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Facultad de Filosofía, Letras y Ciencias de la Educación

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To disseminate multidisciplinary scientific unpublished articles, elaborated under the parameters of the research methodology, written with academic rigor and based on the teaching practice.

TOPICS
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.

From its origins, the Revista Céetdra was published in printed format. It is currently published in electronic format, using virtual environments to align to the needs of the revista s users and editors.

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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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To be promoters in the publication of high quality scientific articles that, guided by research and from different areas of knowledge linked to the Educational Sciences, become the most prestigious reference in the understanding and improvement of the educational process.

FOCUS AND SCOPE: *Revista Cátedra* has as its theoretical basis the Educational Sciences in its different specialties and levels of the educational system. Priority will

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be given to papers describing pedagogical experiences, didactics used, innovation processes, and their relationship with new educational technologies.

It disseminates scientific-academic articles constructed under the parameters of research methodology. It is open to national and international writers interested in contributing significantly to the solution of current educational problems.

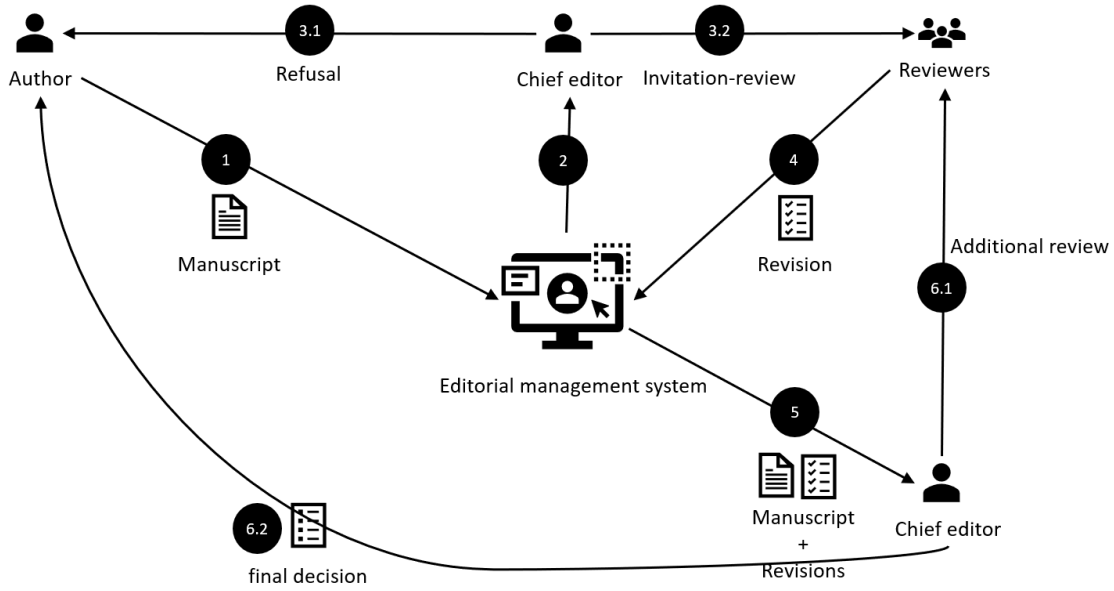
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EDITORIAL

It is an honor for the ***Revista Cátedra*** to present volume 9, number 2 of its electronic version. The topics covered are based on the theoretical foundations of educational sciences in their various specializations and educational levels. Thus, this issue presents relevant and noteworthy aspects of each academic work, addressing areas such as educational psychology, educational resources, and educational innovation.

The content presented in this new issue is characterized by its adherence to established research methodology. Furthermore, it is rigorously researched through blind peer review and grounded in practical teaching theory and practice.

This issue comprises eight approved articles:

The first article, titled "*Interactive environments for learning biochemistry: a pedagogical experience with TopWorksheets in higher education"* was authored by Luis Chonillo-Sislema, María Chicaiza-Uquillas, Erick Ruiz-Totoy, and Génesis Amaguaya-Uvidia. The manuscript aimed to evaluate the impact of interactive worksheets in TopWorksheets on biochemistry learning, using a quasi-experimental quantitative methodology with 67 higher education students to compare conceptual knowledge and experience. The findings indicated that the use of these worksheets significantly improved academic performance (5.50 ± 1.81 vs. 7.20 ± 2.23; p = .01; Cohen's d = 0.83) and fostered high satisfaction (89%), enhancing both the conceptual and attitudinal dimensions of learning.

The second article, titled "*Artificial intelligence and the learning process in Economics students*", was authored by Santiago Vinueza-Vinueza and Alejandra Fonseca-Factos. The research aimed to analyze the influence of artificial intelligence (AI) on the learning process of Economics students at the Central University of Ecuador, focusing on their motivation and academic performance. The methodology employed a quantitative approach with a non-experimental, cross-sectional design. A stratified sample of 149 university students was evaluated using the Study Process Questionnaire (SPC) and descriptive and inferential statistical analyses. The findings demonstrated that the integration of AI has a positive and significant influence on both academic motivation (M = 3.44; p < .001) and performance (M = 2.96; p < .001), establishing it as a key pedagogical resource for enhancing the quality of higher education in the region.

The third article, titled "*Relevance of Codes of Coexistence in the Face of Systematic Violence and the Narco-State in Ecuador: An Exploratory-Descriptive Study"* was authored by Galo Alejandro Palacios-Terán. The objective of the research was to analyze the impact of the guidelines of the Organic Law of Intercultural Education (LOEI) on the creation of safe environments within the Ecuadorian context of systematic violence and its configuration as a narco-state. The methodology consisted of a descriptive study with a qualitative and exploratory approach, which contrasted the regulatory framework of the LOEI and the 2008 Constitution with the territorial reality and the security crisis stemming from organized crime. The conclusions revealed a tactical disconnect between current regulations and the criminal environment, showing that the codes of coexistence lack protocols to

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address criminal co-optation. Therefore, a reform is needed that prioritizes human security and equips teaching staff with crisis management skills in the face of threat scenarios.

The fourth article, titled "*Influence of digital skills on language competency in university students"* was authored by Dina Chela Inga-Lindo, Evelyn Patricia Zavala-Zavala, and Joanes del Carmen Benott-Santander. The objective of the research was to determine the influence of digital skills on the linguistic competencies of students at the Federico Villarreal National University (2024). The methodology adopted a quantitative, correlational-causal approach with a non-experimental design, collecting data through a Likert-scale survey administered to a non-probability sample of 202 first- and second-year students. The findings demonstrated that digital skills have a significant and moderate influence on linguistic competencies, supported by a Pearson correlation coefficient of $r = 0.695$ ($p < 0.05$). This highlights the urgent need for faculty to master and apply technological tools to optimize communication and conceptual interpretation processes in the face of student diversity.

The fifth article, titled "*Associated factors and statistical analysis of alcohol consumption in university students*" was authored by Jimmy Román-Proaño, Marcela Cadena-Figueroa, Nancy Valladares-Carvajal, and Pilar Salazar-Almeida. The objective of the research was to determine alcohol consumption patterns and evaluate the influence of the social environment in a sample of 1,045 higher education students from the National University of Chimborazo (Ecuador). The methodology consisted of a descriptive study with a quantitative approach, applying a structured questionnaire that assessed consumption habits, consequences, and associated factors in future education professionals. The findings showed that, although 57% do not consume alcohol regularly, their drinking decisions are mainly linked to individual preferences and social pressure within the university environment, demonstrating that the family context does not act as a protective factor and requiring a preventive approach focused on awareness and resilience in social settings.

The sixth article, titled *" Interactive applications as a strategy for socio-emotional development in primary school students,* was authored by María Granda-Moreno and Diana Cevallos-Benavides. The research aimed to propose the integration of free interactive applications to strengthen the development of socio-emotional skills in primary school students in rural schools. The methodology employed a mixed-methods approach with a concurrent triangulation design, collecting data through observation sheets applied to 22 students, surveys of 2 teachers, and interviews with 3 experts to evaluate the pedagogical and technical feasibility of the resources. The conclusions demonstrated that the proposal to implement platforms such as Smile and Learn, Respira, Juega, Actúa (Breathe, Play, Act), and Invasión Zombi (Zombie Invasion) is technically and pedagogically viable due to their offline accessibility and cultural relevance, establishing them as an innovative alternative

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to enhance empathy and self-regulation while reducing socio-emotional gaps in rural environments.

The seventh article, titled *" Impact of musical learning on the development of socio-emotional competencies in first-year high school students: a quasi-experimental study*", was authored by Jonathan Pillajo-Tituaña and María Guacho-Morejón. The research aimed to analyze the impact of music learning as a pedagogical resource on the development of socio-emotional competencies in first-year high school students. The methodology consisted of a quasi-experimental design with pre-test and post-test assessments administered to a control group (receiving traditional music instruction) and an experimental group (participating in structured musical activities), using the Bar-On ICE inventory as the measurement instrument. The findings demonstrated significant improvements in the experimental group in terms of emotion identification and management, stress reduction, and the promotion of teamwork, confirming the effectiveness of a structured music intervention as a key tool for overcoming curricular challenges and enhancing socio-emotional development in adolescence.

Finally, the eighth article, *" Learning linear and quadratic functions through the use of artificial intelligence in higher education students",* authored by Bryan Carrera-Arias, is presented. The objective of this research was to evaluate the impact of artificial intelligence (AI), based on Deep Learning and Machine Learning, on the academic performance and acceptance of higher education students learning linear and quadratic functions. The methodology consisted of a quantitative approach and a quasi-experimental design with a sample of two groups (40 in group A and 41 in group B). Data were collected through diagnostic questionnaires, dichotomous final assessments, and a Likert-scale satisfaction survey, analyzed using descriptive and inferential statistics (Student's t-test in SPSS). The conclusions determined that the AI-based model did not significantly improve grades compared to the traditional method; however, it generated positive perceptions, greater motivation, active participation, and efficient interactive feedback in the subject of Mathematics.

Revista Cátedra thanks all the authors and reviewers of articles who made the publication of this issue possible. Furthermore, it invites the national and international academic community to submit their research related to Educational Sciences in its various specializations and educational levels.

Directors/Editors-in-Chief

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REVISTA CÁTEDRA

Interactive environments for learning biochemistry: a pedagogical experience with TopWorksheets in higher education

Ambientes interactivos para aprender bioquímica: una experiencia pedagógica con TopWorksheets en la educación superior

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Abstract

Currently, the use of interactive platforms allows students to independently acquire personalized learning. In this context, interactive worksheets managed on the TopWorksheets platform were applied to teach biochemistry to higher education students. Therefore, a quantitative study based on the positivist paradigm and a quasi-experimental operational design was conducted. The study involved 62 students, 35 in the experimental group (EG) and 32 in the control group (CG), who were enrolled in a Biochemistry course at an Ecuadorian university. Knowledge tests on organic biomolecules were administered before and after the study, along with a survey that collected experiences and anecdotes related to the activities using TopWorksheets. The results showed a significant difference between the mean scores after the intervention (5.50 ± 1.81 vs. 7.20 ± 2.23), with the difference being significant in both groups (t = 3.40; p = .01; Cohen's d = 0.83). Regarding the experience, 72% of the students indicated that the interactive worksheets were ideal for reinforcing biochemistry content and for improving participation (89%); and 89% were satisfied with the experience. It is concluded that the use of interactive worksheets as a teaching resource improved biochemistry learning in both the conceptual and attitudinal domains.

Keywords

Biochemistry, chemistry didactics, higher education, chemistry teaching, ICT (information and communication technologies)

Resumen

En la actualidad, el uso de plataformas interactivas permite que los estudiantes, de forma autónoma, adquieran un aprendizaje personalizado. En este sentido, se aplicaron fichas interactivas gestionadas en la plataforma TopWorksheets para aprender bioquímica en estudiantes de educación superior. Por ello, se realizó un estudio cuantitativo sustentado en el paradigma positivista y un diseño operativo cuasiexperimental; se trabajó con 62 estudiantes, 35 del grupo experimental (GE) y 32 del grupo control (GC) que cursaron la cátedra de Bioquímica de una universidad ecuatoriana. Se emplearon pruebas de conocimientos antes y después sobre biomoléculas orgánicas; además de una encuesta que recoge las experiencias y anécdotas de las actividades utilizando TopWorksheets. Los resultados constataron una diferencia significativa entre la media de calificaciones después de la intervención (5.50±1.81 vs. 7.20±2.23), siendo la diferencia significativa en ambos grupos (t = 3.40; p = .01; d de Cohen = 0.83). En cuanto a la experiencia, el 72% de los estudiantes indicaron que las fichas interactivas son ideales para reforzar los contenidos de bioquímica y para tener una mejor participación (89%); y un 89% están satisfechos con la experiencia. Se concluye que el uso de fichas interactivas como recurso didáctico mejoró el aprendizaje de bioquímica en cuanto al área conceptual y actitudinal.

Palabras clave

Bioquímica, didáctica de la química, educación superior, enseñanza de la química, TIC (tecnologías de la información y comunicación)

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1. Introduction

Undeniably, digital technologies serve as a medium that transforms and contributes to the optimization of both teaching and learning across all educational levels. Higher education has been a privileged setting for integrating innovative tools with high motivational value for students, aiming to modify traditionalist approaches. In a training shift, science education faces the constant challenges of updating pedagogical strategies in response to the growing complexity of content and the diversity of student profiles. In scientific disciplines such as Chemistry, difficulties in assimilating topics are well-documented; this has driven the need to update the way content is addressed to guarantee quality professional training.

Addressing the use of Information and Communication Technologies (ICT) from an innovation perspective provides a means to reposition teachers based on their didactic knowledge. The significance of incorporating ICT into education lies in creating new learning scenarios; to this end, Del Padre et al. (2022) recommend that educators become familiar with such advancements and implement them in the classroom to render the learning process more appropriate, successful, and engaging (Del Padre et al., 2022, p. 1397). From a techno-educational standpoint, Vásquez and Jaramillo indicate that ICT offers ideal environments for the active construction of knowledge, as it enables interaction among students, access to diversified content, and the possibility of immediate feedback—factors that enhance deep learning (Vásquez & Jaramillo, 2025, p. 183).

The teaching of chemical sciences, particularly biochemistry, faces major challenges due to the complexity of concepts, the need for pedagogical methodologies to facilitate comprehension, low academic performance, and the large volume of content that must be memorized. These deficiencies have eroded the alignment between curricular objectives and learning achievements, thereby affecting the professional preparation of students. It is widely known that biochemistry is a complex science, as it studies the chemical composition of living beings, focusing on specific molecules—such as carbohydrates, proteins, lipids, nucleic acids, and vitamins that form cells and tissues—and how they interact and react with one another. Consequently, the language through which biochemistry is communicated requires dynamic and interactive didactic materials. As noted by Dreon, a student learns a concept when they are capable of endowing the presented material or information with meaning—that is, when they comprehend that material, where comprehension is equivalent to translating it into their own words (Dreon, 2023, p. 10).

The use of interactive platforms has consolidated as a pedagogical strategy that allows for the construction of dynamic, meaningful, and student-centered learning environments, fostering exploration and motivation—innovative criteria aligned with technological advancements. In fact, various studies support the effectiveness of digital interactivity in science learning. For instance, Terrado points out that gamification and interactivity increase student motivation and academic performance (Terrado, 2023, pp. 44-45). Furthermore, Chonillo demonstrated that platforms like Liveworksheets allow for the personalization of pedagogical strategies, adapting better to the communication of content and, consequently, favoring the comprehension of chemistry (Chonillo, 2024). For their part, Yustiqvar et al. highlight that the use of digital resources facilitates the visualization of phenomena, thereby improving the understanding of scientific topics through the use of simulations and interactive exercises (Yustiqvar et al., 2019). Similarly, Morgan et al., as well as Rodríguez and Marín, agree that the integration of educational technologies fosters collaborative and dynamic learning environments (Morgan et al., 2025; Rodríguez & Marín, 2019).

