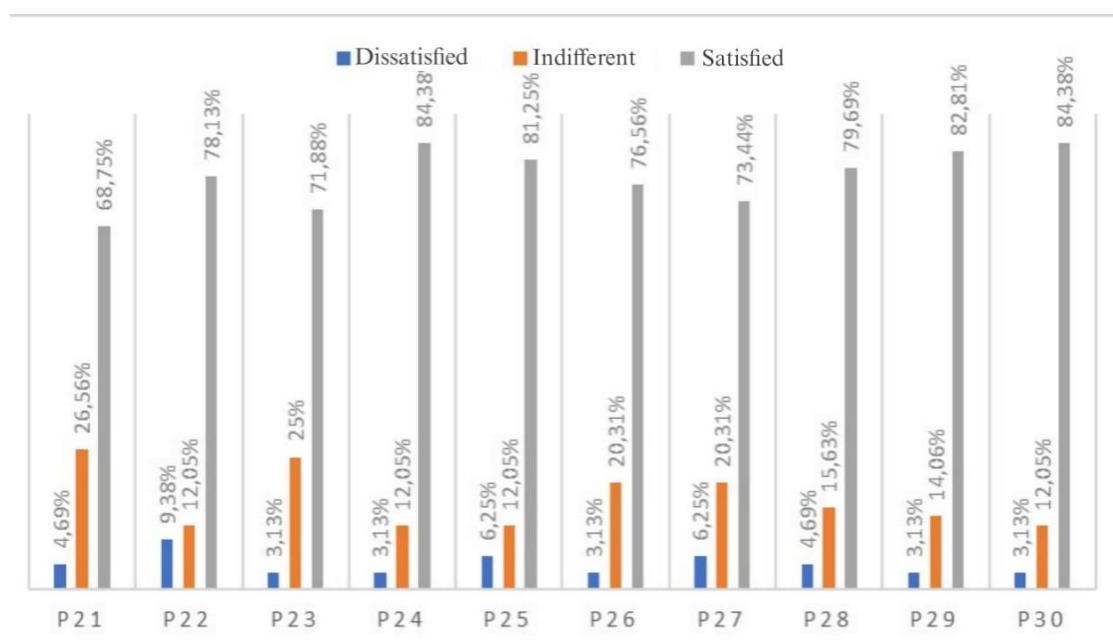
Figure 4. Satisfaction results procedural design

The figure shows the analysis of some questions, which are represented by the letter P. According to the results obtained, Figure 4 shows that, in the area of procedural design, using the *Kahoot* too*l*, more than 50% of the students are satisfied with the procedural design presented in their learning process. According to Zepeda et al. (2016) point out that "the factor to take into account from gamification is the reward scheme used by video games, which is depending on the level reached certain privileges or additional rewards are offered" (p. 6). As can be seen, the teacher's objective is to awaken the student's interest through the game, and to achieve this, he can use the reward dynamics; if the teacher's objective is to generate interest in the activity, he can apply a competitive dynamic, which, although not perceived as positive, can be useful in the educational environment.

From the results obtained, it can be concluded that the procedural design generated with the *Kahoot* tool has made it possible to verify that students understand the steps executed during the activities, following the established planning. In addition, attractive and challenging activities have been promoted, which guide the student's experience in the learning process. It is important to highlight that the data obtained in the study are presented in the corresponding figures, providing additional and complementary information to the analysis.

Model	*R*	*R* square	*R* tight square	Standard error of estimation
1	.997ᵃ	.993	.993	.620

a. Predictors: (Constant), Kahoot Score

Table 1. Summary of the model. Linear Regression Analysis

In the linear regression analysis presented in Table 1, the multiple correlation coefficient (R) was selected because of its importance in determining the strength and direction of the relationship between the variables studied. In this case, the multiple correlation coefficient was found to be 0.997, indicating a very high correlation between the level of participation and the score obtained in *Kahoot*. This statistic was chosen because it provides crucial information on the strength of the linear relationship between these two variables. A high correlation suggests that changes in the level of participation are closely related to changes in the *Kahoot* score in a consistent and predictable manner, which reinforces the validity of the linear regression model used to analyze the relationship between these variables. Thus:

- R-squared: The coefficient of determination (R-squared) is 0.993. This means that approximately 99. 3% of the variability in the *Kahoot* score can be explained by the level of participation using this linear regression model. Such a high R-squared value indicates that the model is highly predictive.
- Adjusted R-squared: The adjusted coefficient of determination (adjusted R-squared) is 0.993. This measure adjusts the R-squared to account for the number of variables and samples used in the model.
- Standard error of the estimate: The standard error of the estimate is 0.620. This value indicates the average variability between the observed values of the Kahoot score and the values predicted by the regression model. A lower standard error indicates better accuracy of the model.
- Predictors: The predictors included in the model are the constant (intercept) and the *Kahoot* score. This means that the model uses the *Kahoot* score to predict the level of participation.

In summary, the linear regression model shows a strong and highly predictive linear relationship between the level of participation and the *Kahoot* score. The *Kahoot* score is a significant predictor of participation level.

Model		Sum of squares	*gl*	Root mean square	*F*	Sig.
1	Regression	1542.616	1	1542.616	4017.715	.000[b]
	Residue	10.751	28	.384		
	Total	1553.367	29			
a. Dependent variable: Level of Participation						
b. Predictores: (Constante), Puntaje Kahoot						

Table 2. ANOVA analysis

In this case, ANOVA analysis was used to determine the significance of the linear regression model applied in the study. ANOVA provides information on the total variability of the data (total sum of squares) as well as the variability explained by the regression model (regression sum of squares). By comparing these two measures of variability, we can determine whether the regression model explains a significant amount of the variability observed in the data.

In the specific case of Table 2, we observe that the regression sum of squares is considerably high compared to the total sum of squares, suggesting that the regression model explains a significant portion of the total variability in the data. This supports the usefulness of the linear regression model in explaining the relationship between the variables studied and justifies its statistical significance using the ANOVA test

- Root mean square: The root mean square is the sum of squares divided by the corresponding degrees of freedom. In this case, the root mean square of the regression is 1542.616 and the root mean square of the residual is 0.384.
- F and p-value: The F-value is a measure of the overall significance of the regression model. A high F value indicates that the model is significant. In this case, the F-value is 4017.715 and the p-value is less than 0.001 (indicated by 0.000). This indicates that the regression model is highly significant.

After performing an ANOVA analysis to determine the impact of the application of Kahoot as a didactic strategy in the evaluation of knowledge in natural sciences, significant results were found. The statistical test revealed a sum of squares of 1542.616 for the regression model, with an F-value of 4017.715 and a p-value (Sig.) of 0.000. This indicated that the regression model was highly significant.

Therefore, the alternative hypothesis (Ha), which stated that the application of Kahoot as a didactic strategy had a significant impact on the assessment of knowledge in natural science, was accepted. This finding suggests that the use of Kahoot as an educational tool could have significantly influenced students' level of participation and performance in the subject of natural science.

These results support the conclusion that the linear regression model is statistically significant in predicting the level of participation using the *Kahoot* score as a predictor. The very low *p*-value indicates that the relationship between the variables is very unlikely to be the result of chance.

Model		Non-standardized coefficients		Standardized coefficients	T	Sig.
		B	Desv. Error	Beta		
1	(Constant)	-5.129	1.247		-4.114	.000
	Kahoot Score	.948	.015	.997	63.385	.000
a. Dependent variable: Level of Participationc						

Table 3. Analysis of the coefficients in the linear regression model. Linear regression line. y= -5.129+0.948x, i.e.: Level of Participation= -5.129+0.948 (Kahoot score), i.e.: Level of Participation= -5.129+0.948 (*Kahoot* score)

Table 3 indicates the analysis of the coefficients in the linear regression model provides information on the magnitude and significance of each predictor. Unstandardized coefficients (B): the coefficient for the constant (intercept) is -5.129. This indicates the expected value of participation level when the *Kahoot* score is equal to zero. The coefficient for the Kahoot score is 0. 948, which means that for each unit increase in the Kahoot score an increase of 0. 948 in the level of participation is expected.

Standardized coefficients (Beta): the standardized coefficients represent the relative contribution of each predictor in the prediction of the dependent variable. In this case, the

standardized coefficient for the *Kahoot* score is 0.997, indicating that the *Kahoot* score has a very strong and positive influence on the level of participation.

The *t*-value is a measure of the individual significance of each coefficient. A high t-value indicates that the coefficient is significant. In this case, both the coefficient for the constant and the coefficient for the *Kahoot* score have high t-values. The *t*-value for the *Kahoot* score is 63.385, indicating high statistical significance. The p-value indicates the probability of obtaining a coefficient value equal to or more extreme if the true relationship between the variables is zero. In this case, the p-value for both coefficients is less than 0.001 (indicated by 0.000). This means that the coefficients are highly significant, and it is unlikely that the relationship between the variables is the result of chance.

In summary, the coefficients indicate that both the constant and the *Kahoot* score are significant predictors of the level of participation. The *Kahoot* score has a very strong positive influence on the level of participation, meaning that as the Kahoot score increases, an increase in the level of participation is expected.
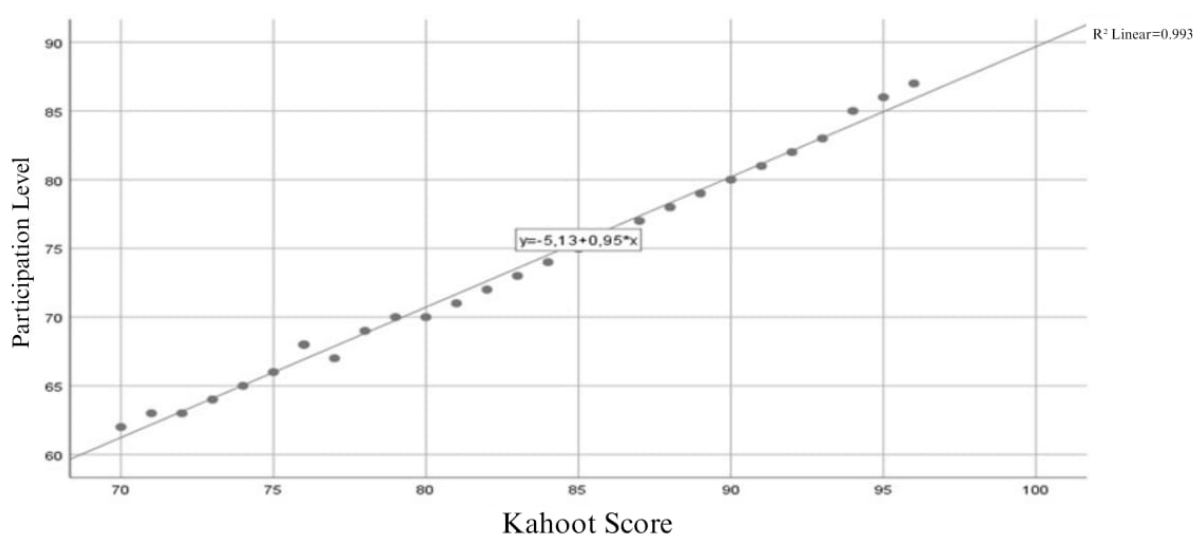
Figure 5. Kahoot as a function of participation

Since the sample size is 96, it is assumed that the visual analysis of the linear regression graph is representative of the data. Looking at the linear regression figure 5 with the data provided, the positive linear trend between *Kahoot* score and level of participation is confirmed. The scattered points are clustered around an ascending straight line, indicating a strong positive correlation between the variables. The fitted regression line shows a positive slope, implying that, on average, as the *Kahoot* score increases the level of participation also tends to increase.

Given the sample size and the consistency of the linear relationship evidenced in the graph, it can be affirmed that there is a significant difference between the mean scores of the groups. In summary, the linear regression figure, based on a sample of 30 observations, supports the existence of a significant difference between the score obtained in *Kahoot* and the level of student participation.