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Within this framework, the present research focuses on determining the effect of the TopWorksheets platform by managing interactive worksheets to learn biochemistry among higher education students. From a comprehensive approach, the study seeks to provide empirical evidence by offering students pedagogical strategies that integrate interactive technologies to optimize biochemistry teaching, thereby strengthening cognitive and procedural competencies, as well as enhancing motivation and classroom participation.

Regarding the structure of this article, Section 2 (Literature Review) presents the concepts related to the study. Section 3 (Methodology) describes the methodology used to develop this research process, including the intervention proposal. Section 4 (Results and Discussion) shows the analysis and discussion of the findings. Finally, Section 5 establishes the conclusions based on the obtained results.

2. Literature review

2.1. Education in the digital age

Education in the digital era constitutes a process of reconfiguring pedagogical paradigms; it is not merely about incorporating electronic devices into the classroom, but rather about transforming the modes of production, circulation, and appropriation of knowledge. According to Reyero, digitalization has broken the boundaries of traditional teaching, giving rise to personalized and ubiquitous scenarios where learning occurs in both formal and non-formal environments (Reyero, 2019, p. 111). From the perspective of the Escuela Nueva (New School) movement, education must be conceived as a digital ecosystem that promotes connectivity, cooperation, and open access to knowledge. As clarified by Largo et al., digital education opens access to virtual libraries, laboratories, global collaboration platforms, and interactive learning spaces, thereby expanding students' formative horizons (Largo et al., 2022, pp. 281-282).

A proverb states that whoever "integrates the new, transforms the old"; this implies that incorporating strategies through technology redefines the way knowledge is constructed, given that ICT and active methodologies transcend traditional methods, generating more dynamic and meaningful learning environments. Thus, in alignment with UNESCO guidelines, educational practice is transformed into a flexible and adaptable ecosystem, capable of responding to societal challenges and shaping autonomous, competent students committed to their own learning. Therefore, education in the digital era is not a simple process of modernization, but rather a structural change that redefines the purposes, methods, and meanings of teaching (UNESCO, 2024).

2.2. Interactivity in teaching and learning

Interactivity is one of the pillars of educational renewal, as it fosters a dialogic process where students manipulate, explore, and generate knowledge from experiences (Córdova & Lino, 2024, p. 1032). Furthermore, it is defined as the exchange of communication and information between individuals. It is also a way for students to interact with content, develop ideas, and work more dynamically.

Consequently, interactive tools should not be understood as simply the presence of a technological medium, but rather as a pedagogical strategy that places the student at the center of the learning process. To this end, technological resources are a vehicle for knowledge construction, but the essential element is the didactic approach that guides them (Rodríguez-Basantes et al., 2023, pp. 194-195). Furthermore, it fosters the affective-motivational dimension, because the student, by being actively involved in digital and

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enriching content, develops a sense of agency and belonging to knowledge, generating a virtuous circle between motivation, curiosity and persistence in the task.

2.3. Didactic and pedagogical potential of interactive tools

The potential of interactive tools transcends their instrumental function. Chaves and De la Peña establish that they are part of pedagogical innovation, serving as platforms that integrate multiple languages—visual, symbolic, textual, and auditory—to address the diversity of learning styles present in the classroom. This multimodality strengthens content comprehension and reinforces long-term memory (Chaves & De la Peña, 2025, pp. 37–39). Pedagogically, they align with constructivist and sociocultural approaches, which conceive of learning as an active, situated, and mediated process, where knowledge is constructed through action, reflection, and interaction.

The multiple interactive platforms are not merely teaching resources, but devices that transform the very meaning of teaching and learning. Web 2.0 offers a variety of interactive tools (see Figure 1).).



Figure 1. Interactive tools for the development of learning content

- *WordWall:* Create interactive activities and customizable educational games, such as crosswords, word searches, and quizzes, to reinforce learning dynamically.
- *Liveworksheets:* Transform traditional worksheets into interactive online exercises, allowing for digital responses, self-correction, and tracking of student progress.
- LearningApps: Create interactive micro-activities, such as puzzles, quizzes, and matching games, that can be easily integrated into face-to-face or virtual classes.
- Quizlet: Create flashcards, quizzes, and games to review concepts repetitively and collaboratively, ideal for memorization and self-assessment.
- ExeLearning: Facilitates the creation of structured, multimedia educational content focused on e-learning, with resources such as text, images, and interactive links.
- ProProfs: Manage quizzes, surveys, exams, and online courses, with learning tracking and results analysis features for teachers.
- *Educandy*: Turn vocabulary or concepts into interactive games, such as crosswords or matching exercises, promoting fun and engaging learning.

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- *Genially*: Create interactive and visual content, such as presentations, infographics, games, and videos, ideal for enriching teaching with multimedia resources.
- *Educaplay*: Create interactive activities, such as word searches, interactive maps, crosswords, and quizzes, that allow you to reinforce concepts in a fun way.

2.4. interactive tools: TopWorksheets for learning Chemistry

Web-based tools have proven to be strategic allies in overcoming the difficulties students face when learning chemistry. On a motivational level, they have succeeded in sparking interest and curiosity in students, who often perceive this science as excessively difficult. In this way, chemistry becomes a fertile ground for innovation, promoting meaningful learning and building a closer relationship between science, technology, and society.

Among the many available platforms, this study focused on TopWorksheets, a platform that allows users to manage interactive worksheets by creating exercises, questions, activities, and educational games. It integrates diverse multimedia resources, such as sounds, videos, links, images, and audio, as well as activities involving fill-in-the-blank, selection, matching, and multiple-choice questions. Together, its various functionalities foster a more dynamic, participatory, and enriching learning experience. According to Cañar et al. (2024), this platform facilitates the creation of engaging activities with automatic grading, reduces paper consumption by being online, and its free and easy-to-use nature makes it suitable for classroom use.

3. Methodology

In the development of this study, a quantitative approach was adopted, adhering to the positivist paradigm and a quasi-experimental pretest-posttest design with a control group (CG). This involved measuring the dependent variable (biochemistry learning). Subsequently, an intervention was implemented using interactive worksheets to assess its effectiveness in the experimental group (EG). The variable was then measured again, and the learning outcomes were compared between the two groups.

The population consisted of 67 students, distributed as 32 students in the CG and 35 students in the EG, from the 2024-1S academic period, enrolled in the Biochemistry course of the Bachelor's Degree in Chemistry and Biology Pedagogy at an Ecuadorian university. This allowed for a balanced comparative analysis between both groups; no sample was selected, as the research was conducted with the entire study population. To begin the investigation, a 10-question online knowledge quiz about carbohydrates, proteins, lipids and fats, nucleic acids, and vitamins was developed and administered via the Quizizz platform. The quiz covered items related to structure, characteristics, function, and food sources. These tests allowed, firstly, for diagnosing the students' level of knowledge at the start of the study and, subsequently, for evaluating the effect of the intervention. Furthermore, the modern McDonald omega coefficient was used to measure the reliability of the instruments (see Table 1.).

	McDonald's ω	N.º of elements	Interpretation
Survey	0.825	5	Good
Knowledge tests	0.801	2	Good

Table 1. Instrument reliability statistics

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Regarding the intervention's development, five interactive worksheets were created and stored (see Figure 2). The worksheets were implemented in ten 60-minute classes over two months. Complementary activities related to the topic were also used (crosswords, word searches, fill-in-the-blank tests, and drawing and painting activities). At the end of each period, each activity was evaluated (post-test) to compare its impact on students' academic performance. Following the implementation, a survey was administered to gather students' experiences using the worksheets, with five response options (Strongly Disagree, Disagree, Neutral, Agree, and Strongly Agree).

Figure 2 summarizes the data collection process.

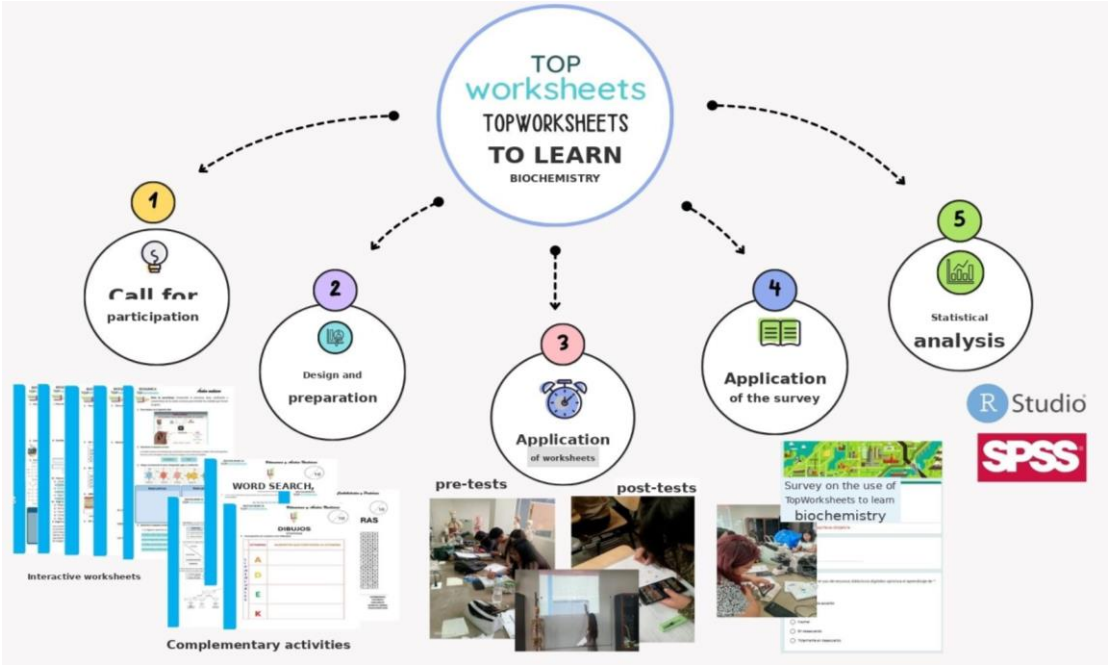


Figure 2. Flowchart of the application of the intervention using interactive cards.

Following the intervention, the tabulated data was used to perform the respective descriptive and inferential statistical analysis, comparatively using IBM SPSS Statistics V.27 and RStudio, to answer the research question: How do the interactive worksheets managed in TopWorksheets promote the learning of biochemistry in students of the Chemistry and Biology Pedagogy program?

4. Results and discussion

Data were collected from 67 students, based on the five topics covered in the syllabus units: carbohydrates, proteins, lipids or fats, vitamins, and nucleic acids. These data were averaged considering the results of the pre-test and post-test assessments, as well as the supplementary activities.

Figure 3 shows the knowledge level of the control group (CG) and experimental group (EG) in relation to the topics covered in the initial assessment. As can be seen, in the CG, 12 students (38%) and in the EG, 11 students (31%) did not reach the required learning levels (NAR, ≤ 4.0). Likewise, in the CG, 15 students (47%) and in the EG, 14 students (47%) were close to reaching them (PAR, 5–6). Similarly, in the CG, 4 students (13%) and in the EG, 4 students (11%) reached them (AAR, 7–8). Furthermore, in the control group (CG), 1 student

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(3%) and in the experimental group (EG), 4 students (11%) mastered the required learning (DAR, 9); only in the EG did 2 students surpass the learning requirements (SAR, 10). After an "within-groups" analysis, the absence of statistically significant differences with respect to the initial academic result was confirmed ($t(65) = 0.16$; $p < .84$), showing that the means in the groups were not significant (5.0 ± 1.6 vs. 5.1 ± 2.6/10), which affirms that both groups are equivalent and are in the same conditions to receive the experimental treatment.

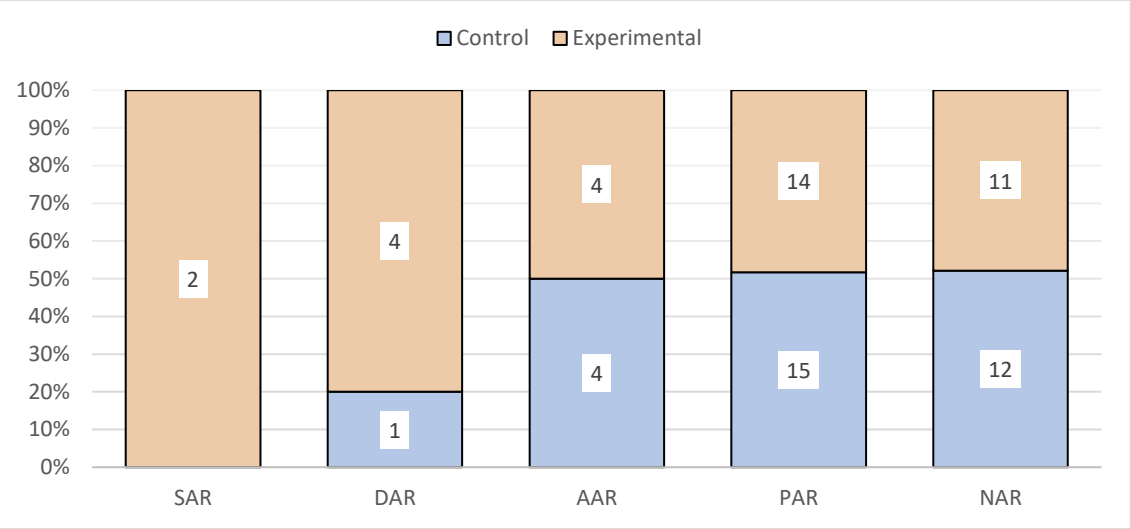


Figure 3. Level of incidence of the application of interactive worksheets for learning biochemistry (pre-test).

Following the intervention, the final evaluation, as shown in Figure 4, reveals that in the control group (CG), 10 students (31%) and in the experimental group (EG), 5 students (14%) did not achieve the required learning outcomes (NAR). Similarly, in the CG, 17 students (53%) and in the EG, 7 students (20%) were close to achieving them (PAR). Likewise, in the CG, 1 student (3%) and in the EG, 9 students (26%) achieved the required learning outcomes (AAR). Furthermore, in the CG, 3 students (9%) and in the EG, 10 students (27%) mastered the required learning outcomes (DAR). Finally, in the CG, 1 student (3%) and in the EG, 4 students (11%) exceeded the required learning outcomes (SAR); this demonstrates a difference in learning levels between the groups.

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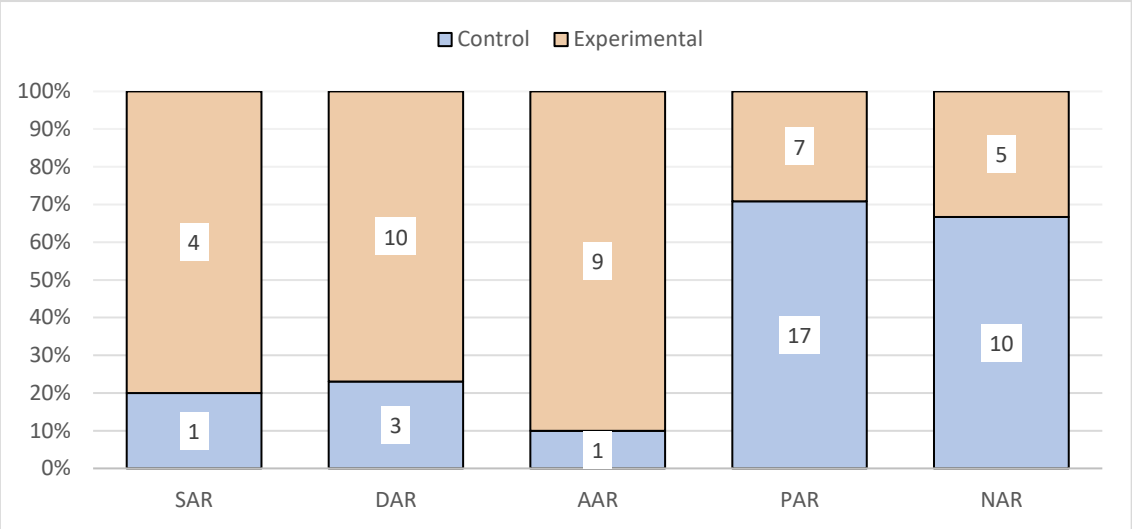


Figure 4. Level of incidence of the application of interactive worksheets for learning biochemistry (post-test).

To verify the effect of interactive worksheets on biochemistry learning, a Student's t-test for independent samples was chosen to evaluate whether there were significant differences when comparing the means of two groups of cases (Guillen et al., 2019).

— Working Hypothesis

H1: There is a difference between students in the experimental group (EG) and students in the control group (CG) with respect to biochemistry learning after the application of interactive worksheets managed through the TopWorksheets resource.

— Determination of (alpha)

α = 5% = 0.05 (admitted error for the statistical test), at a 95% confidence level.

— Statistical Decision

If the obtained probability p-value ≤ Alpha = 5% = 0.05, Ho is rejected (H1 is accepted).).

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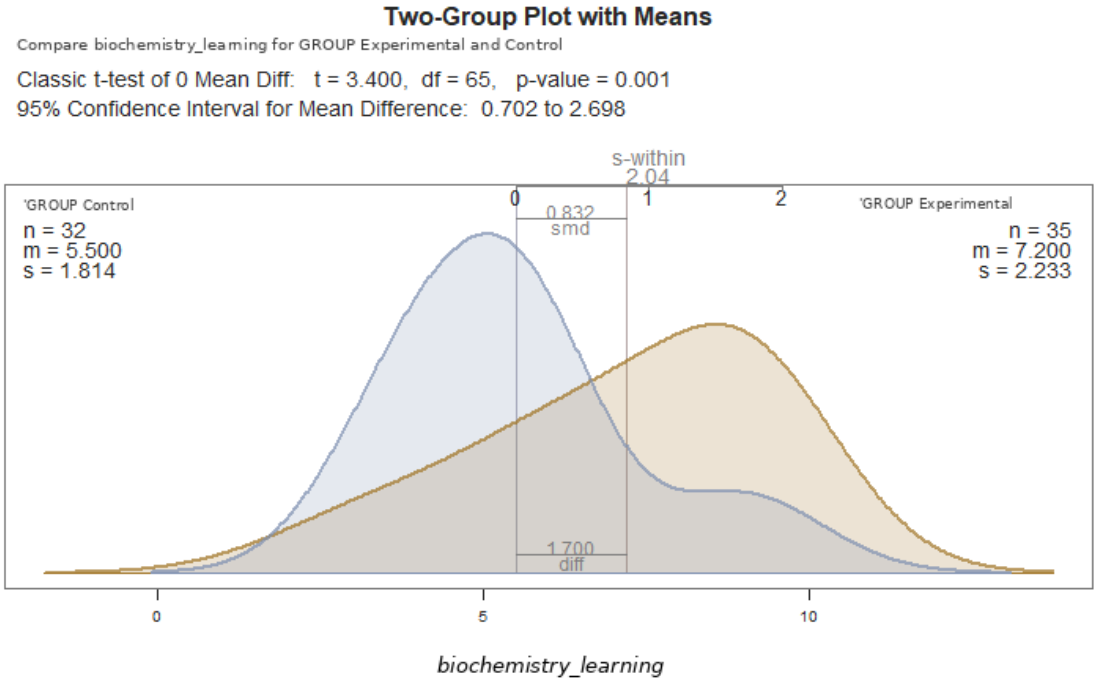


Figure 5. Average biochemistry learning outcomes for different treatments

Depending on the intervention (Figure 5), a difference was found between the mean knowledge test scores for the experimental group (EG) that used interactive flashcards (M = 7.20, SD = 2.23, n = 35) and the control group (CG) that did not (M = 5.50, SD = 1.81, n = 32), such that those who participated in the program obtained better results on the knowledge test. This means that Biochemistry learning was 1.70 times higher on average in the EG compared to the CG. The t-test showed that this difference was statistically significant ($t(65) = 3.40$, $p < .01$, 95% CI [2.70, 0.70]). Because a difference in means was found, Cohen's d was interpreted as an indicator of practical importance for this study, leading to the conclusion that the effect was large ($d = 0.83$, 95% CI [1.33, 0.33], Cohen 2013). Therefore, there is statistical evidence to affirm that biochemistry learning improves significantly after the application of interactive worksheets managed in the TopWorksheets resource.

In line with these results, Delgado-Cobeña et al. explain that digital resources promote dynamic and meaningful forms of learning, which allow students to analyze, discuss, understand, and generate new knowledge (Delgado-Cobeña et al., 2023, p. 21). From a constructivist perspective, Gértrudix and Ballesteros state that ICTs are considered motivating tools for students, as they capture their attention and encourage activity in the classroom (Gértrudix and Ballesteros, 2014, p. 2). A study with Biochemistry and Pharmacy students by Simaluiza established that Web 2.0 platforms are associated with positive and beneficial experiences for students, improving their understanding of the topics covered, teamwork skills, and creativity (Simaluiza, 2024, p. 13). Furthermore, the study explored how the use of Web 2.0 resources impacts motivation and interest in learning.

Innovating the teaching-learning process begins with the creativity applied by the teacher and the selection of resources that are appropriate for new digital models in education. According to Delgado-Cobeña et al., teaching resources must be flexible to achieve a relevant combination with the learning objective; that is, the interaction between the student and

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the educational material should systematically and substantially generate knowledge (Delgado-Cobeña et al., 2023, p. 43).

4.1. Exploring the experience of the interactive course.

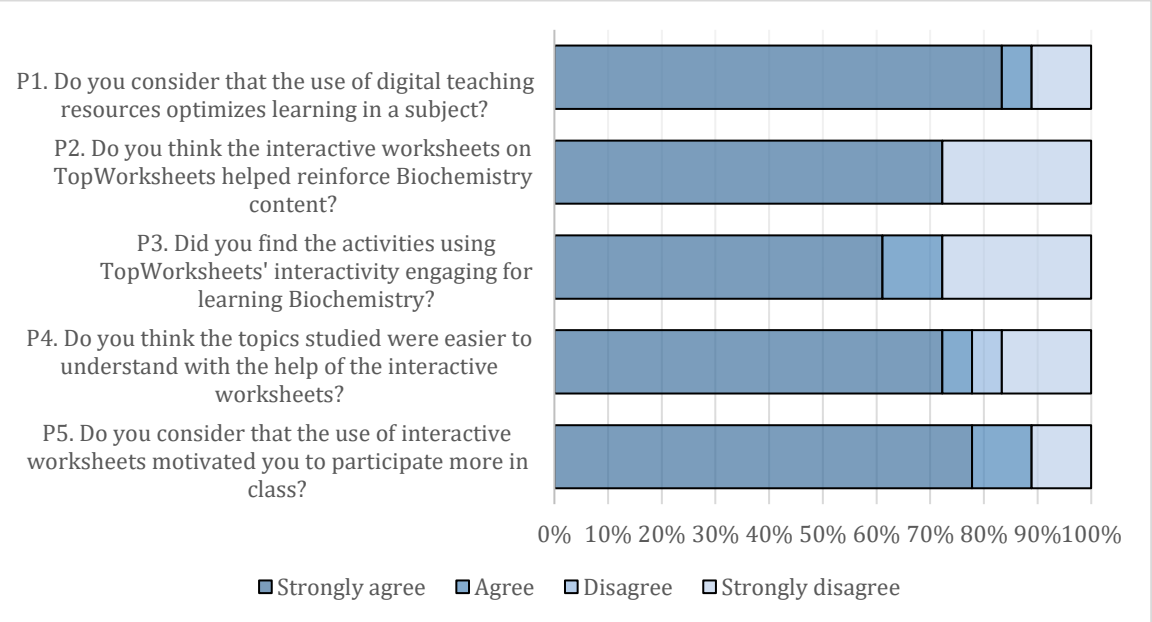


Figure 6. Results of the student perception survey.

In response to the first question, 89% (83% "strongly agree," 6% "agree") stated that the use of digital resources is ideal for optimizing knowledge of a subject. A large proportion of students agreed that digital resources (simulations, interactive videos, and educational applications) offer opportunities to personalize content. Mora indicates that learning can be significantly improved through a variety of pedagogical approaches (Mora et al., 2024).

In response to the second question, 72% indicated that the use of interactive worksheets is very helpful for academic reinforcement in Biochemistry. Many students mentioned that the development of dynamic and creative activities adapted to their learning style, which radically improved classroom participation. Pérez indicates that this strengthens teaching and learning, especially for those students who have greater difficulty understanding the topics (Pérez, 2024).

Regarding the third question, the majority of respondents (72%) mentioned that the worksheets are engaging for learning Biochemistry through interactive exercises. Students gained a better understanding of the material, as Chonillo (2024) notes that interactivity provides an effective learning experience with the content. Tools like TopWorksheets and Liveworksheet allow for the management of interactive PDFs where the self-correction feature helps students better grasp the material.

Regarding the fourth question, the majority of respondents (77.8%) strongly agreed or agreed that the topics studied in the Biochemistry course were easier for them. This was because the worksheets not only facilitated the assimilation of concepts but also made the learning process more engaging. Furthermore, the integration of visual and practical elements in the interactive worksheets helped to better illustrate abstract concepts, making learning a more tangible and concrete experience (García & Santana, 2023).

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In the fifth question, 88.9% felt that the topics covered motivated them to participate more actively in the Biochemistry class (77.8% "strongly agree" and 11.1% "agree"). This aligns with Morales et al. (2015), as the use of technology in classes enhances interest, which in turn motivates students to engage in interactive activities; it also prevents boredom and monotony in the classroom.

A chi-square test was also performed to compare variables (Table 2), comparing the variable "Interactive worksheets on the TopWorksheets platform are attractive for learning biochemistry" with the variable "Consider that the use of interactive worksheets motivates greater participation in the Biochemistry class," yielding the following results:

Chi- square tests

	Value	df	Asymptotic significance (2-sided)
Pearson's Chi-square	16.796[a]	6	.010
Likelihood ratio	15.982	6	.014
Linear-by-linear association	.001	1	.970
Number of valid cases	35		

a. 9 cases (75.0%) were expected to be less than 5. The minimum expected result was .06.

Section 2. Association between motivation, participation and perception of interactive data in Biophysics

The chi-square test analysis of association revealed statistically significant results, $\chi^2(6, n = 35) = 16.80$, $p = .010$, indicating a statistically significant relationship between the two variables. In other words, motivation to participate in class is linked to a positive perception of interactive worksheets as an academic support resource, with a strength of association $\Phi = 0.49$; according to this strength index, the association was moderate. Borbor et al. found that technological solutions increase motivation for learning in science (Borbor et al., 2024). Furthermore, they promote cognitive development through participatory activities.

A question was also added asking students to rate their experience using interactive worksheets to learn biochemistry (carbohydrates, proteins, lipids or fats, vitamins, nucleic acids). As shown in Figure 5, the majority of students (89%) rated the learning experience as excellent.

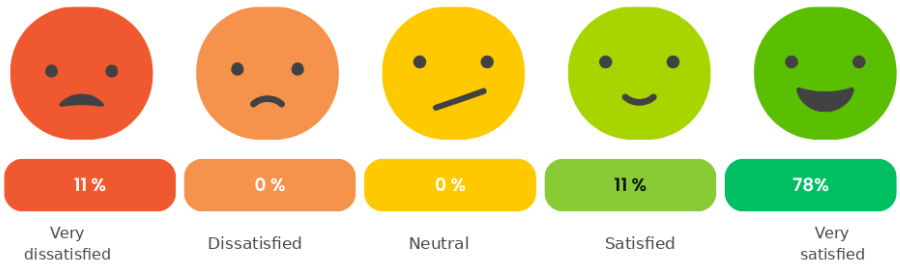


Figure 6. Satisfaction with the use of interactive cards

5. Conclusions

The use of interactive worksheets significantly improved biochemistry students' learning, as it strengthened their understanding of biomolecules (carbohydrates, proteins, lipids, nucleic acids, and vitamins) and enhanced their analytical skills in applying concepts. This

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finding is supported by the results of the Student's t-test, as well as by the students' experiences gathered in the survey.

The survey revealed that students value interactive worksheets as an effective resource for learning biochemistry, since these activities facilitated a meaningful connection with the content, increased motivation, improved class participation, and contributed to more consistent learning, which is reflected in the post-test scores.

The design and implementation of interactive educational platforms like TopWorksheets offers similar benefits to other digital tools, standing out for its accessibility, immediate feedback, personalization, and flexibility. These characteristics make them valuable resources both inside and outside the classroom, fostering meaningful learning through reinforcement activities, gamification, and independent work.

This research contributes to the literature on innovative teaching methodologies by demonstrating that integrating interactive worksheets into digital platforms promotes active learning. It also confirms that their application has a moderate and significant effect on academic performance, thus providing a basis for future research in other areas of science education. However, future research should consider larger populations to strengthen the external validity of these findings.

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Declaration of Authorization-CRediT

LUIS CHONILLO-SISLEMA: estado de la cuestión, concepts relacionados, Escritura-revisión y edición, metodología, validation, análisis de data, elaboración de material didáctico, visualization, redacción- primer borrador, conclusions, revision de ortografía.

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Statement on the use of artificial intelligence

The authors declare that they use the ChatGPT version - model GPT-4 (OpenAI), version from June of 2025, exclusively to support the reformulation and improved language of some of the fragments of the manuscript. It is part of the scientific content, results, analysis or interpretations generated by artificial intelligence. All material has been reviewed and validated by the authors, who are responsible for their accuracy and rigor.

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REVISTA CÁTEDRA

Artificial intelligence and the learning process in Economics students

La inteligencia artificial y el proceso de aprendizaje en estudiantes de Ciencias Económicas

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Abstract

The integration of artificial intelligence (AI) in higher education has generated new opportunities to transform teaching and learning processes through tools that facilitate content personalization, automated feedback, and access to digital educational resources. Despite its increasing incorporation in university settings, there is still limited empirical evidence on its impact on the learning process in Latin American contexts, particularly in areas related to Economics. Therefore, this study aimed to analyze the influence of AI on the learning process of students in the Statistics, Economics, and Finance programs at the Central University of Ecuador, with an emphasis on its relationship to motivation and academic performance. The research was conducted using a quantitative approach, with a non-experimental, cross-sectional design. The population consisted of 243 students enrolled in their second and third semesters, from which a sample of 149 was selected using simple random, stratified proportional sampling. Data was collected using the Study Processes Questionnaire (SPC), composed of 42 items evaluated using a Likert-type scale. The analysis included descriptive statistics and inferential tests such as Student's t-test,

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Pearson correlations, Kendall's Tau-b, and Spearman's rho. The results show that artificial intelligence positively influences academic motivation (M = 3.44; p < .001) and academic performance (M = 2.96; p < .001), while 95.3% of students reported medium or high levels of motivation and perception of educational quality. In conclusion, the pedagogical integration of artificial intelligence-based tools can contribute to strengthening the learning process in higher education.