5. Conclusions

After analyzing the methodology and the data collected, the following main conclusions can be highlighted:

According to García et al. (2021) "the implementation of Kahoot as a didactic tool in the subject of natural sciences has shown a significant improvement in the students' mastery of knowledge" (p. 3). This platform has been shown to be a motivating element in the teaching-learning process, offering various functions and strategies that facilitate learning through play. The use of *Kahoot* in the learning of natural sciences has shown to have a positive impact on the development of social and cognitive skills. The games based on scientific content, combined with a playful environment, encouraged student participation, generating an increase in their self-esteem and promoting interaction within the group.

The results show a significant increase in student learning in the experimental group that used *Kahoot* compared to the control group that did not use the tool. This suggests that the intervention of *Kahoot* in the teaching process contributes to increased student engagement and academic performance.

These findings highlight the practical and positive impact of the application of *Kahoot* as a didactic tool in the teaching of natural sciences. However, future research is recommended to explore in greater detail the long-term effect of the use of Kahoot, as well as its application in other areas of knowledge and its combination with different educational strategies.

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Digital competence in teaching: a case study from a sociocultural perspective

Competencia digital docente: un estudio de caso, desde la perspectiva sociocultural

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Abstract

Digital teaching competence (DTC) stands out as a fundamental component in current education, demanding skills for educators to perform effectively in digital environments. The present research aims to analyze the sociocultural influence on the digital competence of teachers of first grade of General Unified Baccalaureate (BGU) of the Fiscal Educational Unit (UEF) 24 de Mayo, Quito, Ecuador, during the first quarter of the 2023-2024 school year. The importance of considering the cultural and social context of teachers in the

integration of digital competencies in the planning of the didactic process is highlighted. For this purpose, a mixed methodological approach was used, combining quantitative and qualitative elements that link digital competence with empirical indicators. Participants were selected through purposive sampling. Research techniques such as content analysis of documents, surveys and semi-structured interviews allowed obtaining a comprehensive view of teachers' digital competence and how it is influenced by sociocultural factors present in context. The results reveal that the sociocultural perspective affects the integration of digital competencies, highlighting the need to overcome technological limitations and change perceptions rooted in the educational culture. It is concluded that addressing these challenges from a sociocultural perspective can improve the integration of technology in the teaching of Language and Literature.

Keywords

Digital competence, teachers, digital environments, sociocultural influence, integration of competencies.

Resumen

La competencia digital docente (CDD) se destaca como un componente fundamental en la educación actual, exigiendo habilidades para que los educadores se desempeñen eficazmente en entornos digitales. La presente investigación tiene como objetivo analizar la influencia sociocultural en la competencia digital de docentes de Primero de Bachillerato General Unificado (BGU) de la Unidad Educativa Fiscal (UEF) 24 de Mayo, Quito, Ecuador, durante el primer trimestre del año lectivo 2023-2024. Se destaca la importancia de considerar el contexto cultural y social de los docentes en la integración de competencias digitales en la planificación del proceso didáctico. Para esto, se empleó el enfoque metodológico mixto, donde se combina elementos cuantitativos y cualitativos que vinculan la competencia digital con indicadores empíricos. Los participantes fueron seleccionados mediante muestreo deliberado. Las técnicas de investigación como el análisis de contenido de documentos, encuestas y entrevistas semiestructuradas permitieron obtener una visión integral de la competencia digital docente y cómo se ve influenciada por los factores socioculturales presentes contextualmente. Los resultados revelan que la perspectiva sociocultural afecta la integración de competencias digitales, destacando la necesidad de superar limitaciones tecnológicas y cambiar percepciones arraigadas en la cultura educativa. Se concluye que abordar estos desafíos desde una perspectiva sociocultural puede mejorar la integración de la tecnología en la enseñanza de Lengua y Literatura.

Palabras clave

Competencia digital, docentes, entornos digitales, influencia sociocultural, integración de competencias.

1. Introduction

In the digital era, Digital Competence in Education (DTEC) is essential for effective teaching, especially in educational environments where technology plays an increasingly important role. In this context, the influence of the sociocultural perspective on the development of TDD becomes relevant; teachers' individual values, attitudes, and beliefs can significantly affect their willingness and ability to integrate digital competencies effectively into educational planning.

This study focuses on Language and Literature teachers of the First Year of General Unified Baccalaureate (BGU) of the Unidad Educativa Fiscal (UEF) 24 de Mayo, located in the city of Quito, Ecuador during the first quarter of the 2023-2024 school year. In order to carry out this research process, research techniques such as content analysis of documents, surveys and semi-structured interviews have been considered in order to obtain a comprehensive view of the CDD and how it is influenced by the sociocultural factors present in the context.

The results of this research will contribute to the existing body of knowledge in the field of pedagogy in digital environments, providing empirical evidence on the influence of the sociocultural perspective on the development of the CDD. In addition, they could lay the groundwork for the design of more effective teacher training programs aimed at strengthening educators' digital skills and enhancing their ability to leverage technologies in a meaningful way in the classroom. Correspondingly, the study in question poses the following research problem: how does the sociocultural perspective influence the digital competence of Language and Literature teachers of First BGU at UEF 24 de Mayo, Quito, Ecuador, during the first quarter of the 2023-2024 school year? This research process was motivated by the scarce disposition of teachers towards the integration of technology in the educational process and the capacity for the implementation of digital resources in the development of academic activities of Language and Literature.

Consequently, the objective is oriented towards the CDD and the thematic field towards the sociocultural approach on the mentioned competence. In order to respond to the research problem, the general objective is to analyze the influence of the sociocultural perspective on the digital competence of Language and Literature teachers from the planning of the didactic process of First BGU in the UEF 24 de Mayo, Quito, Ecuador, during the first quarter of the 2023-2024 school year. To achieve this objective, the following specific objectives are proposed.

1. Determine the theoretical references related to the CDD and the sociocultural perspective in the educational field.
2. To characterize the digital competence of Language and Literature teachers in the first year of BGU at UEF 24 de Mayo, Quito, Ecuador, during the first quarter of the 2023-2024 school year.
3. To explain the influence of the sociocultural perspective on the digital competence of Language and Literature teachers of the first year of BGU at the UEF 24 de Mayo, Quito, Ecuador, during the first quarter of the 2023-2024 school year.

The purpose of the study is framed within the analysis of the sociocultural influence on teachers' digital competence. Authors such as Reyes and Guevara, among others, highlight the importance of adapting pedagogical practices to the specific sociocultural context and

refer to how specific cultural contexts shape individual and collective perceptions about technology, which affects people's willingness to adopt new digital tools and practices in their daily lives (Reyes et al., 2009). This perspective challenges educators to lead a shift towards a more dynamic and relevant educational paradigm, where sociocultural factors influence the assimilation of new digital tools and practices in educators, not only in the mastery of technical skills, but also in their application in diverse sociocultural contexts.

The research is structured as follows: the Theoretical Framework addresses the fundamental concepts that relate the sociocultural perspective to the CDD. The Methodology details the techniques employed, such as content analysis, surveys and interviews. The Results section provides data on academic background, teaching experience and teachers' use of technology. The Discussion interprets these results through data triangulation. The Conclusions present the implications of the results, highlighting the need to address digital competence from a contextualized perspective. Finally, the References support the study with relevant sources.

2. Digital competence of teachers and sociocultural perspective: theoretical references

The advent of digital technology has transformed the skills needed by teachers. In addition to traditional skills such as classroom management and curriculum organization, effective integration of technologies in the classroom is now required (Shulman, 1987; Fullan, 1991). This evolution implies that teachers must be prepared to use digital tools effectively in their pedagogical practices.

CDD, according to Cabero, encompasses technical, didactic and content and media design skills. It involves the efficient use of digital tools and resources, their effective application in teaching and the creation of appropriate digital educational materials. This implies that, in order to integrate technology into teaching, educators must acquire pedagogical competencies in addition to technical skills, develop positive attitudes towards technology and strategies for its incorporation into education, as well as adapt to changing technological environments, properly select tools, manage resources and foster collaborative and creative educational environments (Cabero, 2009, p.17).

Larraz's (2012) proposal stands out for its multidimensional approach to CDD, which encompasses four key areas to develop it effectively in educational practice.

1. Information literacy: searching, evaluating and using information in digital environments.
2. Technological literacy: mastering technological tools and resources.
3. Multimedia literacy: creating, editing and using digital media.
4. Communicative literacy: communicating effectively in digital environments.

According to Castañeda, the CDD is a constantly evolving concept that requires continuous learning to adapt to the technological and pedagogical changes characteristic of the digital era. This author agrees with Cabero that the CDD goes beyond the acquisition of technical skills, arguing that it involves the development of skills to effectively integrate digital technologies in teaching. In this sense, he affirms that the context is determinant, since it influences the skills and strategies needed to use technologies effectively in the classroom.

Furthermore, that, CDD can be trained, which means that teachers can improve their digital skills through continuous training and practice (Castañeda et al., 2018, p. 8; Cabero, 2009).

Prendes proposes five dimensions of the CDD: technical, informational and communicative, educational, analytical, social and, ethics. These dimensions range from the technical handling of digital tools to the critical reflection on their use in the educational environment, including the consideration of ethical and social aspects.

The dimensions of the CCD cover several key issues:
- Technical Dimension: Refers to the effective use of technological tools and digital resources in teaching.
- Informational and communicative dimension: It involves the ability to search for, analyze and share information using ICTs.
- Educational dimension: Focuses on the pedagogically effective integration of information and communication technologies in education.
- Analytical Dimension: Focuses on critical reflection on the use of digital technologies in education.
- Social and ethical dimension: considers awareness of the social, cultural and ethical impact of technologies in education (Prendes et al., 2018, p.14).

The CDD stands out as a fundamental component in today's education, demanding skills for educators to perform effectively in digital environments. Initially, authors such as Shulman 1987 and Fullan 1991 highlighted the importance of integrating technical and pedagogical competencies, evolving towards a more comprehensive approach that considers ethical, social aspects and adaptation to changing environments, as pointed out by Carrera and Coiduras, 2012 and Castañeda et al. 2018. This change implies that educators must not only master technical skills, but also apply them in a critical and reflective manner in diverse contexts thus evidencing the influence of the sociocultural perspective in the CDD.

The sociocultural perspective considers the interaction between social and cultural aspects in the interpretation of individual and collective phenomena. It also highlights the influence of culture and the social environment on human development, emphasizing the importance of social interaction in the construction of knowledge (Vygotsky, 1978; Bruner,1990; Pérez and Fernández, 2009; Agüero and Álvarez, 2018). Sociocultural theory, according to Pérez and Fernández 2009, Agüero and Álvarez 2018 and Moya 2020, suggests that the individual is formed in a social and historical context that influences his or her identity and beliefs. Vygotsky 1978 highlights social interaction in human development, while Bruner 1990 emphasizes the role of culture in thinking. The theory shows how sociocultural interactions influence cognition and learning.

The sociocultural perspective considers the interaction between social and cultural aspects in the interpretation of individual and collective phenomena. It highlights the influence of culture and the social environment on human development, emphasizing the importance of social interaction in the construction of knowledge (Vygotsky, 1978; Bruner,1990; Pérez and Fernández, 2009; Agüero and Álvarez, 2018).

Sociocultural factors, such as norms and values, arise from the interaction between society and culture, impacting attitudes and beliefs. They include the influence of family, education, religion, and cultural traditions, affecting cultural diversity and social behavior. These factors shape identities and social relations,

being fundamental to understand sociocultural phenomena (see Figure 1) (Triandis, 1995; Hofstede, 2001; Pérez and Fernández, 2009) (Triandis, 1995; Hofstede, 2001; Pérez and Fernández, 2009).
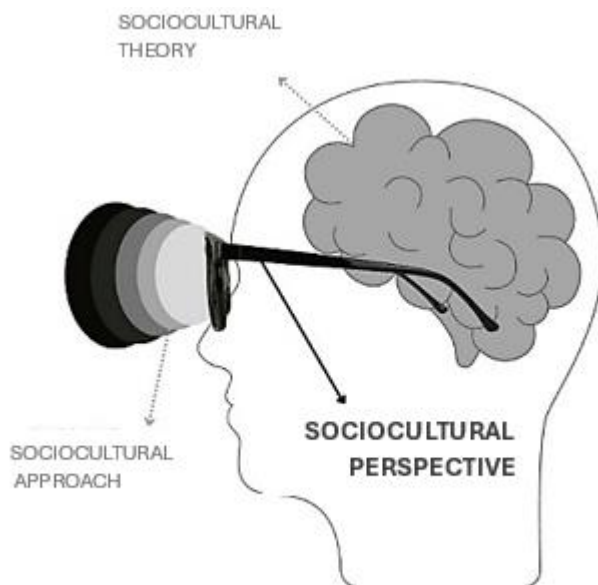
Figure 1: Graphical representation of theory, perspective and sociocultural factors. Own elaboration

Figure 1 represents theory, perspective and sociocultural factors. The brain symbolizes theory, the space where cognition is generated; the lenses represent perspective, determined by interpretation; the lenses symbolize factors such as: norms, values, attitudes, beliefs, family influence, education, religion, among others. This conceptual review leads to the following question: how has the integration of the categories CDD and sociocultural perspective evolved theoretically in the field of education?

In the 1980s, Shulman defined teaching competence and its relationship with the sociocultural environment. His theory of "Pedagogical Content Knowledge" expanded the technical vision by merging technology and teaching action, considering the complex interaction between content, pedagogy and context (Shulman, 1986, p.4). In their analysis of sociocultural factors related to technology adoption, Reyes and Guevara highlight the direct influence of cultural norms, values and beliefs on people's attitudes and behaviors towards technological innovation. Their research highlights how specific cultural contexts shape individual and collective perceptions about technology, which affects people's willingness to adopt new digital tools and practices in their daily lives (Reyes and Guevara, 2009, p. 139).

In contemporary education, Graham, Adell and Castañeda propose a CDD that transforms educators into architects of new pedagogical practices. Their approach transcends mere technological integration, aspiring to a revolution in teaching in the digital era. They argue that digital competence requires a complete re-evaluation of teaching and promotes innovative strategies (Graham, 2011; Adell and Castañeda, 2012). This perspective challenges educators to lead a shift towards a more dynamic and relevant educational paradigm, where sociocultural factors influence the assimilation of new digital tools and

practices in educators, not only in the mastery of technical skills, but also in their application in diverse sociocultural contexts.

Castañeda redefines the profile of the contemporary educator, focusing on the evolving teaching competence to adapt to emerging technological uses. He recognizes the rapid development of technology and the importance of educators being on the cutting edge to meet the changing demands of the digital society (Castañeda et al., 2018, p. 8). García complements this view by highlighting the crucial influence of sociocultural elements on DLT, highlighting the complexity of the interaction between educators, students, and cultural and social environment. This author's sociocultural perspective underscores the profound influence of social, cultural, and contextual actors in the formation of the CDD, highlighting its dynamic nature and its dependence on the complex interrelationships between individuals and the environment (García et al., 2022, p. 2).

Engen broadened the perspective on the sociocultural influence on the disposition towards technological innovation by highlighting the importance of social relations, family structure and education. In this sense, his studies not only consider cultural beliefs, but explore how social interactions, family dynamics, and formal education influence technology-related attitudes and behaviors. He highlights the interconnectedness of these elements in shaping perceptions towards the adoption of emerging technologies, enriching the understanding of how people interact with technology as a function of their sociocultural context (Engen, 2021, p. 13).

In the educational context of Ecuador, the National Educational Model highlights digital competence as a fundamental pillar in teacher training, evidencing the commitment of educational authorities to the effective integration of information and communication technologies (ICT) in educational processes (Ministry of Education, 2022). In parallel, the Pedagogical Route for 2030 according to Herrera et al. emphasize the need for digital competence as an essential element in teacher training, reflecting a prospective vision that recognizes the importance of aligning the preparation of educators with the demands of an increasingly digitized educational environment in the country (Herrera et al., 2021).

The integration of the CDD and the sociocultural perspective in education has evolved into a more integrated understanding. Initially, technology was perceived as a technical tool without considering sociocultural contexts. Over time, the complex interaction between digital competence and sociocultural factors has been recognized, leading to greater attention to cultural diversity and the adaptation of educational practices to specific contexts. This evolution highlights the importance of approaching the CDD from a sociocultural perspective in order to fully understand its role in the educational process.

The aforementioned relationship is based on the learning opportunity that each element represents, arising from the synergy between technical or instrumental procedures and processes of reflection. These processes lead to thoughtful deliberations on the teaching task from both an objective and subjective perspective of the work, with the aim of improving the quality of teaching and learning dynamics in the school. This approach has a positive impact on teachers, students, institutions and society in general, taking shape in each historical context.

3. Methodological procedure

3.1 How was it investigated?

This research was developed under a mixed research approach. Creswell argues that, in the mixed perspective, quantitative and qualitative data are used within the same research; and, because all forms of data collection have their limitations, the use of a mixed design can minimize and even neutralize some of the disadvantages of certain methods and consequently increase validity (Creswell et al., cited in Hernández, 2010. p.32).

By establishing this research approach, it is possible on the one hand, to perform the interpretation of a reality to be discovered, as well as to understand the perceptions and meanings produced by the experiences of the participants within their context (Walliman, 2011, p. 3), to understand the realities , where relevance is given to the lived experiences of the participants as they were experienced (Hernandez, 2010, p. 45), to describe the facts in the context in which they take place, (Azevedo, 2009). On the other hand, Robinson (2000), explains that "using instruments such as interviews, surveys and content analysis can yield useful numerical information to support the information obtained" (p. 25). The type of research underlying the study is the case study. According to Yin, the case study methodology is to be used when the researcher deliberately intends to cover conditions arising from the context and when seeking to develop a study where there are multiple variables, and where different sources of evidence converging in triangulation are used (Yin, 2009).

In addition, he points out that case studies include both qualitative and quantitative evidence that increase their validity and complement the analyses developed in research. Thus, the case study can be used to explain causal relationships, describe an intervention and the actual context where it occurs. In this project, digital competence was initially linked to empirical indicators to obtain quantitative data on the technological skills of Language and Literature teachers of First BGU. Subsequently, the influence of the sociocultural perspective on such competence is ascertained to explain how it manifests itself in the willingness and ability of Language and Literature teachers to integrate digital competencies in the planning of the didactic process.

In this way, the research has a descriptive scope that allows "specifying the properties, characteristics and profiles of groups, processes or objects that are subjected to analysis through the collection of independent or joint information on those that are intended to be studied" (Hernández, 2010, p.80). Through this, it is also possible to "provide an analysis that allows the characterization of a fact to establish its behavioral structure" (Lafuente, 2008, p. 25). This level of research gives the possibility of "conceptualizing a phenomenon or process and its components in an effective way and estimating future states" (Cazau, 2008, p. 14). At the same time, the "descriptive level goes beyond exploration, describing qualitatively and quantitatively the fundamental characteristics of phenomena, as they are presented in reality; with systematic criteria to show their structure and behavior, focusing on measuring with greater precision" (Campos and Sosa, 2011).

This scenario was presented as an opportunity to learn the more general implications of the influence of the sociocultural perspective on the CDD, from the specific, subjective and

idiosyncratic characteristics of this school context. In this sense, the case study considered the following aspects.:

- Author's profile: The author of this research has been teaching for six years at U.E.F 24 de Mayo.
- Role of the author: The author acts as a social gatekeeper to access the population under study.
- Background of the educational scenario: U.E.F. 24 de Mayo is characterized as an institution with significant social and cultural diversity, which influences the way in which teachers develop and apply their digital competencies.

On the other hand, Cisterna's criterion was taken into account, which emphasizes in qualitative research the elaboration and distinction of topics based on the general and specific objectives. These topics become categories and subcategories, which guide the construction of the data collection instruments. These may be aprioristic or emergent. Cisterna's methodological approach was used to determine the categories and subcategories of research related to the sociocultural perspective (Cisterna, 2005).

Category 1: Digital Competence in Teaching Digital Competence in Teaching (TDC) encompasses the ability of educators to make meaningful and contextualized use of technology in their pedagogical practice. It goes beyond technical proficiency and involves adapting approaches to the specific needs of students and the sociocultural context. It is about integrating technology effectively into teaching, considering the complex interplay between disciplinary content, pedagogical strategies, and sociocultural contours (Shulman, 1986; Graham, 2011; Adell & Castañeda, 2012; Castañeda, Esteve, & Adell, 2018; García et al., 2022).

Category 2: Sociocultural perspective The sociocultural perspective refers to the approach that considers the influence of social and cultural factors on the development of individuals and the way in which knowledge is constructed. It examines how social interactions, cultural norms and the sociocultural context in general shape the experiences and learning of individuals (See Box 1) (Vygotsky, 1978).

Category	Subcategory	Definition	Operationalization
Digital Competence	Management of Technological Tools	Ability to use digital tools and platforms.	Use of educational software. Online learning platforms. Digital collaboration tools.
	Technological Adaptability	Ability to adjust the use of technology to the changing needs of the educational environment.	Rapid adoption of new technologies. Adjustment of pedagogical approaches to technological changes.
	Technology Curriculum Integration	Effective incorporation of technology in planning the didactic process.	Development of curricular activities integrating digital tools.
	Contextualized Interaction	Ability to use technology considering the sociocultural context and the specific needs of students.	Use of technology considering the sociocultural context. Adaptation to the cultural and social characteristics of the students..
Perspectiva Sociocultural	Influence of Sociocultural Factors	Consideration of how social and cultural	Analysis of social interactions.

		elements affect individual development and knowledge construction.	Exploration of cultural norms.
	Social Construction of Knowledge	Recognition that knowledge is constructed through active participation in social and cultural contexts..	Identification and promotion of practices that involve the collective construction of knowledge.
	Adaptation to the Sociocultural Environment	Ability to adjust educational approaches according to the characteristics of the social and cultural environment..	Integration of pedagogical practices that respect and reflect cultural and social diversity.
	Contextual Interrelation	Consideration of the complexity of interactions between individuals and their sociocultural environment.	Analysis of how sociocultural factors influence learning dynamics..

Table 1. Breakdown and Operationalization of the Categories and Subcategories of the Research

3.2 Who was investigated?

For the purposes of this research, a population study was conducted with 5 teachers, which represent 100% of the total population. "If the population is small, all the individuals belonging to it will be the object of study" (Buendía, 1998, p.123), since the population is small, 5 Language and Literature teachers of First BGU of the UEF 24 de Mayo who worked in the institution during the first quarter of the 2023-2024 school year were included as a sample, so the selection of the sample followed a non-probabilistic intentional sampling. The intentional choice of participants responded to the postulates of representativeness, determined by the specialized approach of the academic area. In this sense, the following elements were considered:

- **Aims of the study:** The five teachers of Language and Literature of the first year of BGU of the UEF 24 de Mayo were selected as key actors in the context studied.
- **Theoretical and conceptual foundations:** The choice of participants was aligned with the theoretical and conceptual principles that guided the research, ensuring that teachers provided relevant information from an informed and contextualized perspective.
- **Study methods:** A qualitative approach was used to capture the complexity of the educational phenomenon and to ensure that the selected teachers contributed significantly to the understanding of the case.
- **Ethics and confidentiality:** Ethical protocols were established to guarantee the confidentiality of the data and respect for the participants, ensuring that the research was conducted in an ethical and responsible manner.

3.3 What was investigated?

The research used several techniques to collect data and address the complexity of the phenomenon studied, which were validated by experts. This included document content analysis, Hernandez, assures that documents are useful for research processes, relates

documents and organizational materials, such as memos, plans, evaluations, letters, among others, as a valid source of data, thus, the collection instrument will be a document review matrix (Hernandez, 2010). The "content analysis of documents was conscientiously designed with the objective of identifying patterns, recurring themes and relevant relationships that will help characterize the digital competence of the teachers under study" (Andréu, 2020, p. 13).