Keywords

Artificial intelligence, learning process, academic motivation, academic performance, higher education.

Resumen

La integración de la inteligencia artificial (IA) en la educación superior ha generado nuevas oportunidades para transformar los procesos de enseñanza-aprendizaje mediante herramientas que facilitan la personalización de contenidos, la retroalimentación automatizada y el acceso a recursos educativos digitales. A pesar de su creciente incorporación en entornos universitarios, aún existe limitada evidencia empírica sobre su impacto en el proceso de aprendizaje en contextos latinoamericanos, particularmente en áreas vinculadas a las Ciencias Económicas. Por ello, el presente estudio tuvo como objetivo analizar la influencia de la IA en el proceso de aprendizaje de los estudiantes de las carreras de Estadística, Economía y Finanzas de la Universidad Central del Ecuador, con énfasis en su relación con la motivación y el desempeño académico. La investigación se desarrolló bajo un enfoque cuantitativo, con diseño no experimental y corte transversal. La población estuvo conformada por 243 estudiantes matriculados en segundo y tercer semestre, de los cuales se seleccionó una muestra de 149 mediante muestreo aleatorio simple y estratificado proporcional. Para la recolección de datos se aplicó el Cuestionario de Procesos de Estudio (CPE), compuesto por 42 ítems evaluados mediante escala tipo Likert. El análisis incluyó estadísticos descriptivos y pruebas inferenciales como la *t* de Student, correlaciones de *Pearson, Tau-b de Kendall* y *Rho de Spearman.* Los resultados evidencian que la inteligencia artificial influye positivamente en la motivación académica (M = 3.44; p < .001) y en el desempeño académico (M = 2.96; p < .001), mientras que el 95.3 % de los estudiantes reportó niveles medios o altos de motivación y percepción de calidad educativa. En conclusión, la integración pedagógica de herramientas basadas en inteligencia artificial puede contribuir al fortalecimiento del proceso de aprendizaje en la educación superior.

Palabras clave

Inteligencia artificial, proceso de aprendizaje, motivación académica, desempeño académico, educación superior.

1. Introduction

Rapid technological development has significantly transformed the social, economic, and educational spheres, generating the need to rethink traditional teaching models to meet the demands of an increasingly digital society. In this context, AI has acquired a relevant role in contemporary educational processes. According to Suárez-Lima et al. (2025), AI can be understood as "the ability of machines to simulate human cognitive processes such as learning, adaptation, and decision-making" (p. 3), which has allowed its progressive incorporation into various fields of knowledge, including education.

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In the field of higher education, several studies agree on the potential of AI to transform teaching and learning processes. In this regard, Tamayo-Arellano et al. (2024) argue that AI fosters "new forms of interaction between teachers, students, and digital content" (p. 70). These technologies enable the development of more flexible and personalized educational practices, centered on student needs (Gutiérrez-Castillo et al., 2025, p. 194). Additionally, the implementation of intelligent tutors and automatic feedback systems contributes to improving the quality of university learning by offering individualized academic support (Espinoza-Vidaurre et al., 2024, p. 405). Similarly, artificial intelligence plays a significant role in the digital transformation of higher education, highlighting its influence on the redefinition of educational practices and on current debates regarding its integration into learning contexts (García-Peñalvo, 2023).

Other authors also emphasize that the incorporation of adaptive learning systems allows for adjusting content and activities according to each student's pace and characteristics. In this regard, Grijalva-Maigua et al. (2025) point out that these tools "facilitate the construction of dynamic educational environments that promote student autonomy and commitment to their own learning process" (p. 33). In line with this perspective, it is also evident that the use of generative artificial intelligence tools has expanded access to specialized information and fostered the development of analytical skills in areas such as economics, finance, and statistics (Ribas and Provasi, 2024, p. 5).

Several empirical studies conducted in Latin America have also highlighted the importance of strengthening digital competencies in higher education. In this sense, Cabero-Almenara et al. indicate that digital competency frameworks constitute fundamental references for guiding teacher training and performance in university contexts mediated by digital technologies (Cabero-Almenara et al., 2020, p. 20). They also argue that the incorporation of digital technologies into educational processes requires a critical and contextualized pedagogical integration to promote educational innovation (Area and Adell, 2021, p. 85).

However, some authors warn that the incorporation of artificial intelligence into educational processes also poses significant challenges. Torres-Cruz et al. point out that the indiscriminate use of these technologies can generate risks related to technological dependence, a decline in critical thinking, and various ethical dilemmas associated with the use of automated tools in academic contexts (Torres-Cruz et al., 2023, p. 84). From this perspective, it is necessary to critically and contextually analyze the impact of artificial intelligence on university training processes.

Despite the growing number of studies on artificial intelligence in education, significant gaps remain in the scientific literature, particularly in Latin American contexts and, specifically, in the Ecuadorian higher education system. Most studies have been conducted in international contexts or in disciplinary areas other than Economics, which limits the understanding of the impact of these technologies in specific fields of knowledge.

In this regard, studies systematically examining the relationship between the use of artificial intelligence-based tools, academic motivation, and student performance in economics, finance, and statistics programs within the Ecuadorian context are still scarce. Therefore, this study is justified by the need to provide empirical evidence that allows us to understand the role of artificial intelligence in strengthening university learning, contributing to the development of innovative pedagogical practices and the academic debate on the incorporation of emerging technologies in higher education. In this context, the objective of

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this study is to analyze the influence of artificial intelligence on the learning process of students in the Statistics, Economics, and Finance programs at the Central University of Ecuador, with an emphasis on its impact on motivation and academic performance.

Regarding the article's structure, Section 2 presents the research methodology. Section 3 presents the results regarding the influence of AI on motivation and academic performance. Section 4 presents the discussion based on the results obtained. Subsequently, in section 5, the conclusions of the study and its main implications of AI in the student learning process are presented.

2. Analysis and Results

This study was conducted using a quantitative approach, with a non-experimental, cross-sectional design, considering that this type of methodology allows for the analysis of relationships between variables without direct manipulation and at a single point in time. This approach is suitable for examining educational phenomena through the measurement and statistical analysis of observable variables. Recent research on the incorporation of artificial intelligence in higher education has employed similar methodologies to analyze the relationship between variables linked to university learning. In this regard, Espinoza-Vidaurre et al. (2024) point out that "the incorporation of artificial intelligence tools in the university setting allows for the analysis of various factors that influence the efficiency of students' academic performance" (p. 402). Similarly, Grijalva-Maigua et al. (2025) maintain that "artificial intelligence has become a key element for understanding the new dynamics of learning in higher education" (p. 31), which has motivated the development of quantitative research aimed at identifying associations between educational variables without directly intervening in the learning process. In accordance with this approach, the study focused on examining the relationship between the pedagogical integration of artificial intelligence-based tools and variables linked to the learning process in university students, particularly motivation and perceived academic performance.

Data was collected using the Study Processes Questionnaire (SPC), an instrument based on the learning approaches theory proposed by John B. Biggs. According to Biggs, learning is shaped by the relationship between students' motivations and the cognitive strategies they use to process information and achieve academic goals (Biggs, 1987, p. 12). This theory primarily distinguishes three approaches: surface, deep, and achievement. This perspective is consistent with contemporary research that highlights motivation and learning approaches as relevant variables in understanding educational processes mediated by digital technologies. Along these lines, Bermúdez et al. (2025) state that "teaching strategies supported by artificial intelligence allow for the creation of personalized learning experiences that strengthen students' motivation and academic engagement" (p. 6829). Likewise, studies on virtual assistants and intelligent tools in higher education have emphasized that motivation is a relevant factor in students' interaction with educational technologies. Jardón et al. (2024) point out that "virtual assistants based on artificial intelligence can improve academic performance when students demonstrate a positive attitude and motivation toward using these tools" (p. 14). The CPE, composed of 42 items evaluated using a Likert-type scale, allowed for the measurement of these dimensions from a theoretical and empirical perspective consistent with the study's objectives.

The population consisted of 243 students enrolled in the second and third semesters of the Statistics, Economics, and Finance programs at the Central University of Ecuador. The selection of these academic levels responded to the need to work with a relatively

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homogeneous group in terms of academic progress, reducing the variability associated with differences in prior education. To ensure representativeness, a simple random sampling combined with proportional stratified sampling was applied, obtaining a sample of 149 students (68 from the second semester and 81 from the third), which allowed a balanced distribution according to the academic level.

Data collection was carried out using the Google Forms platform, facilitating data systematization in a digital environment consistent with the study's objective. Statistical processing was performed using IBM SPSS Statistics version 29.0, establishing a significance level of 5% for hypothesis validation. The analysis included descriptive statistics (frequencies, means, and standard deviations) and inferential tests such as the one-sample Student's t-test, Pearson correlations, and non-parametric tests (Kendall's tau-b and Spearman's rho), with the purpose of identifying statistically significant associations between the analyzed variables. This type of statistical procedure has been used in research examining the relationship between educational technologies and learning variables in higher education. In this regard, Tamayo-Arellano et al. (2024) point out that "the application of statistical analysis allows us to evaluate the relationship between the use of artificial intelligence tools and various university learning processes" (p. 86). Similarly, Suárez-Lima et al. (2025) highlight that “the analysis of educational data using statistical techniques facilitates understanding how artificial intelligence can contribute to personalized learning” (p. 16). Given the non-experimental, cross-sectional design adopted, the study's results allow for the identification of relationships or associations between the analyzed variables within the research context. Therefore, their interpretation is limited to describing statistical patterns without establishing direct causal relationships.

Regarding ethical considerations, student participation was voluntary, and respect for the principles of confidentiality and protection of personal information was guaranteed. Before answering the questionnaire, participants were informed about the study's objectives, the academic use of the data, and their right not to participate or to withdraw from the process at any time. This procedure constituted informed consent for their participation. The instrument was administered via a digital form on the Google Forms platform, which requested basic identification information for participation control and sample verification purposes. However, during the statistical analysis process, personal data were coded and anonymized, eliminating any element that could identify the participants. In this way, the information was processed only in aggregate form and used exclusively for academic and scientific purposes, guaranteeing the confidentiality of the students and the responsible handling of the collected data.

3. Analysis and Results

Through the analysis of the tables and figures shown below, the behavior of the study unit will be observed in order to gain a better understanding of the characteristics identified in the research. Table 1 shows that the majority of surveyed students come from the Finance program (59.7%), followed by the Statistics program (24.2%) and the Economics program (16.1%). This distribution was relevant because the application and perception of AI can vary slightly among these disciplines within Economic Sciences. Furthermore, the sample distribution for this academic unit is concentrated in the area related to the social sciences (75.8%), while the applied statistics area represents 24.2% of the sample.

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Career	Frequency	Percentage	Cumulative Percentage
Economics	24	16.1 %	16.1 %
Finance	89	59.7 %	75.8 %
Statistics	36	24.2 %	100.0 %
Total	**149**	**100.0 %**	

Table 1. Distribution of students according to their field of study

According to Table 2, there is an equitable distribution between second- and third-semester students, with percentages of 45.6% and 54.4%, respectively. This distribution by academic level was intentional, allowing for control of variability in university experience and familiarity with the content of Economics. By concentrating the sample in these intermediate semesters, it was ensured that participants had a similar knowledge base, which is crucial for more accurately evaluating the influence of AI on their learning process, preventing differences in their level of academic progress from being a distorting factor.

Semester	Frequency	Percentage	Cumulative Percentage
Second semester	68	45.6 %	45.6 %
Third semester	81	54.4 %	100.0 %
Total	**149**	**100.0 %**	

Table 2. Distribution of students by semester

Table 3 shows the equitable gender distribution, with 51.0% women and 49.0% men in the total sample. This distribution ensured that the study results were not biased by gender, allowing us to infer the impact of AI on the learning process from a balanced perspective. Furthermore, this distribution ensured the external validity of the findings, as the sample reflects gender diversity, strengthening the generalizability of the conclusions.

Semester	Frequency	Men	Women	Percentage
Second semester	68	33	35	51.0 %
Third semester	81	40	41	49.0 %
Total	**149**			**100.0 %**

Table 3. Distribution of students by sex

Analysis of Table 4 reveals that the majority of surveyed students are between 18 and 21 years old, representing 73.2%. This concentration at early stages of university life is consistent with the second- and third-semester student population, resulting in a sample composed primarily of students who are actively engaged in their studies and have grown up in an increasingly digital environment.

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Age range	Frequency	Percentage	Cumulative Percentage
Between 18 and 19 years old	35	23.5%	23.5%
Between 20 and 21 years old	74	49.7%	73.2%
Between 22 and 23 years old	26	17.4%	90.6%
Between 24 and 25 years old	7	4.7%	95.3%
Over 25 years old	7	4.7%	100.0%
Total	**149**	**100.0%**	

Table 4. Distribution of students according to age range

To analyze the variables associated with the learning process in the context of using artificial intelligence-based tools, the following statistical hypotheses were proposed: H_0: there are no statistically significant differences in the variables of motivation and academic performance in the studied population; H_1: there are statistically significant differences in the variables of motivation and academic performance in the studied population. In this regard, the results of the Student's t-test for a single sample, presented in Table 5, indicate that the evaluated variables show levels of statistical significance ($p < .001$). The Motivation variable registered the highest mean ($M = 3.439$) and a t-value of 64.332, with $p < .001$, which demonstrates a statistically significant difference with respect to the reference value considered in the analysis. Similarly, the Academic Performance variable presented a mean of $M = 2.958$ and a t-value of 45.753, with $p < .001$. These results allow us to identify statistically significant differences in the analyzed variables within the studied population. Consequently, the null hypothesis (H_0) is rejected, and the alternative hypothesis (H_1) is accepted.

Motivation for learning is primarily distributed at intermediate levels, corresponding to categories 3 (Medium) and 4 (High), with level 3 being the most frequent among the surveyed students. Furthermore, the proportion of students at the lowest motivation levels (levels 1 and 2) is small, indicating a limited presence of demotivation in the analyzed population. However, the low representation at the highest motivation levels (levels 5 and 6) suggests that there is still room to strengthen this aspect within the learning process. Overall, approximately 90% of the students are concentrated at motivation levels 3 and 4, demonstrating a predominant trend toward medium and relatively high levels of academic motivation in the analyzed context. These results allow us to describe a favorable pattern of student motivation in the studied population within the considered educational context.

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Variable	T	Gl	p (bilateral)	Media	IC 95% Inferior	IC 95% Superior
Career	40.211	148	< .001	2.081	1.980	2.180
CPE_P1	30.025	148	< .001	2.745	2.560	2.930
Motivation	64-.332	148	< .001	3.439	3.333	3.545
Performance	45.753	148	< .001	2.958	2.830	3.086
TICS_P1	56.869	148	< .001	1.054	1.020	1.090

Table 5. Distribution of students by age range. Source: Study Process Questionnaire (SPQ), question (Q1), Information and Communication Technology (ICT), question 1 (Q1).

Pearson's correlation (Table 6) was used to demonstrate the linear relationship between the technological and academic domains. The results showed no statistically significant linear relationships between the evaluated factors (academic motivation, technological access, and academic performance); all p-values were greater than .05 (the correlation between subject choice based on personal satisfaction or market interest and academic performance was r = .086, p = .299). This suggests that access to technological tools alone does not directly modify the learning process. The alternative hypothesis is partially accepted, indicating that the quality of technology use and its pedagogical integration with AI are more significant than mere possession of the technology.

Variable	1	2	3
1. Choice of subjects based on personal satisfaction or market interest	1.000	.001	.086
2. Has a computer at home	.001	1.000	.126
3. Academic performance	.086	.126	1.000
Sig. (bilateral)	—	.990	.299
		—	.125

Table 6. Pearson correlation between motivation, technological access and academic performance in Economics students

Note: Pearson correlation (two-tailed) relationship between variables. No statistically significant correlations were found (p > .05). N = 149 for the variables.