During this process, key documents related to the planning of the didactic process were examined with the First Trimester of the 2023-2024 school year as:

- Microcurricular Planning 001: Scoring the Scene: Classical Theater and its Expressions.
- Disciplinary Project: Navigating in a World of Heroes and Gods.
- Annual Curriculum Plan for Language and Literature, First Grade B.G.U 2023-2024.

According to the authors López and Fachelli, the survey is defined as a technique of data collection through the interrogation of subjects whose purpose is to systematically obtain measurements on the concepts derived from a previously constructed research problem. Data collection is carried out by means of a questionnaire, which is the survey instrument itself. It was applied to the selected sample (5 teachers), its purpose was to collect quantitative data whose items were elaborated from the operationalization of the research categories and subcategories (López and Fachelli, 2015).

The interview is defined as a "meeting to converse and exchange information between one person (the interviewer) and another (the interviewee) or others (interviewees)" (Hernández, 2010, p. 47). The questions were prepared according to the research objectives, since it is directly on these where the inquiry is conducted, which provided a holistic approach to understand the digital competence of the teachers of First of BGU, in the specific sociocultural environment of the U.E.F. 24 de Mayo. This type of interview provided a flexible framework that facilitated the free expression of the participants, allowing to capture essential qualitative nuances such as experiences, representations and interpretations (Hernández et al., 2018). The entire sample (5 teachers) was interviewed. to inquire about individual values, attitudes and beliefs of teachers regarding their digital competence.

This type of study represents a significant advance in the understanding of the CDD and its relationship with the sociocultural perspective. By combining quantitative and qualitative elements, it achieves a comprehensive view that highlights the importance of adapting pedagogical practices to the specific sociocultural context. The methods used in this research offer a valuable model for future studies in other academic areas and in different educational institutions, as they provide a solid methodological structure to analyze how teachers integrate digital competencies into their didactic process.

4. Results

4.1.1 Content analysis: Annual Curriculum Plan

The PCA analysis reveals a strong integration of the CDD. This is evidenced in the consideration of informed and reflective decision making about the interaction between individuals and technology, as well as in the use of technology to disseminate relevant information. In addition, it fostered active and collaborative practices to improve students' digital skills by proposing digital resources adapted to their educational level. The evaluation of the CDD is established through the use of digital tools, their integration in

teaching, adaptability and ethics, using instruments such as surveys, classroom observation, portfolios and formative assessments, which would serve to evidence the mastery of digital tools, quality of content, adaptability and teaching professional development.

4.1.2 Content analysis: Micro-curricular planning 001 Scoring the scene, classical theater and its expressions

- **Technology integration:** Technology integration in authentic assessment activities is partial, using audio and online resources inconsistently. In the theatrical representation of "Plautus' Host" and the reflection on healthy nutrition, technology is not used. Neither is it used in the resolution of a cooperative workshop on punctuation marks nor in the elaboration of a concept map for the reading "The summary". However, the use of technology is suggested to listen to a song and answer a questionnaire on the importance of knowing, accepting and loving oneself, as well as to consult synonyms in the reading "Newén, el alma de la planta de guayusa" by Silvio Vicuña.

- **Technological innovation:** Technological innovation is limited, since the activities involving the use of technology, such as: Application of thinking skills to analyze and reflect on the importance of knowing, accepting and loving oneself through the song 16 añitos by Dani Martín and Investigation of new vocabulary: identify ten words in the reading "Newén, el alma de la planta de guayusa" by Silvio Vicuña and consult two synonyms for each one, are relatively conventional and do not reflect an innovative approach to the use of technology.
- **Technological support for learning:** Of the eight authentic assessment activities, only two suggest the use of technology, which indicates a limitation in the support of digital resources compared to the activities carried out in a conventional manner.

This analysis reveals a variable level of technological integration in the activities proposed in the Micro curricular planning 001. Although some use of technology is observed in activities such as listening to a song to reflect on the importance of knowing and accepting oneself, as well as in the search for information to identify synonyms, this use is not consistent in all authentic assessment activities. In addition, technological innovation is limited, as the activities involving technology do not reflect an innovative approach. Of the eight authentic assessment activities, only two suggest the use of technology, indicating a limitation to the support of digital resources compared to conventional activities.

4.1.3 Content Analysis: Disciplinary Project Navigating in a World of Heroes and Gods

1. **Integration of digital resources:** Teachers use paper projections of images of Greek and Roman gods to enrich students' understanding of the epic poems.
2. **Information management skills:** Teachers search, select, and organize relevant information about epic poems and their cultural-historical context using print sources, such as textbooks, and digital.
3. **Design and production of digital content:** Although no activity is planned to be developed digitally by students, teachers design and produce educational content

that involves digital competencies such as online collaborative work and the creation of didactic material for printing.

4. **Use of digital communication and collaboration tools:** Although no specific activities are planned to use digital communication and collaboration tools, teachers communicate among themselves and with students through face-to-face meetings and social networks to coordinate the development of the project and share relevant information.

The analysis of Proyecto Disciplinar reveals a limited integration of digital competencies by teachers. Although they designed educational content that could have involved digital competencies such as online collaborative work, most of the activities were carried out in a traditional manner. Furthermore, although they sought information from print and digital sources, the absence of strategies to leverage digital communication and collaboration tools restricted teachers' ability to enrich the project with additional resources.

4. 2 Survey results

The study reveals that 60% of the teachers surveyed have a bachelor's degree, followed by those who have reached the master's level, indicating an academic background adequate for research. 60% have more than ten years of experience in teaching Language and Literature, suggesting considerable experience in the field. In addition, 60% have more than ten years of experience in teaching Language and Literature, suggesting considerable experience in the field. 80% received specific training in Language and Literature, during their professional training, and 100% received continuing education in the last five years, demonstrating an interest in keeping up to date in educational methodologies and technologies.

Regarding the use of technology in the classroom, 40% use it "often", 20% "occasionally" and the other 40% "rarely", showing a variety in its use. Limitations in technological skills, resources and institutional support are factors that influence its limited use. Teachers, indistinctly, use various technological tools, such as educational software, online platforms, digital content creation tools, educational mobile applications and social networks for educational purposes to enrich their classes and support learning (see Table 2).

	Frequencies	% of Total	% Acumulated
Educational level			
Bachelor's degree	3	60.0 %	60.0 %
Master's degree	2	40.0 %	100.0 %
LL teaching experience			
6-10 years	3	60.0 %	60.0 %
More than 10 years	2	40.0 %	100.0 %
LL Specific Training			
No	1	20.0 %	20.0 %
Yes	4	80.0 %	100.0 %
Continuing Education LL last 5 years			
Yes	5	100.0 %	100.0 %
Use of technology in the classroom			
Often	2	40.0 %	40.0 %
Occasionally	1	20.0 %	60.0 %
Rarely	2	40.0 %	100.0 %

Table 2. Frequency of Language and Literature Teacher Profile: Educational Level, Experience, Training and Use of Technology

All teachers keep themselves updated in teaching methodologies, mainly through collaboration with colleagues, online courses, workshops and conferences, as well as consulting books and academic articles, demonstrating a high commitment to professional development. Challenges identified by teachers include lack of didactic materials, difficulties in motivating students, limited time in class, need to adapt to different ways of learning, difficulty in assessing and tracking students' progress, as well as the challenge of using technology effectively in the classroom (See Figure 2). 80% of teachers expect to improve their pedagogical skills, incorporate new technologies, encourage active student participation, develop strategies to motivate students, adapt to different learning styles, collaborate more with colleagues and obtain continuous feedback, showing a strong interest and commitment to improve their educational practices.
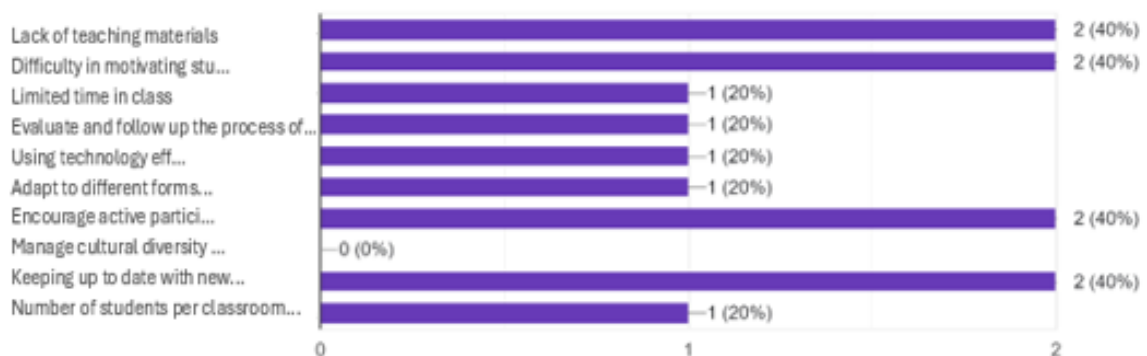
Figure 2: Challenges in Language and Literature Teaching

4.3 Interview results

The following are the units of analysis identified in the interviews, accompanied by textual quotations that illustrate each one of them (See Table 2).

Nº	QUESTION	ANSWER	CATEGORIZATION OF THE VARIABLE	DIMENSION	INDICATOR	INTERPRETACIÓN
1	Influence of personal experiences and values	"Education must contemplate otherness and unequal access to technology in teaching, especially in the reality we have."	Personal experiences and values	Personal and professional influence	Inclusion and technological equity	The educational vision must consider otherness and the lack of access to technology in teaching.
2	Strategies for integrating digital competencies	"I use online quizzes, YouTube and virtual dictionaries to motivate students' research and use of technology."	Teaching strategies	Integration of digital competencies	Use of technological tools	Teachers use digital tools to encourage research and online activities.

3	Definition of CDD	"Language Arts teachers must have digital skills to motivate students and teach the importance of technology in their learning."	Concept of Digital Teaching Competence	Definition and understanding	Digital knowledge and skills	Digital Teaching Competence is essential to motivate students and highlight the importance of technology in the educational process.
4	Importance of integrating digital competencies	"Technology is advancing and traditional education is not enough. Literature teaching needs innovative digital resources that adapt to new realities and needs."	Importance of digital competence	Educational innovation	Need for digital resources	The integration of digital competencies is crucial as traditional education is not enough to motivate students, and innovative digital resources are required.
5	Actions to improve digital competence	"Constant and self-taught training is key to be aware of new educational tools and strategies."	Continuous improvement	Training and professional development	Continuous training	Ongoing training and self-directed learning are essential to improve teachers' digital competencies.
6	Influence of the academic environment and educational traditions.	"The environment affects: classrooms without technological equipment, short classes. Teachers have little time to plan due to institutional documentation. Educational traditions limit the development of digital competencies in Language and Literature."	Academic environment	Limitations and challenges	Infrastructure and available resources	The lack of technological equipment, internet and disabled laboratories, together with educational traditions, limit the development of digital competencies in Language and Literature.
7	Personal experiences in the use of technology	"Despite having experience with technology, the environment and time limit the development of digital competencies in Language and Literature. The educational system needs to be restructured to integrate technological skills effectively."	Personal experiences	Use of technology in education	Effectiveness and implementation	Personal experiences with technology are positive, but environmental and time constraints prevent effective development of digital competencies.

Table 3. Summary of the integration of digital competencies in the planning of Language and Literature teachers in the first year of high school.

5.1. Socio-cultural characterization of UEF 24 de Mayo

UEF 24 de Mayo stands out in Ecuador for its history of innovation and academic excellence. Understanding its impact on the community and society requires a socio-cultural perspective, considering its historicity, social inclusion, gender equity, academic excellence and institutional adaptation.

Since its founding in 1934 as the "Gimnasio Educacional Femenino 24 de Mayo", UEF 24 de Mayo has evolved into a center of coeducation, reflecting an effort to adapt education to regional characteristics and enrich the socio-cultural diversity of students. Regulations such as student sectorization and the promotion of gender equity have impacted UEF 24 de Mayo. The inclusion of male students as of 2012 coincides with student sectorization in Ecuador, reflecting its commitment to equity and educational quality.

The International Baccalaureate (IB) Diploma Program, implemented in 2014 through 2020, demonstrates UEF 24 de Mayo's commitment to academic excellence and preparation for global challenges. The EDUCA 24 DE MAYO: LEADERSHIP, INNOVATION AND TRANSFORMATION project seeks to improve pedagogical practices and the teaching-learning process. This project, supported by MINEDUC and with contributions from parents, focuses on building a flexible educational model and educating well-rounded young people.

The aspects analyzed highlight the deep-rooted legacy of academic excellence at UEF 24 de Mayo, which has an impact on the formation of individual values, attitudes and beliefs within the educational community. These elements, influenced by the sociocultural context, shape behavioral patterns and the reproduction of practices that foster integral education, community participation, pedagogical innovation, educational inclusion, and the strengthening of ethical and civic values. This legacy is reflected in a significant impact on education and society, consolidating its role as an agent of change and educational development in the country.

5.2. Content analysis: critical review

Content analysis of documents reveals significant differences in the integration of ICTs in the educational context. First, the PCA shows a solid integration of the CDD by considering informed and reflective decision making, as well as the use of technology to disseminate relevant information. There is a clear focus on planning for the development of digital skills in students, with specific objectives, content, methodologies and assessments related to ICT.

Micro Curricular Planning 001 reveals a less coherent integration of ICT. Although technology is used in specific activities such as information search and reflection, its use is not uniform in all authentic assessments. In addition, technological innovation is limited; activities with technology reflect a traditional approach. This lack of coherence suggests that the integration of ICT in pedagogical practices is not being implemented consistently.

In the case of Proyecto Disciplinar, an even more limited integration of digital competencies by teachers is evident. Although they designed educational content that could have involved digital competencies such as online collaborative work, most of the activities were carried out in a traditional manner. The lack of strategies to take advantage of digital communication and collaboration tools restricted teachers' ability to enrich the project with additional resources.

While the PCA shows an effort in integrating the CDD, the Micro curricular Planning and the Interdisciplinary Project present significant deficiencies in this aspect. This suggests the need for greater coherence and focus on the effective incorporation of ICTs in the educational process to improve the quality of education offered and prepare students for a digital world.

5.3. Analysis and discussion of the survey results

The analysis of the data reveals a teaching profile with a solid academic background. The majority have a bachelor's degree, followed by those with a master's degree. In addition, considerable experience in teaching Language and Literature is observed mainly among those who have more than ten years of experience in the field. This formative and professional context is supported by a constant updating in teaching methodologies. Collaboration with colleagues and participation in online courses and workshops stand out. Despite this training, the use of technology in the classroom shows a variety of levels, with "often" being the highest frequency, followed by "rarely" and "occasionally".

Limitations in the use of technology are due, in part, to the lack of technological skills and the availability of adequate resources. Despite these challenges, teachers show a remarkable commitment to their professional development and the integration of educational technology. This commitment is reflected in their expectations and personal goals, where the improvement of pedagogical skills, the incorporation of new technologies, student motivation and collaboration with colleagues are highlighted. These results characterize the CDD in this context as dynamic and constantly evolving, where training, experience and willingness to adapt are key elements for an effective integration of technology in the teaching of Language and Literature.

5.4. Analysis and discussion of interview results

The integration of digital competencies in the planning of first-year high school Language and Literature teachers is significantly conditioned by various aspects related to their individual values, attitudes and beliefs. On the one hand, the values of these professionals are reflected in their perception of education as a process that should consider diversity and equitable access to technology, as evidenced in the quote: "A vision of education based on otherness and the recognition of otherness is essential for teaching in any area of study".

In terms of attitudes, teachers show willingness to integrate digital competencies in their teaching, as seen in the quote: "When there is the opportunity, I usually use online quizzes, YouTube and virtual dictionaries". However, this willingness is limited by beliefs rooted in educational traditions, such as the preference for traditional teaching and evaluation methods, as seen in the statement: "The classrooms do not have technological equipment or internet, disabled computer labs, short class hours. Educational traditions prevail, such as asking students to submit handwritten queries, drawing pictures and decorations manually, among others".

The results of the interviews show that the influence of the academic environment and educational traditions has a significant impact on the willingness and ability of teachers to effectively integrate digital competencies in didactic planning. Despite having positive personal experiences with technology, teachers find it difficult to effectively implement these tools in the classroom due to the limitations of the physical and academic environment, as well as the lack of time for planning due to institutional documentation requirements.

5.5. Triangulation of results: theoretical and empirical evidence

The integration of digital competencies in the teaching of Language and Literature in First Baccalaureate at UEF 24 de Mayo is significantly influenced by the sociocultural perspective of teachers. A solid integration of the CDD is observed in the PCA, but less coherent in the micro curricular planning and limited in the disciplinary project. Although teachers show a willingness to integrate digital competencies in their teaching, as evidenced by the use of online quizzes, YouTube and virtual dictionaries when the opportunity exists, they also demonstrate a remarkable commitment to their professional development, collaborating with colleagues, participating in online courses and workshops. However, limitations in the physical and academic environment, such as the lack of technological resources, hinder their effective implementation in the classroom.

These findings coincide with Cabero's theory, who argues that "CDD implies not only technical skills, but also their adequate application in the educational process" (Cabero, 2004, p.34). Likewise, Larraz's proposal highlights the importance of techno-pedagogical literacy, which encompasses information, technological, multimedia and communicative literacy, to efficiently integrate technology in teaching (Larraz, 2012). This disposition is reflected in the ability of teachers to use digital tools when the opportunity exists.

In addition, the results obtained in this research find support in the theories of Graham 2011 and Castañeda et al., 2018 who propose an ambitious vision of the CDD, focusing on the transformation of educators into active architects of new emerging pedagogical practices. On the other hand, the influence of the sociocultural perspective on the disposition towards technological innovation, as mentioned by Engen, highlights the importance of considering how people interact with technology based on their sociocultural context, which supports the idea that the integration of digital competencies in teaching is influenced by the sociocultural perspective of teachers (Engen, 2021).

This confirms that, the sociocultural perspective, reflected in values such as diversity and equitable access to technology, as well as in attitudes of readiness to integrate digital competencies in teaching and beliefs rooted in educational traditions that favor traditional methods of teaching and assessment asking students to submit handwritten queries or to make drawings and decorations manually has a significant impact on teachers' willingness and ability to effectively integrate digital competencies in didactic planning.

This assertion is supported by studies conducted by Vygotsky 1978, Bruner 1990, Pérez and Fernández 2009, Agüero and Álvarez 2018), Engen 2021, who have highlighted how the sociocultural perspective influences teachers' disposition towards technological innovation and the integration of digital competencies in teaching. These authors have also highlighted the importance of considering social interactions, family structure and education in attitudes and behaviors related to technology, which supports the idea that the integration of digital competencies in teaching is influenced by the sociocultural perspective of teachers (See Figure 12).

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EMPIRICAL RESULTS

Solid integration of digital competencies in the Classroom Curriculum Project (PCA).Limited coherence in micro-curricular planning and scarce integration in the disciplinary project.Teachers' willingness to integrate digital competencies in their teaching.Obstacles in the physical and academic environment that hinder effective implementation in the classroom.

INTERPRETATION

Confirmation of the significant influence of the sociocultural perspective on the integration of digital competencies in education.
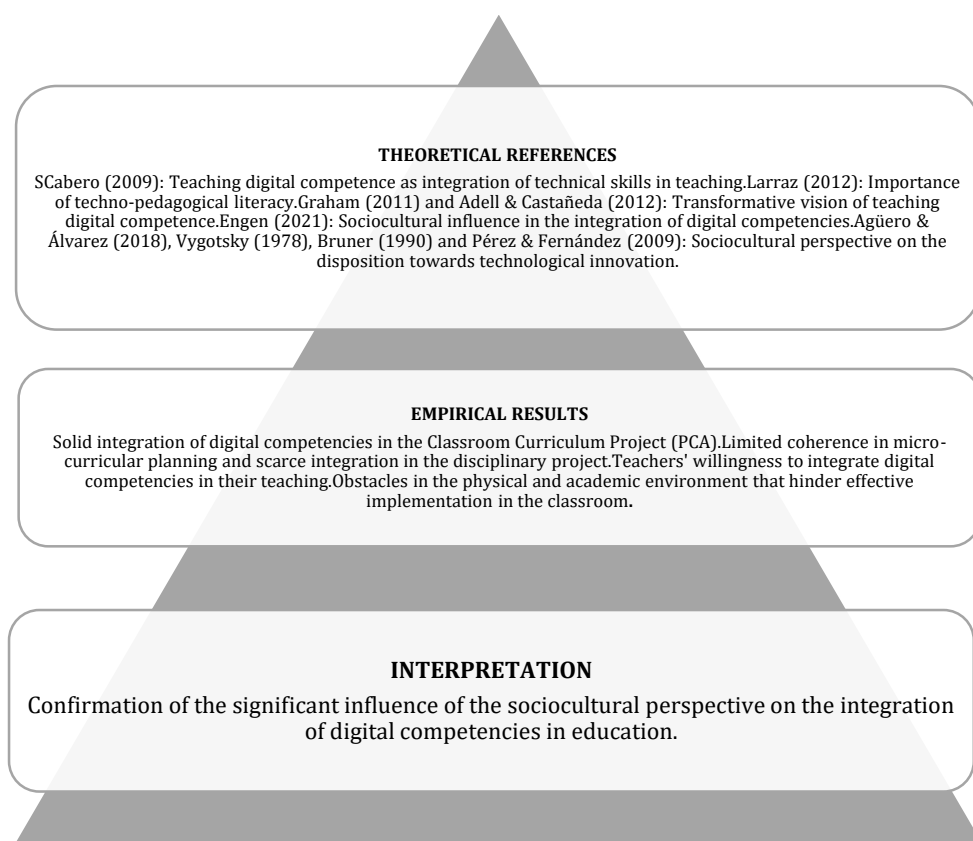
Figure 3. Triangle of results-Theoretical references-Empirical results-Interpretation

6. Conclusion

The analysis of the research results led to the following conclusions:

- Theoretical references in education, such as Shulman's theory of Pedagogical Content Knowledge, and the perspectives of Vygotsky and Bruner, highlight the sociocultural influence on human development and the construction of knowledge.
- The sociocultural perspective in the CDD highlights the importance of considering teachers as social agents influenced by cultural interactions and contexts, which affects the integration of digital technologies in education.
- The academic prestige of UEF 24 de Mayo consolidates it as an educational reference in Ecuador, influencing the formation of values in its educational community. However, this has led teachers to maintain traditional pedagogical practices, hindering the integration of digital competencies in the teaching of Language and Literature.
- During the first quarter of the 2023-2024 school year, Language and Literature teachers in the first year of high school at U.E.F 24 de Mayo, Quito, Ecuador, demonstrated a solid academic profile and significant teaching experience, but face limitations in the effective use of technology in the classroom due to the lack of technological skills and adequate resources, which reflects the need to change perceptions rooted in the educational culture with respect to technology.

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- Individual values, attitudes and beliefs affect the integration of digital competencies in Language and Literature teaching. Educational traditions hinder technological innovation, underlining the need to address these aspects for a successful integration of technology in education.
- The case study has been effective in understanding how the sociocultural perspective influences teachers' digital competence, as it allows exploring specific and subjective aspects of educational contexts.