The results of the one-sample t-test on the influence of AI on motivation (Table 7) showed statistically significant differences with respect to the zero reference value (p < .001). Specifically, "motivation for pedagogical use" had a mean of M = 3.47 and "Pedagogical impact of AI" a mean of M = 3.32. These findings, along with the perception of the quality of education received (where 74% of students reported a high or very high perception), allow us to accept the alternative hypothesis (Hi). It is confirmed that AI positively influences the pedagogical dimension, improving motivation, resource use, and the overall perception of educational quality.

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Variable	*T*	*p* (bilateral)	Media
Pedagogical Impact of AI	24.38	< .001	3.32
Use of Pedagogical Tools	21.57	< .001	2.98
Motivation for Pedagogical Use	26.14	< .001	3.47
Improvement in Academic Performance	22.05	< .001	3.11
Variable	*T*	*p* (bilateral)	Media

Table 7. Influence of AI on motivation for pedagogical use: test results t

Note: One-sample t-test.

The results in Table 8 showed no statistically significant links between motivation for subject selection and academic performance ($\tau = .072$; $p = .259$), nor between the presence of a computer at home and academic performance ($\tau = .096$; $p = .169$). This suggests that instrumental access to technology alone does not have a direct influence. However, a previous multivariate study showed that motivation does explain a significant percentage of academic performance (adjusted $R^2 = 0.327$; $p < .001$), indicating a more complex and mediated impact: AI, by increasing motivation, may have an indirect impact on academic performance.

Variable	1	2	3
1. Choice of subjects based on personal satisfaction or market interest	1.000	–.007	.072
2. Has a computer at home	–.007	1.000	.096
3. Academic performance	.072	.096	1.000
Sig. (bilateral)	—	.924	.259
		—	.169

Table 8. Kendall's Tau-b correlations on the instrumental influence of AI on motivation, technological access, and academic performance

Note: Ordinal and non-parametric variables.

The Spearman's rho statistic shown in Table 9 determined that the correlation between motivation in subject selection, the presence of a computer at home, and academic performance was not statistically significant (Motivation/Performance ρ=.090, p=.272; Computer/Performance ρ=.113, p=.170). This reinforces the idea that neither simple motivation nor access to technology directly influences performance. However, the multivariate analysis showed that motivation plays a crucial role in the impact of AI on academic performance, confirming that AI significantly increases student engagement and motivation, which in turn contributes to improved academic performance.

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Variable	1	2	3
1. Choice of subjects based on personal satisfaction or market interest	1.000	–.008	.090
2. Has a computer at home	–.008	1.000	.113
3. Academic performance	.090	.113	1.000
Sig. (bilateral)	—	.924	.272
		—	.170

Table 9. Spearman correlations on the influence of AI on the cognitive dimension

Note: Ordinal variables and ranks.

Artificial intelligence has a positive impact on the learning process of Economics students at the Central University of Ecuador. The high t-values and $p < .001$, such as those for motivation ($t = 64.33$; $M = 3.44$), academic performance ($t = 45.75$; $M = 2.96$), and pedagogical perception of Artificial Intelligence ($t = 24.38$; $M = 3.32$), indicate that students perceive the use of AI as effective in their studies. Furthermore, 95.3% of survey participants showed medium or above-average levels in motivation and educational quality, while 88.6% scored between levels 3 and 5 in self-assessed academic performance. Thus, the impact of Artificial Intelligence is genuine, positive, and statistically significant

4. Discussion

The main finding of this study demonstrates that artificial intelligence has a positive impact on the teaching and learning process of Economics students, particularly on academic motivation and perception of academic performance. This result confirms the hypothesis and shows that the pedagogical integration of AI-based tools is a relevant factor in strengthening academic performance in higher education. These results are consistent with recent research. In this regard, Suárez-Lima et al. point out that artificial intelligence allows for the optimization of learning processes through adaptive and personalized pedagogical strategies (Suárez-Lima et al., 2025, p. 14). Similarly, other authors highlight that the development of digital competencies in university professors favors the implementation of methodological strategies aligned with the demands of digital learning environments (Cabero-Almenara et al., 2020, p. 28).

The interpretation of the results shows that artificial intelligence does not act solely as a technological resource, but as a pedagogical mediator that directly impacts students' motivation, autonomy, and active participation in their learning process. In this sense, Galván-Fernández (2024) argues that “artificial intelligence should be understood from its educable dimension, that is, as a tool capable of integrating into pedagogical processes and contributing to the student's critical development” (p. 1). The significant relationship identified between motivation and academic performance reinforces the importance of motivational factors in the construction of learning. Tarira-Caice et al. (2018) point out that “motivation is an essential element in the student learning process, as it directly influences their interest in and commitment to academic activities” (p. 170). Similarly, Martín-Cruz et al. (2009) highlight that “intrinsic motivation favors the transmission and construction of knowledge by encouraging the active participation of individuals in the learning process” (p. 193).

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In this context, the integration of artificial intelligence in university environments fosters the development of more personalized and meaningful learning experiences. Ludeña-Yaguana et al. (2025) demonstrate that "personalized pedagogy supported by artificial intelligence contributes to strengthening motivation and improving students' academic performance" (p. 231). Likewise, Suárez-Lima et al. (2025) indicate that AI-mediated personalized learning allows for adapting content to the individual needs of students, increasing their academic engagement (Suárez-Lima et al., 2025, p. 16). Additionally, Jardón et al. (2024) report that "virtual assistants based on artificial intelligence generate improvements in academic performance and in the perception of the quality of university learning" (p. 15).

However, several authors warn that the pedagogical impact of artificial intelligence depends largely on the motivation and preparation of the teaching staff. Franco (2023) argues that "the incorporation of artificial intelligence in education requires teachers prepared to integrate these technologies from a pedagogical perspective and not solely a technological one" (p. 2). Similarly, Galván-Fernández (2024) emphasizes that AI should be understood as an integrating component of the educational process and not as a merely instrumental resource (Galván-Fernández, 2024, p. 2). Ludeña-Yaguana et al. (2025) underscore that the planned use of artificial intelligence-based technologies enhances both student motivation and academic performance when there is conscious and contextualized didactic mediation (Ludeña-Yaguana et al., 2025, p. 236).

Compared to recent literature, the findings of this study align with research indicating that AI significantly contributes to student motivation and improved academic performance when strategically integrated into the educational process. Franco (2023) states that "contemporary education must move towards a critical understanding of artificial intelligence as part of the digital educational ecosystem" (p. 1). In this sense, the results expand upon these contributions by demonstrating that, while the perception of AI is positive, structural limitations still persist that restrict its full utilization, particularly regarding teacher training and curriculum adaptation.

The relevance of these findings lies in their contribution to the current debate on the role of AI in higher education, especially in fields related to Economics, where automation and data analysis are increasingly in demand. In this regard, Tarira-Caice et al. emphasize that academic motivation is a determining factor for effective learning (Tarira-Caice et al., 2018, p. 172). Similarly, it is highlighted that the interaction between intrinsic and extrinsic motivation influences knowledge construction (Martín Cruz et al., 2009, p. 195). In this context, artificial intelligence can be understood as a resource that enhances these motivational processes by fostering more dynamic and interactive learning experiences. Likewise, it is argued that the critical integration of emerging technologies allows for the articulation of technological innovation with human development in the educational field (Galván-Fernández, 2024, p. 2). In accordance with the above, personalized pedagogy mediated by artificial intelligence promotes motivation and academic performance in university students (Ludeña-Yaguana et al., 2025, p. 238). Similarly, it is noted that virtual assistants can improve the perception of the learning process when they are appropriately integrated into the pedagogical design (Jardón et al., 2024, p. 18).

However, it is necessary to acknowledge certain limitations of the study. First, the research was conducted at a single higher education institution, which could limit the generalizability of the results to other academic contexts. Furthermore, the use of instruments based on

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student perceptions may have introduced subjective biases. These limitations could be addressed in future research through longitudinal designs, larger samples, and the incorporation of mixed methods approaches that allow for contrasting perceptions with objective indicators of academic performance. In this regard, the importance of expanding empirical research on artificial intelligence in education to understand its effects in different academic contexts is highlighted (Ludeña-Yaguana et al., 2025, p. 240). It is also noted that the development of new research will strengthen the pedagogical integration of AI in educational systems (Franco, 2023, p. 3).

From both a practical and theoretical perspective, the results of this study suggest the need to strengthen institutional policies focused on teacher training in digital competencies and curriculum updates in line with advances in AI. In this regard, Galván-Fernández (2024) emphasizes that the incorporation of emerging technologies in education must respond to a comprehensive pedagogical approach (Galván-Fernández, 2024, p. 2). Similarly, Jardón et al. (2024) highlight that the effectiveness of intelligent systems in education depends on their planned integration into instructional design and teaching strategies (Jardón et al., 2024, p. 20).

In summary, this study demonstrates that artificial intelligence constitutes a strategic resource for improving the motivation and academic performance of Economics students, provided that its implementation is accompanied by adequate pedagogical and curricular training. These results coincide with recent research. In this sense, Ludeña-Yaguana et al. (2025) demonstrate the potential of AI to strengthen educational processes when it is critically and contextually integrated into teaching practice (Ludeña-Yaguana et al., 2025, p. 241).

5. Conclusions

The results of this study identify a statistically significant relationship between the use of artificial intelligence-based tools and variables associated with the learning process of students majoring in Statistics, Economics, and Finance at the Central University of Ecuador. Specifically, a positive trend was observed in academic motivation levels and in the perception of student performance within the analyzed context. These findings suggest that the incorporation of artificial intelligence tools can be a valuable resource within university educational environments, facilitating more flexible learning dynamics that align with current technological demands.

From an educational perspective, the results highlight the importance of considering artificial intelligence as a complementary element in training processes, especially in areas related to data analysis, statistics, and economics, where digital tools can support the development of analytical and problem-solving skills. However, due to the non-experimental, cross-sectional design of the study, the findings should be interpreted in terms of observed associations within the investigated context, without establishing direct causal relationships.

Based on the above, it is recommended to promote pedagogical strategies that integrate the use of artificial intelligence tools in the classroom in a planned manner, aimed at strengthening student motivation and fostering more personalized learning experiences. Likewise, it is pertinent to promote teacher training programs focused on the pedagogical use of artificial intelligence-based technologies, so that teachers can critically and effectively incorporate these tools into their educational practices.

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Similarly, it is suggested that the curriculum in Economics-related fields be updated to incorporate digital competencies and the use of artificial intelligence tools applied to information analysis and decision-making. Finally, it is recommended that future research with longitudinal or experimental designs be developed to further analyze the relationship between artificial intelligence and university learning, expanding the sample size and considering other educational variables that may influence the learning process.

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Declaration of authorship-CRediT

SANTIAGO VINUEZA-VINUEZA: State of the art, related concepts, methodology, validation, data analysis, writing – first draft.

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Statement on the use of artificial intelligence

The authors declare that they did not use Artificial Intelligence (AI) tools for any part of the manuscript. All material was reviewed and validated by the authors, who are responsible for its accuracy and rigor.

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REVISTA CÁTEDRA

Relevance of Codes of Coexistence in the Face of Systematic Violence and the Narco-State in Ecuador: An Exploratory-Descriptive Study

Pertinencia de los códigos de convivencia ante la violencia sistemática y el narcoestado en Ecuador: un estudio exploratorio-descriptivo

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Abstract

This study analyzes the impact of the guidelines of the Organic Law of Intercultural Education (LOEI) on the creation of safe environments within Ecuador, a country characterized by systematic violence and its status as a narco-state. Through descriptive research with a qualitative approach, the study examines the gap between legal regulations and the reality on the ground. It contrasts the regulatory framework of the LOEI and the 2008 Constitution with the security crisis stemming from the infiltration of transnational organized crime. Preliminary findings from this exploratory phase indicate that, while the LOEI seeks to guarantee the right to education, current codes of conduct lack tactical protocols for addressing criminal co-optation, thus requiring an update in the crisis management skills of teaching staff. The results suggest that current regulations exhibit a tactical disconnect with the "narco-state" environment, necessitating a reform that prioritizes human security and institutional resilience over administrative formality. Consequently, there is a need to strengthen prevention, comprehensive protection and

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educational response to scenarios of threat, violence and community vulnerability, with a territorial and inter-institutional approach.

Keywords
Coexistence, exploratory research, LOEI, narco-state, violence.

Resumen
Este estudio analiza la incidencia de los lineamientos de la Ley Orgánica de Educación Intercultural (LOEI) en la creación de entornos seguros dentro de un Ecuador caracterizado por la violencia sistemática y su configuración como narcoestado. A través de una investigación de nivel descriptivo con enfoque cualitativo, se examina la brecha entre la normativa legal y la realidad territorial. El estudio contrasta el marco normativo de la LOEI y la Constitución de 2008 con la crisis de seguridad derivada de la infiltración del crimen organizado transnacional. Los hallazgos preliminares de esta fase exploratoria indican que, si bien la LOEI busca garantizar el derecho a la educación, los códigos de convivencia vigentes carecen de protocolos tácticos para enfrentar la cooptación criminal, demandando una actualización en las competencias de gestión de crisis del personal docente. Los resultados encontrados sugieren que la normativa vigente presenta una desconexión táctica con el entorno de "narcoestado", lo mencionado exige una reforma que priorice la seguridad humana y la resiliencia institucional sobre la formalidad administrativa. En consecuencia, se plantea la necesidad de fortalecer la prevención, la protección integral y la respuesta educativa frente a escenarios de amenaza, violencia y vulnerabilidad comunitaria, con enfoque territorial e interinstitucional.

Palabras clave
Convivencia, investigación exploratoria, LOEI, narcoestado, violencia

1. Introduction
Contemporary education in Ecuador not only faces the challenge of pedagogical innovation and bridging the digital divide, but is also immersed in an unprecedented security crisis. According to Olivo and Corrales, new educational needs emerge directly from the transformations that society is undergoing and represent one of the great challenges of the 21st century. These demands develop in a context marked by uncertainty and ungovernability, conditions that manifest themselves in both the central government and local governments (Olivo and Corrales, 2020). In this scenario, the teacher, as a key player in the educational community, must transition from being a mere instructor to a guide capable of building bridges between the student's intuitive reality and institutional security.

Ecuador, historically recognized as a country of relative stability in the Latin American context, has, according to the World Bank, risen to the top of the region's crime statistics, with homicide rates exceeding 40 per 100,000 inhabitants by 2023 (World Bank, 2026). This indicator positions the country as one of the most violent environments in South America, based on comparative data. This acceleration of violence is neither a spontaneous nor an isolated phenomenon; on the contrary, it reflects one of the most dramatic structural

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transformations in its recent history, the result of a convergence of institutional, economic, and geopolitical factors that developed over decades.

One of the most significant changes, though scarcely visible in public debate, is the transformation of Ecuador's role within the international drug trafficking chain. The country has ceased to be merely a transit corridor—an operational function that predominated for much of the 20th and early 21st centuries—and has progressively consolidated itself as a strategic center for the collection, logistical processing, and large-scale shipment of controlled substances, primarily to European and North American markets (Masson-Fiallos, 2024). This shift in the global criminal ecosystem has had devastating consequences for the institutional fabric, community dynamics, and, in particular, for the normative systems that regulate school coexistence.