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Statement of Authorship-CRediT

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Gender and education In África: the case choice of the choice of baccalaureate studies in Ecuatoguinean educational centers

Género y educación en África: el caso de la elección de los estudios del bachillerato en los centros educativos ecuatoguineanos

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Abstract

This research focuses on the gender and education approach in Africa, as one of the main scenarios where the difficulties of access to education are registered, prioritizing more the

training of boys to the detriment of girls. In order to better understand this issue, the analysis is focused on the specific case of the choice of high school studies in Equatoguinean schools. There is evidence of a division of the student body when it comes to choosing the branches of the baccalaureate, with students opting for the science or technology branch, while female students opt for the arts or humanities. As for the methodological aspects, the use of descriptive research based on the quantitative method was deemed necessary. This was chosen because the object of study is expressed in percentages. The population studied is Equatorial Guinea with a representative sample made up of educational centers under study, such as the Colegio Privado Nuestra Señora de Bisila de Nkolombong; Centro Educativo Madre Catalina II; Centro Privado la Divina Pastora; INES Carlos Lwanga; INES Padre Joaquín María Sialo, all in the city of Bata (mainland). And, the Nostradamus Private Center of the city of Malabo (insular part). One of the main conclusions is that girls opt more for the letters branch because hypothetically, this is related to feminine stereotypes, i.e. easy. Therefore, it is recommended to the students to show their cognitive skills regardless of sex.

Keywords

Baccalaureate, educational centers, education, gender, specialty

Resumen

Esta investigación se centra en estudiar el enfoque de género y educación en África, como uno de los principales escenarios donde se registra las dificultades de acceso a la educación, priorizando más la formación de los niños en detrimento de las niñas. En este sentido, para comprender mejor esta temática, se ha centrado el análisis en el caso específico de la elección de los estudios del bachillerato en los centros educativos ecuatoguineanos. Se evidencia una división del estudiantado a la hora de elegir las ramas del bachillerato, donde los estudiantes optan por la rama de ciencias o tecnología, mientras que las estudiantes optan por las letras o humanidades. En cuanto a los aspectos metodológicos, se ha visto necesario el uso de la investigación descriptiva basada en el método cuantitativo. Ésta se ha elegido porque el objeto de estudio se plasma en porcentajes. La población estudiada es Guinea Ecuatorial con una muestra representativa constituida por centros educativos objetos de estudio, como el Colegio Privado Nuestra Señora de Bisila de Nkolombong; Centro Educativo Madre Catalina II; Centro Privado la Divina Pastora; INES Carlos Lwanga; INES Padre Joaquín María Sialo todos de la ciudad de Bata (parte continental). Y, el Centro Privado Nostradamus de la ciudad de Malabo (parte insular). Una de las principales conclusiones es que las chicas optan más por la rama letras porque hipotéticamente, ésta se relaciona con estereotipos femeninos, es decir, lo fácil. Por lo tanto, se recomienda al estudiantado mostrar sus aptitudes cognitivas sin importar el sexo.

Palabras clave

Bachillerato, centros educativos, educación, género, especialidad.

1. Introduction

The purpose of this study is to show how the gender perspective influences high school students in Equatorial Guinea when they opt for the branches of study offered by the educational system of this country, such as Humanities, Science and Technology. Each of these fields of study clearly shows the preferences of one or the other according to gender.

As in other areas, such as social, economic, political or cultural, the educational context has not been exempt from the inequalities that exist between men and women, which allow the masculine to be seen as the most perfect to the detriment of the feminine.

If gender marks the differences of what each society considers to be for men and women, the school as an agent of socialization tends to reproduce these same patterns of behavior assumed by the culture in which they are carried out.

> In Africa, the proportion of women in primary education is 60% compared to 68% for men. In secondary education, the proportion is 11% for women and 21% for men. The exit of women from school in the middle and upper reaches is very high, due to early marriage, pregnancy, need to help or take care of household chores, performance of paid activities, subsistence agricultural work, water and firewood collection, care of younger siblings, etc. (Herrera-Santana et al., 2017, p. 119).

The problem of this research thus lies in the division that exists between girls and boys when it comes to choosing the branches of study of the baccalaureate. Although the Equatoguinean educational system is the result of the colonial education introduced by the Spaniards during their occupation of Spanish Guinea, there is still a clear division in the educational field, with girls opting more for the humanities, which they consider easier and more gender-specific, while science and technology are more difficult for men.

Taking into account that the choice of the branches of study of the baccalaureate involves several factors such as the vocation of the students themselves, the influence of peers or the existence of social references, gender is very accentuated in this whole question.

According to Bidaurratzaga-Aurre (2012) estimates that:

> The factors of gender, income and location often combine with others related to language, ethnicity or different types of disabilities, generating a set of barriers that hinder the entry into the formal education system of the most vulnerable groups (p. 35).).

The phenomenon of analysis of this study leads us to defend the following thesis: Despite the initiatives undertaken at the social level to achieve gender equality in all areas, in education still remain gender stereotypes that lead students to opt for a particular branch according to their gender, so that girls are more inclined to the humanities or social sciences, while boys are of technology or science.

Education in African educational systems faces many precariousnesses, as higher education is not always guaranteed, especially for girls. Those who succeed must face stereotypes of all kinds disseminated by the patriarchal structure of their societies. This study is positioned as an answer to understanding the division that exists in high school between girls and boys when it comes to choosing the different routes.

The school is not an isolated entity from society, so it tends to reproduce the patterns of behavior that are installed in it. This happens especially in precarious educational systems where there is no deep analysis of it. That is why, sometimes, adolescents have many difficulties to finish high school. Moreover, it is not an isolated fact that "some young women fear being considered 'unfeminine' if they pursue a university career 'for men' or if they excel too much in masculine subjects" (Barmeosolo-Beltrán, 2010, p. 97). This argument is

what sometimes leads girls to always be in the humanities or social sciences, they seem to be in a sempiternal status quo, as is the case in Equatoguinean schools.

Based on the above, the research questions posed in this article are: does gender influence the choice of baccalaureate studies? is the humanities branch more chosen by girls? why are the science and technology branches considered as a particular choice for boys? what are the employment difficulties faced by girls?

The theoretical framework of this subject is very little developed, especially at the national level. However, the existence of an international literature is what allows an approach to a holistic understanding of the influence of gender on the choice of branches of study of high school students, based on the analysis of schools in Equatorial Guinea.

The methodology used is fundamentally descriptive. The reasons for the choice of this methodology are numerous. First, it is the one best suited to this type of study and, secondly, because, according to Tamayo and Tamayo (2003), descriptive research is that which "involves the description, recording, analysis and interpretation of the actual nature, composition or processes of phenomena. The focus that is made on conclusions is dominant, or how a person, group or thing, leads to functions in the present" (p. 54). Therefore, this research best fits the methodology stated ut supra.

According to the internal structure of this article, it is divided into sections: in section 1, introduction where the reasons for the research are explained; section 2, literature review on the subject under study for its justification and theoretical foundation; section 3, defense of the thesis that is carried out; section 4, description of the methodology and the analysis and discussion of the results, finally there are the main conclusions, the limits and future lines that are opened with this research.

2. Literature review

The issue of education in Africa is not a trivial one, just as it is not to consider that gender is currently present in the analysis of education. In African countries, education systems seem to be even more complex because they represent watertight projects that do not benefit the majority of their populations. Therefore, it can be said that the fight against illiteracy continues to be a necessary task in Africa because of "the existence of 77% female illiteracy, compared to 51% male illiteracy" (Sanz-Martin, 2011, pp. 62-63).

For this purpose, implementing gender equality policies in education is one of the commitments of the leaders of the African Union. Evidence of this is the following regulations: the Protocol to the African Charter on Human and Peoples' Rights on the Rights of Women in Africa (2003), the Solemn Declaration on Gender Equality in Africa (2004) and the African Women's Decade 2010-2020 proclaimed in 2009, among others. All of this is aimed at achieving inclusive education.

In this regard, African education systems have emerged in imitation of Western countries, their former metropolises, as happened in Equatorial Guinea, which ended up imitating or badly plagiarizing the Spanish education system, even though they are two totally different countries.

As pointed out by Sanz-Martín (2011)

> In Africa, the proportion of women in primary education is 60% compared to 68% for men. In secondary education, the ratio is 11% for

> females and 21% for males. The exit of women from school in middle and upper secondary education is very low in Africa due to early marriage, pregnancy, the need to help or take care of household chores, performance of paid activities, subsistence agricultural work, collection of water and firewood, care of younger siblings, etc. (p. 63).

Therefore:

> This situation leads to illiteracy, with very serious consequences, so much so that they can endanger the lives of those who suffer from it. They will live in more desperate poverty and in a worse state of health than those who have access to the competencies, skills and abilities provided by education (Sanz Martín, 2011, pp. 62-63).

It is not even easy to carry out a comparative analysis within the African education systems themselves, as they are heterogeneous in all respects. At the international level, there is really little interest in studies related to education in Africa. Therefore, the theoretical framework of this issue is difficult to access.

Nevertheless, the studies cited in this research highlight the need to apply the gender approach in African educational policies. That is the real sense in which this research is oriented. Before talking about digital or virtual education, there is still a large number of children who do not even have desks to write on. Education is not static, but it continues to be a privilege for a few. Evidently, it is a right that can be guaranteed to all people, but if it is not supported by public policies that are inclusive of all, then we will have a large part of the population with a low level of education, with the majority being women.

The term gender was reserved "to designate the cultural elaboration of the feminine and the masculine" (Maquieira, 2001, pp.127-190). Nor is it limited to the biological differences that exist between men and women. Its presence goes beyond, it is imprinted in the very structure of societies. It is a matter of abandoning veteropatriarchal schemes in education in order to form free men and women where their aptitudes are the starting point of everything, distancing ourselves from any hint of discrimination solely on the basis of sex.

The transformation of educational systems is still necessary, but even more so where living conditions are difficult and the gender gap that exists in education is visible. It should be recognized, therefore, that "the issue is complex, as it seeks not only women's access to higher education, but also to transform the social conditions that have kept them subordinated" (Zapata and Ayala, 2014, p. 7). Education must first be educated recognizing that girls have not always been given the same prominence as boys. Gender stereotypes and sexist behaviors have collapsed education; however, in a world more open to equality policies, that type of thinking is now obsolete. Nevertheless, it is worth recognizing that more challenges remain. In general, the baccalaureate corresponds to a stage of higher education, i.e. the prelude to university studies, where students must choose the field of study in which they are most interested or where they see themselves as most qualified.

Objectively, the choice is voluntary, but one cannot avoid thinking that it is conditioned by the students' perspectives on their social context. Thus, for example, girls choose the social sciences or the humanities, while boys opt for the natural and health sciences, or in their case, engineering.

> A wide variety of studies have demonstrated the gender differences that originate in relation to the preferences shown by the various opinions

that must be chosen at the end of compulsory studies. It has been pointed out that girls mostly choose the Humanities and Social Sciences Baccalaureate, while boys are in the majority in the technological option (Rodríguez-Menéndez et al., 2006, p. 240).

With this way of understanding education, the conditions of access or choice will always be biased and collapsed. This prevents the existence of a real principle of equality, at least in this context, because "when mathematics, physics or chemistry are called 'hard sciences', they would be somehow assimilated to the 'masculine', while literary or artistic expression would be a 'feminine' field-although certain disciplines more than others" (Morgade, 2001, p. 59). The baccalaureate comprises the first and second year, where students are trained in the area that they will later broaden with university studies. There is a historically widespread fear, probably to keep girls out of science careers, that they are seen as difficult because they require a lot of thinking. Evidence of this is that there is very little female presence in engineering or technology careers, precisely because many girls are discouraged from high school and accept the status quo of the humanities.

The different mechanisms or actions aimed at implementing an education based on the principles of equality are still a great challenge in the world. In underdeveloped areas such as Africa, schooling is a privilege. Studying is not an option because living conditions are very low and education is highly privatized with exorbitant economic costs. Although many countries declare themselves open to policies of equality in education, this is still far from being a tangible reality. In fact, "(...) it is not enough to declare equal treatment, when in reality there is no equality of opportunity" (Begné, 2011, p. 14). We are witnessing a condition that is highly institutionalized because the difficulties in education are not trivial, but are due to the same socio-cultural structure of each context. It is no coincidence that there is a division in the choice of fields of study in higher education, and that the tendency is always for women to end up studying the so-called easy sciences, which include the humanities. Outside any Western context, education is an area where the female presence is very low, Africa itself is an example of this, where social inequalities only aggravate this situation.

Despite pointing out in this research that gender is one of the factors influencing the choice of branches of study in higher education, it is actually not the only factor. However, it must be recognized that the patriarchal system of several African societies, such as Equatoguinean society, makes gender the main factor that greatly influences education. In other words, the fact that you are a girl makes you more likely to fail in school, as opposed to what happens with boys.

Following the previous approach, Meena (2009) affirms that:

> Gender is another relevant factor of inequality; especially in higher education in the sub-Saharan area. The most prominent aspects influencing gender disparity are: social and cultural norms; poverty; domestic chores; distance between home and school; lack of female role models in education; lack of professional ethics; and the tension between formal and religious education (p. 103).

All of the above aspects help to perpetuate inequalities in the field of education, where most African education systems are confronted with this reality. The need for public funding is evident; however, there are still major obstacles to solving this issue. Gender and education

are two issues that are present in all education systems, as the differences that persist in access to education are clearly visible.

3. Thesis defense

The thesis is presented as follows: *Despite the initiatives undertaken at the social level to achieve gender equality in all areas, in education still remain gender stereotypes that lead the student body to opt for a certain branch according to their gender, being so that girls are more inclined to the humanities or social sciences, while boys are technology or science*. However, one of the issues that should be clear when dealing with this kind of research is that:

> Conducting an analysis of the education system from a gender approach involves paying attention to the causes and consequences of gender inequality in access and completion of studies, but also in the process and in the system as a whole (Martínez-Martín, 2015, p.74).

In Africa, in general, the gender approach is necessary in educational policies if we want to achieve a development that leaves no one behind. As indicated in the introductory part, this research focuses on the analysis of gender and education in Africa, based on the study of the choice of baccalaureate study branches in Equatoguinean schools. It is not, therefore, a study of the Equatoguinean educational system, but rather a study of how gender influences the choice of baccalaureate courses.

Equatorial Guinea is a Central African country that was colonized by Spain, gaining its independence in 1968. Education is a fundamental right guaranteed to all citizens without distinction of sex, gender, ethnicity or race, as stipulated in Article 24, paragraph 1 of the current Fundamental Law of Equatorial Guinea. It is a concept composed of two words of Latin origin, educere and educare, both of which always imply instruction or guidance to the person for their cognitive training. It should be noted that the Equatoguinean Education System has undergone several modifications, with the ultimate purpose of bringing it into line with international standards of Education Systems. As mentioned above, there is not much research on African education systems in general, so it is difficult to find a theoretical framework to show the different problems of the Equatoguinean education system. However, one of the researches carried out on this issue points out that the Equatoguinean education system "is organized in levels and modalities. There are four levels of education: preschool education, primary education, secondary education and higher education. The modalities of secondary education are the baccalaureate and vocational training" (Dyombe, 2009, p. 7).

The chosen modality is the baccalaureate, considered as the prelude to university studies or vocational or occupational training. It is a very recent modality in this educational system, so in quantitative terms we can say that it is recent, although it has been changing. All Equatoguineans must go through this modality once they have passed secondary education, which ends with the fourth year of ESBA (Compulsory Basic Secondary Education). Education in Equatorial Guinea is only compulsory and free at the primary level, although this free education is only provided in public schools, because in private schools this does not occur in this way. It is necessary to clarify this issue because it is possible to think that education is free in Equatorial Guinea.

Within this analysis, it is impossible not to highlight the fact that primary, secondary and higher education is more expensive than university studies. The National University of

Equatorial Guinea is very cheap at the level of the Central African sub-region, a way for the Government to undertake education policies for all, because it is understood that "school education in Equatorial Guinea must take into account the socio-cultural reality of the Equatorial Guineans; the anthropological and psychological dimension of the learner must be a concern of the school" (Nguema-Nkié, 2022, p. 14).

In contrast to the approach of the previous quote, without inclusive education, based on the principles of equal access to the same rights, school education cannot result in the development of human beings. All citizens must have access to education and it is the job of governments to guarantee this right. Not having sufficient income to pay for schooling should not prevent people from being educated, because at all times public institutions must assume their role of facilitating access to education for all social strata. In many parts of the world there are problems in terms of access to education; however, it must also be acknowledged that:

> On the African continent, access to higher education is limited for the majority of citizens, but Sub-Saharan Africa is the region with the lowest gross enrollment rate in higher education in the world (5%) (UNESCO, 2009, p. 8).

Higher education cannot take place if not even primary education, the most fundamental education, has been guaranteed. Now, to return to the question of the choice of the branches of study in Equatoguinean schools, it is essential to understand the notion of the baccalaureate, i.e. how it functions in this educational system. The baccalaureate is a two-year course of study: the first and second year of the baccalaureate. In other words, in the context of the Equatoguinean context:

> The baccalaureate has as its objective the humanistic and technical training that allows the student to join the productive work, to integrate socially and to be oriented to continue higher studies. This modality has four options which are the four branches of studies: Science, Humanities, Technology and Arts. All the branches have core, elective and specific subjects; let's see it: *Core subjects: Spanish language, French language, social-civic formation, physical education and sports, etc. *Electives: English language, religion, music, vernacular languages, etc. *Specific: Mathematics, physics, chemistry and drawing in the branch of Science and Technology and Latin, Greek, philosophy, history of art in the branch of Humanities (Dyombe, 2009, p. 8).

Generally, in Equatorial Guinea, the most common way of referring to the branches of study of the baccalaureate is to speak of sciences and letters, which is the most common way of referring to the branches of study of the baccalaureate. Depending on the needs or influences of all kinds, students choose one of the options. Traditionally, the branch of science is by antonomasia the space occupied by boys, while the letters are occupied by girls. This is a distribution where gender becomes one of the components of the choice of branches, because the very veteropatriarchal structure imposed or rooted in society allows it, since there is an erroneous conception that makes one think that letters are the field where girls would perform better because they are easy, while future engineers, mathematicians or physicists are for men due to their rigorousness that requires mental aptitudes that girls lack. This thinking is the result of the way society is structured and, based on this, a curriculum is also designed to expel girls from the sciences.

> Legally there are no obstacles in access to careers, but even today there are still differential socialization processes that lead to a "masculine mystique" or an "androcentric bias" in science, induce optimal curricular itineraries for male and female students and finally influence career development and professional transitions (Santana Vega, Feliciano García, and Jiménez Llanos, 2012, p. 360.)

It is observed that gender influences this choice of fields of study. In general, girls are more likely to study the arts and boys the sciences. The reasons for this fact are diverse, but it cannot be ignored that gender stereotypes contribute greatly to perpetuating girls in the arts, because socioculturally it is understood that women cannot handle difficult subjects such as mathematics, physics and chemistry. This is a very deep-rooted thought in the Equatoguinean context and that is why there are, at least in this context, few women working in the more empirical sciences. But this does not only happen at the baccalaureate level, but also at the university level. This argument should not be understood as a postulate that there is little female presence in Equatoguinean educational centers. In fact, if we compare it with other countries in the subregion, education in Equatorial Guinea is guaranteed to girls. According to UNESCO data (2012) "parity is found in States such as Cameroon, Central African Republic or Equatorial Guinea" (pp. 30-31). However, this does not imply that African education systems are not weak, because sector funding and resources for access to education are limited.

Inclusive education is necessary, but it must also aim to end the gender stereotypes that prevent many girls from accessing education in many African countries. There are many arguments why girls' education must be guaranteed. However, the most striking one is presented by UNESCO (2014) when it emphasizes that "if all women in sub-Saharan Africa completed primary education, the maternal mortality rate would be reduced by 70%, from 500 to 150 deaths per 100,000 births" (p. 2). This would occur because women would be trained and educated to face situations that can only be faced with the knowledge provided by education.

The case of the choice of branches of study in the baccalaureate cannot include a female mass if the policies of empowerment or emancipation of women are not carried out, because the intentions are necessary, but even more so the implementation of this. Equatorial Guinea, like other African countries, must implement in its educational centers mechanisms that guarantee that girls can choose the branch of studies because they are really qualified for it, and not be obstructed to develop their cognitive potentialities because the socio-cultural environment prevents them from doing so.

The Equatoguinean education system depends on the Ministry of Education and University Education, which implements the Government's education policy. It is fundamentally based on two educational laws: Education Law No. 14/1995 dated January 9, 1995 and Law No. 5/2007 dated October 30, 2007, both of which have been amended, all with the purpose of guaranteeing education for all, although the materialization of this also depends on the degree of pedagogical, anthropological and sociological competence of those responsible for these laudable policies of the Government.

Despite educational initiatives to provide inclusive and quality education, Equatoguinean schools still have to make great efforts to train teachers to implement inclusive strategies and motivate students, which also helps them to be self-confident and be able to choose the career they want to study. Therefore, it must be recognized that "many higher education

institutions have initiated processes to institutionalize and mainstream the gender perspective and promote changes in favor of equality in university communities, inequalities remain, if not intact, then with a strong presence" (Buquet Corleto, 2016, p-. 43).

The issue is not exclusively of university communities, but all educational communities, although in this case we focus only on the secondary level in the baccalaureate modality. Clearly, inequalities still remain, as discussed in the methodological section of this research. The data on how gender influences educational systems in Africa, especially in the central zone of sub-Saharan Africa where Equatorial Guinea is located, reveal the following:

> Women's enrollment is concentrated in studies related to education and health, social sciences and humanities, with little presence in engineering studies. A representative example of this African reality is Madagascar, where the participation of women in education is 66%, in health 46% and in social sciences and humanities 25% (Akkari, 2011, p. 152).

These data can be perfectly extrapolated to Equatorial Guinea as an African country, where the health field is more represented by women, in general terms, the female presence is more present in the social sciences and humanities. This phenomenon does not occur randomly, it is not only due to the baccalaureate, which is the modality that gives access to university studies, but it is mainly due to the way in which Equatoguinean society conceives men and women. In this case, from the sociocultural point of view, men are seen as superior to women, which is why, even if women also have access to studies, they are not taken seriously, and if they are, they are entrenched in the humanities, because there they can perform better, while men are the ones who deal with the more difficult branches of science. That is precisely why, when a girl masters mathematics in class, she is considered a boy because socially it is not understood that this is possible. Although social postulates on this issue have been changing, invisible obstacles still persist, due to the strong influence of patriarchal thinking that rewards the masculine to the detriment of the feminine, in such a context it is impossible for an egalitarian education to exist.

In the same order of arguments that have been presented in this research on gender and its influence on education in the African context, without specifications of any specific country, Wabgou (2019) emphasizes that.:

> In Africa, the gender relationship must be taken into account in the implementation of higher education policies in order to propel gender equity policies in higher education with a differential approach between rural and urban areas (...) The education of boys and girls is conditioned by their sex; the boy expands his spaces while the girl, confined to the domestic space, is limited to the performance of specific tasks that make her the subject of social practices anchored in subjugating traditions (Wabgou, 2019, p. 107).

It is imperative, not only in the Equatoguinean education system, but also in other education systems in Africa, to implement public policies for gender equality in education, so that boys and girls have the same opportunities in this field as in any other. Otherwise, there is a risk that many girls will remain illiterate, not only because the economic resources of their families do not allow them to do so, but also because the State has not implemented practical plans to ensure inclusive education.

Educational conditions are very precarious and access to education is impossible for a large part of the population. This is obviously an issue of great concern in Africa. However, corruption and other facts prevent the achievement of inclusive education. There is still a long way to go to make academia free of gender stereotypes. In some African countries such as Equatorial Guinea, education is seen as the main driver for development. The problem is always in putting into practice everything that is on paper. Girls still find it difficult to gain access to higher education once they have finished high school. Thus, most of the time, girls' lives revolve around marriage and household chores. As a result, not as much is invested in their education and although African governments make efforts to empower women, there are still places where it is difficult for them to enjoy the right to a decent and guaranteed education.