Given this scenario, the central question guiding this study addresses an area frequently overlooked by actors in the educational and legal systems: How are codes of conduct relevant instruments for responding to, preventing, or mitigating the manifestations of violence that has ceased to be merely interpersonal or community-based, becoming instead a reflection of criminal structures capable of co-opting state institutions themselves? The working hypothesis argues that, in their current formulation, these codes present a profound structural gap in the face of the scale, nature, and scope of the violence that characterizes contemporary Ecuador.

The educational reality of Ecuador in 2026 unfolds within a complex scenario of unconventional internal conflict. While the State guarantees in Article 26 of the Constitution that education is a fundamental right throughout life and an unavoidable and inexcusable duty of public authorities, the factual dimension shows a progressive erosion of this guarantee due to the presence and interference of organized crime groups (OCGs). The Organic Law of Intercultural Education (LOEI), 2011, in its purpose of promoting a "culture of peace," establishes codes of conduct as the central axis for school harmony. However, this exploratory study posits that these codes have lost practical validity and operational capacity in the face of the surrounding systematic violence.

While the Constitution of the Republic and the Organic Law of Intercultural Education (LOEI) mandate the creation of spaces for peace, the ordinary development of subjects using traditional methodologies is recurrently interrupted by criminal dynamics that permeate the boundaries of educational institutions. To support this analysis, the article draws on local academic production generated in reference centers such as FLACSO Ecuador, the Institute of Higher National Studies (IAEN), and the Eloy Alfaro Lay University of Manabí (ULEAM); on regional and international perspectives from the College of Michoacán (COLMICH) and the Center for Research and Higher Studies in Social Anthropology (CIESAS); and on normative sources such as the Constitution of the Republic, the Comprehensive Organic Criminal Code (COIP), and current educational legislation. The review is complemented by an examination of journalistic coverage from local media outlets such as El Comercio and television channels, as well as specialized reports from

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international organizations, including the Inter-American Commission on Human Rights (IACHR).

Regarding its structure, the study addresses the national security crisis, focusing on institutional vulnerability to drug trafficking and the impact of youth assassinations in classrooms. A qualitative and exploratory methodology is presented, including bibliographic analysis and source triangulation. The results examine the disconnect between the regulations of the Organic Law of Intercultural Education (LOEI) and the dynamics of criminal co-optation. Finally, guidelines are proposed for updating teacher competencies and reformulating codes of conduct from a human security perspective.

1.1 Interpretive perspectives

An analysis of violence trends in Ecuador between 2020 and 2024 reveals an exponential increase in critical indicators: homicides, extortion, kidnappings, femicides, and deaths linked to organized crime (Barrionuevo-Santamaría et al., 2024). In their contributions to the journal Dominio de las Ciencias, they document how drug trafficking acts as a catalyst for social destabilization, fracturing entire community structures, among which educational institutions suffer a fundamental impact.

For their part, Pontón-Cevallos and Rivera-Velez propose five interpretive perspectives to approach the increase in violence in the country: intra-organizational criminal conflict, the war on drugs and its unintended consequences, the formation of criminal ecosystems, the capture of public institutions, and the geopolitical dimension of transnational drug trafficking (Pontón-Cevallos and Rivera-Velez, 2024). None of these variables can be analyzed in isolation; their interrelation produces systemic violence that completely overwhelms conventional instruments of social management and mediation.

The multifactorial nature of the Ecuadorian crisis has been underscored by numerous researchers. Tenemaza-Ponce et al. demonstrate how violence impacts social development in differentiated ways, affecting women, youth, and communities in conditions of extreme vulnerability with particular severity. Gender-based violence, far from being an isolated phenomenon, is intertwined with the logic of organized crime, which instrumentalizes it as a mechanism for territorial control and social discipline (Tenemaza-Ponce et al., 2025). This demonstrates that the phenomenon cannot be interpreted solely from a traditional criminal or public security perspective, but rather demands comprehensive approaches that incorporate educational, community, and human rights dimensions. In this context, institutional weakness becomes both a cause and a consequence of the spiral of crime. As Pontón-Cevallos and Rivera-Veléz point out, the State's inability to guarantee the legitimate monopoly on force, administer justice effectively, and provide equitable conditions for social development has created a governance vacuum that criminal groups exploit with remarkable efficiency (Pontón-Cevallos and Rivera-Veléz, 2024). This vacuum is not only operational but also normative, directly affecting the legitimacy and effectiveness of micro-institutional instruments such as codes of conduct.

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1.2 The narco-state: criminal penetration and institutional weakness

The concept of a narco-state, while controversial in political science and public debate, is operationally useful for describing the process of partial capture of state institutions by criminal organizations. In the Ecuadorian context, Masson-Fiallos accurately describes how drug trafficking operates as an ecosystem with a high capacity for adaptation, branching out, and co-opting officials at various levels of public administration: from judicial and police officers to local authorities and legislators (Masson-Fiallos, 2024). This infiltration occurs not only through mechanisms of direct economic corruption but also through the use of armed violence as an instrument of institutional coercion, which is critically reflected in the presence of recruiters of minors for organized crime groups both inside and outside of school environments.

Several authors, from a historical and comparative perspective that articulates the experiences of Mexico and Ecuador, analyze how neoliberal economic dynamics and drug trafficking have converged to produce profound transformations in Latin American organized crime (Maldonado-Aranda and Vera-Cabrera, 2025). In their analysis published in the journal Iuris, they argue that the criminal crisis in Ecuador is linked to state restructuring processes that weakened the regulatory capacities of the public sector, reduced social investment, and worsened the living conditions of large segments of the population. These variables created the objective conditions for the expansion of organized crime, transforming it into a breeding ground that exploits the lack of development opportunities to recruit young people into organized crime groups. Similarly, Barrionuevo-Santamaría et al. identify institutional weakness as one of the determining factors in the cycle of violence. This fragility manifests itself in the erosion of public trust in institutions, the collapse of the prison system, and the widespread perception of impunity (Barrionuevo-Santamaría et al., 2024). The National Assembly of Ecuador, in its investigation of the prison crisis, documented how the various branches of government failed to prevent and resolve the security emergency, revealing an institutional paralysis of historic proportions (National Assembly of Ecuador, 2021, 223).

1.3 Codes of coexistence: a regulatory framework in the face of the crisis

Codes of conduct were conceived in the Ecuadorian education system as participatory instruments designed to regulate interpersonal relationships within the school community, promote the peaceful resolution of conflicts, and guarantee a violence-free learning environment. Their legal basis lies in the General Regulations to the Organic Law of Intercultural Education, which mandates their design, implementation, and evaluation in all institutions nationwide. In theory, these instruments should be developed democratically with the educational community and reviewed periodically to address specific local contexts.

However, an examination of contemporary reality reveals a structural gap between the purely normative design of codes of conduct and the scale of violence facing the country. These instruments were designed to address low-intensity conflicts inherent in ordinary school dynamics: bullying, indiscipline, peer tensions, or non-compliance with rules that affect the right to education. Its original conceptual architecture does not consider scenarios

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in which the school environment is permeated by the logic of organized crime, the recruitment of minors by drug trafficking networks, or the presence of weapons in educational spaces as an extension of external territorial disputes.

Maldonado-Aranda and Vera-Cabrera offer a structured critique of state responses to the explosion of violence, pointing out that the ineffectiveness of policies based exclusively on punitive populism and a "tough on crime" approach lies in their failure to address the structural causes of the problem (Maldonado-Aranda and Vera-Cabrera, 2025). This same logic is applied, on a micro scale, to codes of conduct when implemented in contexts of systematic violence without genuine adaptation to such hostility; they end up being reduced to formal tools lacking the effective capacity for transformation or protection.

It is important, however, to distinguish between absolute ineffectiveness and contextual inadequacy. Codes of conduct are not inherently sterile; If reformulated and integrated with macro-level policies for social protection, crime prevention, and psychosocial support, these regulations can constitute a valuable component of a comprehensive institutional strategy. According to Maldonado-Aranda and Vera-Cabrera, the academic discussion should not focus on their elimination, but rather on evaluating whether their current design is relevant to contemporary Ecuador. Thus, school coexistence regulations cannot operate as if the violence occurring within schools were the same as it was twenty years ago. Reality has changed radically, and regulatory instruments must be updated accordingly (Maldonado-Aranda and Vera-Cabrera 2025).

1.4 Youth contract killings and violence in educational settings as manifestations of the crisis

Youth contract killings constitute one of the most critical manifestations of organized crime's penetration into Ecuadorian society. Baquerizo-Balladares, in a systematic review of the phenomenon, documents how children and adolescents are recruited, exploited, and discarded by criminal organizations that take advantage of social exclusion by offering financial rewards which, in marginalized contexts, are presented as a survival alternative in the face of a lack of opportunities (Baquerizo-Balladares, 2025). This phenomenon cannot be understood without considering its structural roots: economic insecurity, territorial segregation, school dropout rates, and the collapse of traditional references to legitimate authority.

For their part, Sabando-Ordóñez and Cruz-Marte, in their analysis of predictors of violence in Ecuador published in the journal Aula 24, identify the relationship between adolescents involved in micro-trafficking and the impact of the historical application of consumption threshold tables as a specific criminogenic factor. This tool, originally introduced to distinguish between consumption and commercialization, has in practice created areas of regulatory ambiguity that criminal networks have exploited to operate at the lowest levels of the distribution chain, employing minors under the assumption of less severe penalties (Sabando-Ordóñez and Cruz-Marte, 2024).

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Likewise, gender-based violence takes on complex characteristics in this context. Tenemaza-Ponce et al. document how criminal networks instrumentalize aggression against women as a mechanism for territorial control and community subjugation (Tenemaza-Ponce et al., 2025). Female students and mothers living in areas under criminal control become trapped in dynamics of violence that conventional codes of conduct, designed strictly for the school perimeter, are unable to contain or intervene in, requiring differentiated, intersectoral responses.

1.5 Relevant Regulations and Legislation

Analyzing the relevance of codes of conduct requires a review of the legal framework that underpins them. Ecuador has a legal framework that, in theory, offers broad protections in the areas of human rights, education, and violence prevention. However, the gap between the written law and its effective application is one of the most pressing institutional concerns.

The following section systematizes the normative hierarchy that governs and defines the formulation of these instruments within the national education system:

1. **Constitution of the Republic (2008**): Supreme law that establishes in Article 26 education as a fundamental, inalienable, and non-excusable right of the State, prioritizing the best interests of the child and the principle of shared social responsibility
2. **Organic Law of Intercultural Education (LOEI):** Specific regulatory framework that defines the structure of the education system, promotes the principles of a Culture of Peace, and mandates Codes of Conduct as mechanisms for institutional self-regulation.
3. **Comprehensive Organic Criminal Code (COIP**): State punitive instrument that defines criminal conduct, micro-trafficking, and hate crimes or acts of violence that may occur within the school environment, delineating the boundaries between administrative sanctions and criminal proceedings.
4. **Guidelines of the Ministry of Education:** Technical and methodological guidelines issued by the national education authority to guide the development, dissemination, and formal validation of codes of conduct in the circuits and districts.

Having considered this brief systematization of current regulations, it is crucial to note that legislative proliferation does not, in itself, guarantee the effectiveness of the law. Ecuador possesses a robust legal framework on paper; however, the capacity for implementation and punitive enforcement of these regulations is hampered by institutional weakness and pressures from the criminal environment (Maldonado-Aranda and Vera-Cabrera, 2025). Codes of conduct operate within this same precarious ecosystem, which structurally limits their capacity for real impact.

1.6 Journalistic evidence and press reports

Journalistic coverage of the security crisis in Ecuador has been extensive. The media has played a fundamental role in making the magnitude of the phenomenon visible to the public,

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providing factual data that complements academic analysis and allows for tracing the crisis's evolution over time. In September 2023, the newspaper El Comercio reported the dismantling of infrastructure for processing illicit substances in border areas, demonstrating Ecuador's qualitative leap within the international drug trafficking logistics chain (El Comercio, September 23, 2023). This same publication historically documented the institutional optimization processes of 2018, which involved the reduction or merger of state entities linked to security and justice coordination—a factor that analysts associate with the progressive weakening of territorial governance and its subsequent repercussions in school communities (El Comercio, 2018).

On the other hand, the Ecuavisa network, through its news program Televistazo, reported in March 2024 specific statistical variations in violent death rates during the first months of the year, presented within the context of the declaration of a state of emergency and the government's emergency measures (Ecuavisa, March 1, 2024). However, the specialists consulted for that report emphasized that, beyond these temporary fluctuations, absolute crime levels remained historically high and that the sustainability of these reductions depended on profound structural reforms and not solely on temporary police interventions.

2. Methodology

To lend scientific rigor to the present analysis, a methodological structure based on systematic and sequential processes has been designed:

- **Research Approach:** A qualitative design was adopted under the interpretive-hermeneutic paradigm, which allows for the analysis of theoretical assumptions by confronting them with the social and phenomenological reality of school insecurity based on pre-established analytical categories**.**
- **Level of Research**: Exploratory-descriptive in nature, aimed at specifying the characteristics, profiles, and critical properties of educational communities affected by the dynamics of organized crime. The primary method employed was systematic bibliographic-documentary analysis, based on an inductive view of reality.
- **Type of Research:** Cross-sectional documentary research was combined with advanced literature review, allowing for the comparison of normative theoretical categories with the factual conditions of systematization recorded in recent scientific literature.

3. Sample selection criteria (inclusion and exclusion)

For the formation of the documentary sample, the following inclusion and exclusion criteria were strictly defined, guaranteeing the relevance, validity and scientific rigor of the corpus analyzed:

3.1. Inclusion criteria:

1. **ubject Matter**: Studies, scientific articles, institutional reports, and legal frameworks that directly address school coexistence, institutional security, educational regulations (such as the LOEI), and the impact of the socio-

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criminal context in classrooms.
2. **Timeframe**: Documents published within the last five years, prioritizing cutting-edge research that reflects the most recent social transformations.
3. **Type:** Articles indexed in high-impact scientific databases (Scopus, SciELO, Latindex), postgraduate theses, and official regulatory documents.
4. **Language:** Publications in Spanish and English.

3.2. Exclusion criteria:

1. Documents that address social violence in a general way without a direct link to or applicability within the pedagogical or institutional sphere of education.
2. Opinion pieces, blogs, or grey literature that lack peer review or institutional validation, which could introduce bias.
3. Duplicate publications or publications that repeat the same findings by the same author in different repositories.

3.3. Data collection techniques and instruments

The primary technique employed was bibliographic and documentary review, which enabled the tracing and critical selection of the literature. The following instruments were designed and used for recording and systematizing the information.:

1. **Content synthesis matrices:** used in the initial phase to map the selected sample. These matrices tabulated key data such as: author, year, source objectives, methodology used, main variables or categories, and an analytical summary of the main conclusions.

2. **Information analysis matrices:** used in the in-depth coding phase. This instrument was structured according to the emerging research categories (normative challenges, evolution of social violence, school coexistence strategies). The theoretical postulates and evidence supporting the study were extracted from these matrices both textually and analytically.

3.4. Information analysis mechanisms

The processing and interpretation of the collected data were not limited to a linear description, but were carried out using the following high-level analytical mechanisms:

1. **Contrastive analysis:** The matrix findings were organized according to the study categories. This allowed for a comparison of different researchers' perspectives on the same reality (for example, contrasting how the theoretical literature perceives the effectiveness of current regulatory reforms in addressing security demands in the territory).
2. **Triangulation of documentary sources:** A methodological triangulation was applied to compare three fundamental axes:
    1. Current legal regulations (state regulatory frameworks).
    2. Specialized scientific and empirical literature (case studies and context analyses by contemporary authors).
    3. Reported factual realities regarding coexistence in classrooms.