Education has become so commodified, which has also accelerated its privatization, something that prevents many families from sending their sons and daughters to school, because public schools are too few to take on the entire student body. In theory, men and women study on an equal footing, but as long as there are branches of study where the female presence is scarce, not because of lack of knowledge but because they are women, it is still difficult to solve this issue ipso facto. According to Martínez-Martín (2015) it must be understood that.:

> Education should not remain on the sidelines of the debates on equity and social justice, therefore it is an important strategy of feminist action against the dominant logics, where empowerment, critical awareness, freedom, equality, emancipation, the creation of collective and community networks are fundamental aspects of this thinking, becoming engines of real change (p. 75).

To think that there is a geographical context that does not need to implement inclusive policies in the field of education is a way of trying to deny this issue. The right to education is guaranteed in Equatorial Guinea, and at the primary and secondary levels there is a certain parity. The problem begins at the high school level when it comes to choosing the branches of study, where one begins to appreciate the way in which gender influences these choices.

After the baccalaureate is the university, which is part of higher education, where women are not banned, at least in the Equatoguinean context, but they are entrenched in the social sciences or humanities. This means that it is a continuity of what begins in the baccalaureate. If one wants to change, it is considered that one should start not necessarily in the baccalaureate, but rather the entire educational system to make it more inclusive. It should be emphasized that "higher education institutions produce and reproduce their own culture, of which gender is a fundamental element" (Palomar, 2005, p. 28). Boys and girls should have equal access to education, but it is precisely the place where they should be educated with a gender perspective, i.e. recognizing that aptitudes should be enhanced. The African context needs many educational improvements so that education is not a privilege of a few. The precarious situation of education in Africa is evident, but:

> It cannot be denied that the sub-Saharan States have made serious efforts to achieve the Millennium Development Goals and the Education for All Goals, especially with regard to gender equality in education. However, these have not been achieved despite the commitments made at the beginning of this century. Very low enrollment rates in higher education

persist in Sub-Saharan Africa and gender inequality remains very prominent (González Pérez and Ledesma Reyes, 2015, p. 175).

Gender inequality is, as we pointed out earlier, an obstacle to women's access to higher education. Although the number of girls enrolled in the baccalaureate is high, as will be observed when presenting the data of this research, there is still work to be done so that women's access to engineering studies continues to be possible. From this initial phase, which we call baccalaureate because it is the prelude to university studies, progress must be made in improving both the school curriculum and the teaching staff itself, because "one of the most important challenges facing Higher Education Institutions (...) almost everywhere in the world, is to eradicate the gender inequality that is still manifested and reproduced within them" (Ordorika, 2015, p. 7). Throughout the corpus of this research, it is accentuated that gender inequality exists in many educational systems, therefore, the same occurs within the Equatoguinean educational system. Precisely, it is important to work from this area to put an end to this phenomenon that prevents several women from accessing higher education, and that the baccalaureate that corresponds to them is mostly in letters because they are women.

Letters and sciences, as the baccalaureate options are called in Equatorial Guinea, are designed so that each student chooses the branch of study where he or she is best suited, but in reality it is not always a voluntary option, but access to letters is for girls, it is designed for them, because they are conceived as an easy educational field. That is precisely why there are very few boys studying the baccalaureate in literature, just as there are very few girls studying the baccalaureate in science in the Equatoguinean education system. The current conditions of the educational centers of the Equatoguinean society require pedagogical criteria aimed at promoting inclusive education. It is necessary to enhance the aptitudes of the student body, but all this must be done with a gender perspective, that is, by introducing educational policies that do not impose a kind of educational segregation based on gender.

4. Methodology

As for methodological aspects, it was necessary to use descriptive research based on the quantitative method. This was chosen because the object of study is expressed as a percentage. With the quantitative research method, the approaches to be investigated are specific and delimited within the study. Within this methodology, it is important to consider the population and the sample. The population is Equatorial Guinea and the sample is made up of the selected educational centers.

In the sample, the students of the different centers have participated, namely: Our Lady of Bisila de Nkolombong Educational Center; Mother Catherine II Educational Center; Divine Shepherdess Private Center; Carlos Lwanga INES; Father Joaquin Maria Sialo INES, all from the city of Bata (mainland). And the Nostradamus Private Center of the city of Malabo (insular part). It should be noted that this is a representative sample because it includes the centers with the largest number of students in the country.

4.1. Analysis and discussion of results

At this stage of the research, the sampling is probabilistic and simple random by the random selection of 50 high school students in each school. Therefore, the sample consisted of 300 students equally divided between 150 boys and 150 girls chosen at random.

The technique used was the personal survey, and the instrument used was the questionnaire. The closed questions were formulated taking into account the sex of the students.

		Frequency	Percentage	Valid percentage
Valid	Science	73	48.6%	48.6%
	Technology	14	9.3%	9.3%
	Humanities	63	42.1%	42.1%
	Total	150	100%	100%

Table 1. In which branch of the baccalaureate are you?

Analysis: With a total of 150 boys surveyed, 48.6% are in Science, 9.8% in Technology and, finally, 42.1% in Humanities.

Interpretation: The result of that first question reveals that boys are more representative in the Science strand. That choice is due to the social aspects of where a real boy has to be in the Science stream. So, very few have actually specified the reason for their choice in the Science branch. As for the Humanities, well, the reason has been that the subjects do not go well for that reason have chosen the branch of letters.

		Frequency	Percentage	Valid percentage
Vaqlid	Science	67	44.6%	44.6%
	Technology	58	38.6%	38.6%
	Humanities	25	16.8%	16.8%
	Total	150	100%	100%

Table 2 What is the most difficult branch?

Analysis: 44.6% have marked Science, 38.6% have marked Technology and lastly, 16.8% of the boys surveyed have marked Humanities.

Interpretation: After obtaining the results, it can be said that the respondents were mostly inclined towards science and technology. For them, science subjects are more difficult. And boys, because of their stereotypes, are the ones who identify more with the difficult. Thus, many of the boys surveyed consider the two aforementioned fields to be more difficult than the humanities.

		Frequency	Percentage	Valid percentage
Valid	YES	103	68.6%	68.6%
	NO	47	31.4%	31.4%
	Total	150	100%	100%

Table 3. Do you think that the choice of baccalaureate studies depends on gender?

Analysis: The 150 boys surveyed gave us the following results: 68.8% answered yes to the question; the rest, 31.4%, said the opposite.

Interpretation: The question asked here allows us to see and analyze whether students relate gender to branch choice. And, of course, many have this perspective or vision. The impact of the social environment is evident since, in Equatoguinean society, in the educational field, boys are the ones who opt for the sciences and girls opt for the other branch namely the Humanities.

Phase 2 of this research is presented below. As stated in previous points, the research questions are the same, but they have been grouped according to the gender of the students. In other words, the same questions have been answered by both boys and girls. The purpose of these independent phases is to measure the degree of consideration that the students have about the question of the choice of the branches at the baccalaureate level.

		Frequency	Percentage	Valid percentage
Valid	Science	71	47.3%	47.3%
	Technology	15	10%	10%
	Humanities	64	42.7%	42.7%
	Total	150	100%	100%

Table 4. In what branch of the baccalaureate are you?

Analysis: Of the 150 girls surveyed, 47.3% are in Science, 10% in Technology and 42.7% in Humanities.

Interpretation: In response to this question, the girls claimed that humanities is the branch for girls. It is not specified in this question why they say so. But it is clear that, in the Equatoguinean school society, most of the girls or young women choose the Humanities. Although it is estimated that many of them do so out of mimicry, that is, because they always want to be among friends regardless of the career that each one.

		Frequency	Percentage	Valid percentage
Valid	Science	94	62.6%	62.6%
	Technology	18	12%	12%
	Humanities	38	25.4%	25.4%
	Total	150	100%	100%

Table 5. Which is the most difficult branch?

Analysis: Among the 150 girls surveyed, it is worth noting that 62.6% recognize that the Science branch is the most difficult, while others, representing 12%, believe that it is the Technology branch, and the rest, in a percentage of 25.4%, believe that it is the Humanities.

Interpretation: Many of the girls in the Equatoguinean education system opt for the Humanities when they arrive in the first year of the baccalaureate. In other words, they turn away from science because they consider it too difficult. For them, it is a matter of boys doing mathematics, chemistry and physics. For them, Greek and Latin as specific subjects of the Humanities are very easy subjects, and this is a peculiar characteristic of girls. However, it is observed that the careers they choose to study at the university, which in the Equatoguinean context are practically considered as careers for girls, are medicine, administration, banking and finance, among others, which identify girls as purely science careers. Thus, we are faced with a dialectic in which girls consider that the branch of science is the most difficult, but that the university opportunities in this branch are the most coveted by girls.

		Frequency	Percentage	Valid percentage
Valid	YES	111	74%	74%
	NO	39	26%	26%
	Total	150	100%	100%

Table 6. Do you think that the choice of baccalaureate studies depends on gender?

Analysis: With a total of 150 girls surveyed, 74% answered Yes, while the rest, i.e. 26% said No, and the remaining 26% said No.

Interpretation: As we have seen in relation to boys, it is almost the same thinking. When it comes to choosing a field in the baccalaureate, young women are more inclined to choose the Humanities because it is hypothetically said that this field is for girls.

5.   Conclusions

After having conducted this research on education and gender in Africa, taking as a case study the choice of branches of study at the baccalaureate level within the Equatoguinean education system, the following conclusions were reached:

- In the first place, girls opt for the arts because, hypothetically, it is related to feminine stereotypes, i.e., what is easy.
- Secondly, in the Equatoguinean educational system, there are more girls in the humanities or arts than in science and technology.
- Then, it is still thought that girls or women cannot become engineers, mechanical technicians, etc. because they are professions that clearly define boys. Women identify more with careers such as administration, journalism, and cashiering, among others.
- Another relevant conclusion is the influence of social, family and cultural factors that have repercussions on the academic future of girls, among which are pregnancy, sexual harassment, marriage, etc.

It should be remembered that the planned thesis is as follows: *Despite the initiatives undertaken at the social level to achieve gender equality in all areas, in education still remain gender stereotypes that lead the student body to opt for a particular branch according to their gender, being so that girls are more inclined to the humanities or social sciences, while boys are technology or science*. Based on this thesis, it should be emphasized that education should be a right for all people regardless of gender, sex or race, something that is not currently defined in the education system. In a society rooted in the stale values of patriarchy, it is still thought that boys are the most qualified for certain careers. Stereotypes are created that psychologically block girls from accessing careers or fields of study that are considered masculine. To combat this scourge of inequality, educational policies with a gender perspective have been undertaken to strengthen the educational institutions themselves, investing in teacher training so that they do not imprint sexist divisions in the school.

The answers to the research questions illustrated how gender influences the choice of baccalaureate studies. In fact, many girls opt for the humanities while boys opt for science and technology. However, science and technology are considered to be particularly linked to boys because they are associated with the stereotype of being difficult, arduous and hard. At the labor level, girls or women have difficulties because of their condition. And, it is a fact that men put women in an inferior position despite gender-inclusive policies.

However, with the passage of time this situation is taking other aspects. The baccalaureate is a phase where students must show their cognitive aptitudes regardless of gender. To this end, it is necessary to avoid conditioning the choice of careers according to gender.

One of the limitations of this research was not having found a previous study that analyzes the current Equatoguinean educational system from a gender perspective. This shows that no attention has been paid to it. In this sense, for future research, it would be possible to study the factors or phenomena that make it difficult for girls to access certain careers, especially the more technical ones. Moreover, we could also study whether women who have managed to break through these obstacles are being references for girls who would also like to be like them. Inclusive education is the best option for advancing development.

This work is part of the framework of gender research in Equatorial Guinea. It is not a vindication of women's rights, nor is it even a feminist position to defend women. It is rather an analysis of the gender situation in relation to the Equatoguinean educational system. Therefore, this work does not exhaust the gender issue in education, but rather opens the door to other research of this nature, it would be here as a kind of theoretical framework at the national level.

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