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Through this triangulation, the gaps between the rigidity of previous regulatory instruments and the dynamic demands of current social reality were identified, guaranteeing the internal validity and objectivity of the conclusions reached.

4. Results and discussion: the conflict of coexistence

4.1. The impact of insecurity on learning

Contemporary scientific literature suggests that, to achieve favorable results in teaching and learning processes, teachers must stimulate curiosity and cognitive interest through innovative methodological environments. However, in a context strained by the narco-state, students' intrinsic motivation is fragmented by the emergence of models of rapid socioeconomic success linked to criminal economies.

The application of dynamic pedagogical strategies is imperative to maintain student retention, but the scarcity of institutional resources and the lack of teacher training in managing critical environments limit this possibility. As UNESCO points out, structuring innovative learning environments requires minimum conditions of security and infrastructure (UNESCO, 2019); a premise that becomes utopian within schools where technological connectivity and control of physical space are conditioned by the interference of local criminal organizations. Consequently, the general provisions of the LOEI risk becoming merely nominal pronouncements devoid of practical effectiveness due to their superficial application in the most socially vulnerable territories. This scenario demonstrates that the core problem of the education system does not necessarily lie in the absence of regulatory frameworks, codes, or formalized decrees, but rather in the lack of effective mechanisms for implementing, monitoring, and enforcing the law in the face of highly complex contingencies.

To analytically contrast the aspects discussed above, Table 1 summarizes the main contradictions identified between the formal spirit of the law and current territorial dynamics.

Analytical dimension	LOEI Guidelines (Theoretical Framework)	Institutional Reality (Narco-State Context)
Citizen participation	Democratic and collective construction of the code by educational actors.	Coercion, intimidation, and conditioning by external criminal actors.
Conflict resolution	Prioritization of community mediation, institutional dialogue and consensus.	Interference of forceful and coercive tactics characteristic of organized crime.

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Learning environment	Guarantee of a safe, motivating and inclusive physical and psychological space.	A scenario of high vulnerability, lack of protection, and struggle for territorial control.

Table 1. Matrix of institutional contradictions: Regulatory framework vs. Dynamics of criminal cooptation

4.2 Analysis of regulatory relevance

The normative analysis of these instruments cannot be limited to a linear reading of the legal texts, but rather requires a multidimensional approach that understands the gap between formal positive law and the factual dimension. It is observed that current codes of conduct, although formally compliant with the technical requirements of the Ministry of Education and specific regulations, do not produce consistent results in the face of external threats of a macro-criminal nature. These instruments exhibit severe limitations in attempting to articulate the comprehensive education of students within a community environment affected by systematic violence, a state incapable of acting, and institutions tainted by rampant corruption.

- **Curriculum gap and factual disconnect:** A structural difficulty is identified in relating the conceptual premises of a culture of peace to the daily experiences of students in high-risk areas, where the peaceful resolution of conflicts faces imposed codes of silence**.**
- **School dropout and exposure to risk:** The complexity of the educational environment translates into high rates of pedagogical vulnerability. This reality demands the urgent design of new strategies that go beyond classroom teaching and establish genuine protocols for physical and psychosocial protection.
    - The teaching profession is compelled to transform the traditional environment to meet the demands of new interactive methodologies; however, under the pressure of the narco-state, the role of the educator is frequently displaced towards a practice of administrative survival and containment of immediate crises.

5. Conclusions

Research shows that modern management of school codes of conduct must strengthen the theoretical and practical integration of human security principles, enabling autonomous and collective learning processes even within hostile community environments. It is imperative to link school codes of conduct with macro-level state strategies for social crime prevention. These strategies should include ongoing psychosocial support programs, pathways to employment and education for at-risk youth, and the strengthening of community protection networks.

It is necessary to recognize that codes of conduct cannot, in isolation, address the structural deficiencies of the state. Their effectiveness is linked to the existence of a public apparatus

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that guarantees basic conditions of citizen security, thus revaluing these instruments as genuine tools for promoting harmony in schools. Strengthening institutional coordination at the circuit, district, and zone levels is an essential condition for the effectiveness of any regulatory reform. Continuing teacher training programs are required to incorporate specific competencies in institutional risk management, school safety, and crisis mediation, enabling teachers to provide timely responses that contribute to safeguarding the integrity of the educational community.

The practical relevance of the Organic Law of Intercultural Education (LOEI) to the phenomenon analyzed is partial. Current legal guidelines demand an urgent regulatory and operational adaptation that empowers educational institutions to become more organized, participatory, and critical spaces in the face of the surrounding geopolitical and criminal reality. It is essential to design specific programs focused on preventing forced recruitment by criminal organizations, prioritizing the educational reintegration of children and adolescents in critically vulnerable situations by identifying their specific risk factors and providing educational, cultural, sports, and artistic options.

The reconceptualization of school coexistence proposed in this study stems from the necessary recognition that present-day Ecuador presents dynamics of violence that are qualitatively different from those under which the codes of conduct were originally designed. Rethinking these regulatory frameworks requires doing so from the concrete realities of the territories, integrating contributions from local, regional, and international academia, under an ethical commitment to human rights that avoids both pessimistic nihilism and naive optimism. Only from this perspective can these instruments aspire to be true tools for resilience and social transformation. This problem requires a more comprehensive approach, one that considers the educational environment as the optimal space for the holistic development of the learner and as a genuine agent of social change.

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Statement on the use of artificial intelligence

The author declares that the Gemini software was used only partially during the manuscript revision stage, focusing exclusively on syntactic restructuring of specific paragraphs, evaluating stylistic variations for titles, and optimizing the text's structure. The fundamental tasks related to methodological design, analytical literature review, critical discussion, and the formulation of academic conclusions were carried out entirely by the author, who assumes full scientific responsibility for the accuracy, content, and rigor of this document. It is also confirmed that no sensitive data or confidential documents were entered into the system during the text optimization process.

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REVISTA CÁTEDRA

Influence of digital skills on language competency in university students

Influencia de las habilidades digitales en las competencias lingüísticas en estudiantes universitarios

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Abstract

Technology has transformed human life, becoming an integral part of academic, professional, and social life. People use digital media (virtual assistants, social networks, digital platforms) and languages for linguistic communication (oral and written comprehension and expression). However, some educational institutions show little interest in incorporating these technologies into the cognitive process, which limits learning and widens educational gaps. The objective of this study was to determine the influence of digital skills on linguistic competencies in students at the Federico Villarreal National University in 2024. The approach was quantitative, correlational-causal, and non-

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experimental. The population consisted of 600 students, and the sample comprised 202 students from the first and second semesters. Non-probability sampling was used, and the data collection techniques included surveys and document analysis. The instrument was a scale-type test with the following values: Never (1), Almost Never (2), Sometimes (3), Almost Always (4), Always (5). The results were analyzed using SPSS V29 software, yielding a Pearson correlation coefficient of r = 0.695, a significance level of 0.05, and a 95% confidence level, indicating a moderate positive correlation. In conclusion, digital skills significantly influence linguistic competence in students at the Federico Villarreal National University in 2024. The study shows that teachers must know, manage, and apply technological tools to improve linguistic competence, because students come from diverse cultural, social, and academic backgrounds, which hinders the interpretation of abstract ideas or complex concepts.

Keywords

Competencias lingüísticas, comprensión, expresión oral, expresión escrita, habilidades digitales.

Resumen

La tecnología transformó la vida de los seres humanos, porque forman parte de su mundo académico, laboral y social, utilizan medios digitales (asistentes virtuales, redes sociales, plataformas digitales) y lenguajes para la comunicación lingüísticas (comprensión y expresión oral, escrita), sin embargo, algunos entes educativos no tienen interés de emplearlas en el proceso cognitivo, el cual limita al aprendizaje y amplía las brechas educativas. El objetivo del estudio fue determinar la influencia de las habilidades digitales en las competencias lingüísticas en estudiantes de la Universidad Nacional Federico Villarreal, 2024, el enfoque fue cuantitativo, tipo correlacional-causal, diseño no experimental, la población estuvo constituida por 600 discentes y la muestra por 202 que pertenecen al I y II ciclo, se utilizó el muestreo no probabilístico, la técnica fue la encuesta y el análisis documentario, el instrumento un test tipo escala, con valores: Nunca (1), Casi nunca (2), A veces (3), Casi siempre (4), Siempre (5). Los resultados fueron analizados mediante el software SPSS V29, el coeficiente de correlación de Pearson *r*=0,695, nivel de significancia (0.05) de 95% de confiabilidad, determinando una correlación positiva media o moderada. En conclusión, las habilidades digitales influyen significativamente en las competencias lingüísticas en estudiantes de la Universidad Nacional Federico Villarreal, 2024. El estudio muestra que los docentes deben conocer, manejar y aplicar herramientas tecnológicas para mejorar las competencias lingüísticas, porque los estudiantes vienen marcados por la diversidad cultural, social y académica, que dificultan la interpretación de ideas abstractas o conceptos complejos.

Palabras clave

Competencias lingüísticas, comprensión, expresión oral, expresión escrita, habilidades digitales.

1. Introduction

In the 21st century, information and communication technologies (ICTs) have radically transformed human life, facilitating new forms of interaction and access to diverse knowledge, which has significantly influenced education. According to Ancira and Gutiérrez, the use of ICTs in the teaching-learning process translates into greater opportunities to

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access materials, as well as increased student motivation and productivity, improving their comprehension and performance. However, despite these advances, obstacles persist, such as a lack of access to resources and insufficient teacher training (Ancira and Gutiérrez, 2011). Furthermore, linguistic competencies remain fundamental pillars of university academic training. The ability to understand, interpret, and write effectively is essential in a constantly evolving educational and professional environment. Expressing and arguing requires the use of precise, coherent, appropriate, clear, concise, and concrete language—elements that demand linguistic proficiency, not only for academic performance but also for students' interpersonal interactions in a digital context. According to Area and Pessoa, navigating the knowledge society implies continuous literacy in the use of digital tools and incorporating them as a cross-cutting, interdisciplinary, and indispensable axis in the cognitive process. Immersing oneself in the digital world is not just about knowing platforms, gathering, or selecting information, but about producing, reproducing, and disseminating knowledge, guided by critical, creative, autonomous, and collaborative thinking (Area & Pessoa, 2012).

Including technology in learning plays a crucial role in a globalized, dynamic, and ever-changing education. However, it is recognized that there are negative impacts on the development of linguistic skills; in the oral sphere, the lack of interpersonal interaction and socialization experienced during the pandemic meant that the brain and articulatory organs were not exercised. This effect is evident in the classroom when students are afraid to communicate their ideas or make mistakes when expressing words, sentences, etc. In the written domain, various technological tools (ChatGPT, Gamma, Gemini, etc.) exist to aid academic writing; however, students often copy and paste without analyzing or understanding the text, nor do they respect the language's spelling rules. Regarding reading, there are texts of diverse types, ranging from basic to complex, but disinterest in reading is increasingly widespread because some students have become accustomed to reading out of obligation, without considering that reading benefits every field of human knowledge. According to Macías et al., digital media enhance linguistic competencies and develop communicative skills through oral and written interaction; they can also serve as motivation to increase cognitive level (Macías et al., 2022).

Generation Z demands that educators embrace digitalization to navigate a changing education system. According to the Organisation for Economic Co-operation and Development (OECD), a country's development requires proficiency in information technologies that promote the digital transformation of students. Developing linguistic skills based on grammar, morphology, syntax, phonetics, phonology, semantics, and pragmatics, as well as training students in accordance with the evolution of these disciplines, is a fundamental necessity in today's educational context (OECD, 2019). The goal is to renew traditional techniques and utilize technological and innovative tools for reading comprehension and multimodal writing. Therefore, it is urgent to foster literacy in linguistic competencies and digital skills, which are key to the holistic development of future professionals.

According to Lloyd, digital divides exist, such as the availability of resources, the ability to manage and use technology appropriately, and the fact that not everyone has the conditions or desire to learn, which hinders constructive learning (Lloyd, 2020). In various public universities in Peru, it is observed that traditional methods focused on listening, memorizing, repeating lessons, using outdated books, and standardized tests continue to be used. Based on this, the research question posed was: How do digital skills influence the linguistic competencies of students at the Federico Villarreal National University in 2024?

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We are aware of the reality of students entering the university; they have deficiencies in reading comprehension, writing, and argumentation of academic texts. Furthermore, not all of them have digital skills or access to electronic devices, connectivity, etc., which limits the student's active participation in constructing their own learning. Finally, social media (Facebook, TikTok, WhatsApp) weakens language practices, hindering and distorting the development of linguistic competencies. Therefore, training should be implemented to incorporate the virtual world into pedagogical activities and curricula. Teaching is not just about delivering information, but about fostering lasting, creative, innovative, and knowledge-sharing learning.

This study is based on enhancing comprehension, oral and written expression through fundamental and instrumental digital skills. Arango and Manrique mention that the virtual environment predominates in education and facilitates the creation of new forms of interaction between knowledge and students (Arango & Manrique, 2023). There is a need to fill gaps in the educational field. The theories cited in this research contribute to the sustainability of the study and future work, including the results, recommendations, and proposals that will be incorporated into education. In practice, this study proposes strategies and techniques to enhance digital skills and linguistic competencies, as well as the application of formative and continuous assessments to observe cognitive processes. The methodology presents structured methods, approaches, and techniques that follow a systematic, authentic, and reliable order. This research is important because it provides a data collection instrument that will be useful for other researchers. Furthermore, it will foster creativity, critical thinking, and independence in student learning.

The overall objective of the research was to determine the influence of digital skills on linguistic competencies in students at the Federico Villarreal National University in 2024. The specific objectives were: a) to determine the influence of digital skills on oral comprehension and expression, and b) to determine the influence of digital skills on written comprehension and expression.

The article is structured as follows: Section 1 presents the abstract and introduction, outlining the problem, objectives, literature review, and its importance in oral and written expression and comprehension; Section 2 outlines the methodology, approach, design, type, population, sample, techniques, and instruments used for data collection; Section 3 presents the results obtained from the applied instrument and interprets them based on the analysis of the tables and figures generated from data processing using SPSSv29 software; Section 4 presents the discussion, contextualizing the results, comparing the study with previous research, and establishing the findings. Finally, a summary or recap of the thematic content, the bibliography, and the authors' contributions are presented.

2. Literature review

2.1 Digital skills

Digital skills encompass the set of knowledge, abilities, and skills related to the use of ICTs, which are developed primarily through experience, continuous practice, and learning processes. These skills are based on broad digital literacy that allows for the effective, critical, and relevant use of technological tools (Jiménez & León, 2024). Furthermore, the authors emphasize that digital skills play a fundamental role in higher education, involving not only mastery of diverse tools and resources in the digital environment but also the ability to leverage them to strengthen teaching and learning processes. In this context, teachers must be prepared to adapt to technological advancements, develop advanced

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digitalization skills, and effectively integrate ICTs into their pedagogical practice (Jiménez & León, 2024). Saptura indicates that these skills are essential in the 21st century because they allow people to navigate using various devices, where they can manage information and share it about: culture, education, language, the environment, politics, economics, or topics that are relevant in the social context (Saptura, 2021).

2.1.1 Fundamental digital skills

Permite al sujeto conocer y comprender el entorno digital, para poder manipularlo con eficiencia, seguridad, responsabilidad ético–moral. Requiere de la capacidad de cooperación, participación y transformación de los conocimientos básicos en complejos. En el internet existe información por doquier, se evalúa si son fuentes confiables que reflejan la realidad y dar crédito a quien corresponde (evitar el plagio); conocer estas habilidades son esenciales para analizar, construir argumentos, interactuar con otros, crear y editar contenidos en Google Apps, Twitter, Skype, Canva, Genially, Prezi, YouTube, etc., además, implica la flexibilidad en el uso del lenguaje, que puede ser formal (estándar) e informal (coloquial), dependerá del receptor a quien se dirige, empleando los medios tecnológicos que ayudan al universitario a la perfección académica, personal y social, Morduchowicz, define que las personas necesitan conocer las habilidades digitales fundamentales para adquirir saberes basados en el pensamiento crítico, desafiar argumentos, detectar falencias en un contenido temático, todas estas competencias son importantes para la vida cotidiana, la participación activa en la sociedad, acceso a la instrucción, uso de diversas informaciones, desarrollo de la creatividad, desenvolvimiento libre y seguro en el entorno virtual Morduchowicz, 2024).

2.1.2 Instrumental Digital Skills

Practical skills in using devices and platforms encompass specific functions and actions such as: researching information to manage academic activities, using formal language, mastering cognitive processes, analysis and integration, discernment, and questioning. Therefore, teachers and students must strengthen these skills to understand their operation and the challenges posed by the digital world. Morduchowicz mentions that these skills will not promote proficient use of technology if they are not based on critical thinking and an understanding of how virtuality works. For example, creating email for formal communication, using templates to design academic activities, using spreadsheets, managing social media, creating digital presentations, using videoconferencing applications, and utilizing specialized software. Digital literacy and inclusion in education are essential and indispensable; they facilitate open access to information, enable the performance of daily tasks, manage time and work, and allow interaction with the digital universe (Morduchowicz, 2021).

2.2 Linguistic skills

In universities today, students develop the knowledge necessary to understand, interpret, produce, and express oral and written texts. According to Carlino, writing and oral participation require mastery of the language, reasoning, analysis, and argumentation, as well as the use of formal language adapted to diverse registers and communicative contexts. However, students entering higher education face difficulties in analyzing, synthesizing, and evaluating specialized texts, and struggle to complete assignments, essays, reports, critical summaries, research papers, and identify key ideas (Carlino, 2013). According to Serrano et al., mastering linguistic competencies is an important factor in the university setting, especially in the comprehension and production of academic texts (Serrano et al., 2025).

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Linguistic competencies in the university have evolved; they are no longer conceived as simply correcting grammar, spelling, or intonation, but rather as an integrative concept that allows students to understand, produce, interpret, and use formal, functional, and effective language in academic, professional, and social environments. Next, the dimensions of linguistic competence are conceptualized: reading comprehension, which focuses on interpreting academic, scientific, and technical texts of varying complexity; written production, the ability to draft essays, reports, and articles, ensuring coherence, cohesion, appropriateness, and correctness; oral expression, the ability to communicate ideas with valid and clear arguments that encourage debate and critical thinking; listening comprehension, the ability to understand seminars, lectures, and other presentations; and finally, pragmatic competence, the ability to use language and communicative intent in a given context.

In the university setting, linguistic competence is conceived as multidimensional, integrating communicative, critical, collaborative, and digital skills, all considered fundamental for students' academic and professional development. In this regard, Carlino (2013) points out that these skills are essential for accessing knowledge and actively participating in the academic context, since reading, writing, and argumentation, developed through diverse discourse genres, strengthen the student's intellectual and communicative development (Carlino, 2013).

Regarding oral comprehension and production, according to Padilla et al., the use of oral and written language are tools for representing and interpreting reality. This information is then organized in thought, and finally, ideas are mastered and expressed skillfully and fluently. Education has the function of equipping students with linguistic skills and making them competent speakers. However, to develop these abilities, digital platforms such as Tandem or HelloTalk are necessary. These platforms connect students with native speakers of other languages, facilitate the practice of conversational skills, and allow the use of videos and audio. Gamification and Duolingo contribute to the didactics of learning, making it more attractive, motivating, and even providing practical exercises. Quizzes in learning activities are more dynamic, interactive, and engaging; therefore, it is suggested to research online about virtual tools that enhance language skills, especially written and oral production, as well as to have access to digital libraries and academic databases that allow students to access complex and specialized texts, which will help improve reading and critical comprehension skills (Padilla, et al., 2008).

There is a need to thoroughly analyze the benefits of digital tools that specifically influence language skills in the ever-changing university environment. In this regard, the support of educational institutions is required to learn about and explore diverse strategies and techniques applied to education. For example, in an assessment, the teacher asks students to write a project using technological tools and then asks them to contextualize it to their own reality. This action requires critical and analytical interpretation, stimulating the student's brain and helping them become accustomed to such an action. For this reason, the teacher-student pairing, both key figures in the teaching-learning process, is crucial. The teacher acts as the pilot, familiar with the pathways to knowledge, while the student acts as the co-pilot, possessing prior knowledge and a desire to learn and master digital skills, integrating them with linguistic competencies. Furthermore, this approach allows for the analysis of all types of information: real/unreal, objective/subjective, true/false, relevant/irrelevant, and so on.

2.3 digital skills and language skills

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Digital and linguistic competencies are intrinsically linked to equip higher education students with the necessary tools to navigate a globalized society where knowledge evolves rapidly. Furthermore, mastering language tools is essential, not in their traditional sense, but rather through technological transformation, enabling the interpretation of multimodal texts, production in diverse formats (written, video, visual graphics, or podcasts), and dissemination via educational platforms, forums, blogs, and social networks (Lankshear & Knobel, 2006). These platforms enrich linguistic competencies and incorporate multilingualism not as a barrier, but as an opportunity that promotes cultural and linguistic diversity.

The digital world impacts various fields of knowledge and is geared towards the development of critical thinking. In this context, university students are required not only to master technological skills but also to strengthen their communicative competence in order to broaden their linguistic and cultural horizons. In this way, collaboration, knowledge sharing, real-time dialogue, and the search for innovative solutions to problems that affect or jeopardize human well-being are facilitated. UNESCO maintains that digital learning should be geared towards reducing inequality gaps and consolidate itself as a force for positive change, ensuring that every student, regardless of their background, has the opportunity to develop and thrive in the digital age. Platforms such as Google Classroom, Zoom, Moodle, Microsoft Teams, etc., and other online collaboration tools, allow students to interact and refresh their language skills, connect with their peers and teachers (UNESCO, 2022). They also serve for feedback, online assessment, grammar correction programs, access to learning various languages, and help cultivate digital and linguistic skills in order to address complex problems that only human beings can solve.

To promote the use and practice of digital and linguistic skills, multilingual education and literacy programs should be promoted to adapt students to the digital transformation. Investment should also be made in developing active and adaptable citizens in the knowledge age. Furthermore, this will contribute to the continuous enrichment of writing and oral expression skills. According to Delgado, there is a need for instruction to produce students who are digitally competent, who can search for and evaluate information, transform it into new knowledge, and disseminate it. In the digital environment, it is important to create materials and resources to demonstrate knowledge and instruct students in the responsible use of technology and safe navigation within the virtual world (Delgado, 2010).

The influence of digital skills on linguistic competence is increasingly close and relevant in the current context, especially given the amount of content found on the web (videos, podcasts, social media, educational platforms). This provides diverse, rich, and essential linguistic exposure for comprehension and communication. The two variables addressed in this research have changed how language is used (instant messaging, emails, blogs, etc.). Therefore, it is necessary to develop multimodal linguistic competence, adapting to different media, audiences, and registers, both formal and informal.

Higher education aims to train individuals who can interpret diverse sources, identify biases, and argue clearly. Furthermore, digital and linguistic skills are not isolated competencies but rather complement each other to develop communicative, inquisitive, autonomous, critical, and participatory students in a digital, global, and intercultural context. Gaps in technological and linguistic access would limit full participation in the university and professional spheres.

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3. Methodology

The research employed a quantitative methodological approach, which facilitated the analysis, validation, reliability, and contextualization of the data collection instrument. A correlational-causal study was conducted within a non-experimental design to determine the influence of digital skills and linguistic competencies on first- and second-year students at the Federico Villarreal National University. The collected data were not manipulated at the researchers' discretion, as the aim was to ensure equitable results across the student population and fulfill the research objective.

The population consisted of 600 university students. From this population, a sample was selected using purposive non-probability sampling. Participants were required to be in their first or second year, enrolled in the 2024 academic year, and taking general studies courses. The sample comprised 202 students, of whom 126 were female and 76 were male. Representativeness, participant characteristics, the university context, and other pre-established criteria were also considered to obtain accurate and reliable results.

The data collection technique was a survey. The instrument was a questionnaire created by the researchers, consisting of 20 items for each variable, with the following rating scale: Never (1), Almost Never (2), Sometimes (3), Almost Always (4), Always (5). It was validated by three expert methodologists and education specialists. A pilot test was also administered to 15 students, using Cronbach's alpha coefficient. The results for the digital skills variable were 0.868 and for linguistic competencies 0.926, indicating that the instrument is reliable and acceptable.

The researchers collected the data in the Faculties of Social Sciences, Law and Political Science, Architecture and Urban Planning, Humanities, Human Medicine, Geographic Engineering and Ecotourism, and Industrial and Systems Engineering, obtaining informed consent from the sample after submitting requests to the deans of the Faculties. The fieldwork was carried out using Google Forms; the link was sent to students via institutional email and WhatsApp. The data was stored in a Google Drive, in Excel, and the analysis was performed using SPSS V29 software.

4. Results

The study was conducted with students from the National University Federico Villarreal, Lima, Peru, and the results from the applied instruments were as follows:

	Frequency	**Percentage**	**Valid percentage**	**Cumulative percentage**
Sometimes	70	35	35	35
Never	4	2	2	37
Always	128	63	63	100
Total	202	100	100	

Table 1. Results of the application of digital skills in university students

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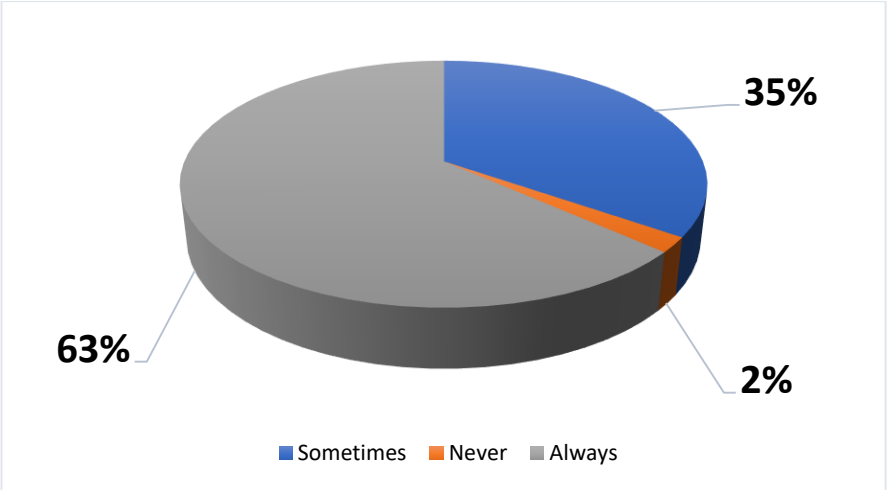


Figure 1. Results of the application of digital skills in university students

Interpretation: Table and Figure 1 reflect the knowledge that students at the Federico Villarreal National University have regarding digital skills. It can be observed that 63% of the students state that they always possess these skills, while 35% indicate that they possess them sometimes. Consequently, it is evident that the students demonstrate an adequate level in this area.

	Frequency	Percentage	Valid percentage	Cumulative percentage
Sometimes	109	54	54	54
Never	7	3	3	57
Always	86	43	43	100
Total	202	100	100	

Table 2. Results of the application of fundamental digital skills in university students

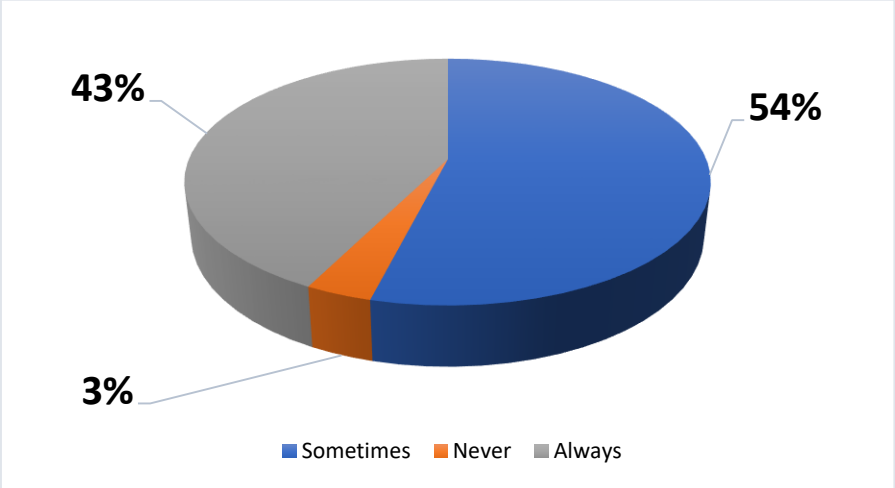


Figure 2. Result of the application of fundamental digital skills in university students

Interpretation: Table 1 and Figure 2 reflect university students' knowledge of fundamental digital skills. The results show that 54% of respondents indicate they sometimes use these

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skills, while 43% indicate they always use them. This suggests that students seek technological tools online, such as software applications, forums, social networks, Google, and YouTube, to enhance their learning and apply methods that strengthen their oral and written communication skills.

	Frequency	Percentage	Valid percentage	Cumulative percentage
Sometimes	38	19	19	19
Never	5	2	2	21
Always	159	79	79	100
Total	202	100	100	

Total 202 100 100

Table 3. Results of the application of instrumental digital skills in university students

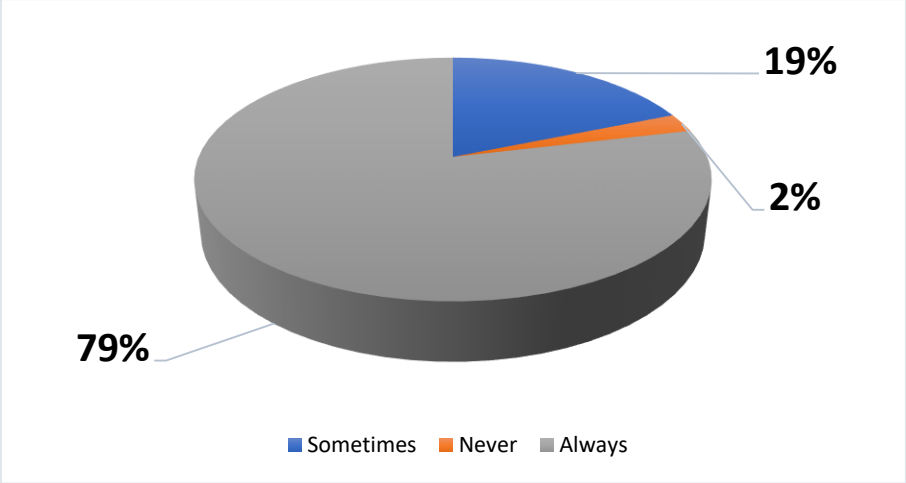


Figure 3. Result of the application of instrumental digital skills in university students

Interpretation: Table and Figure 3 reflect university students' knowledge of instrumental digital skills. The results show that 79% of respondents indicate they always use these skills, while 19% indicate they use them sometimes. This suggests that students use digital applications to manage academic activities, strengthen their command of formal language, and develop cognitive processes aimed at achieving meaningful learning.

	Frequency	Percentage	Valid percentage	Cumulative percentage
Sometimes	90	45	45	45
Never	1	1	1	46
Always	111	54	54	100
Total	202	100	100	

Table 4. Results of applying digital skills to linguistic competencies in university studentss

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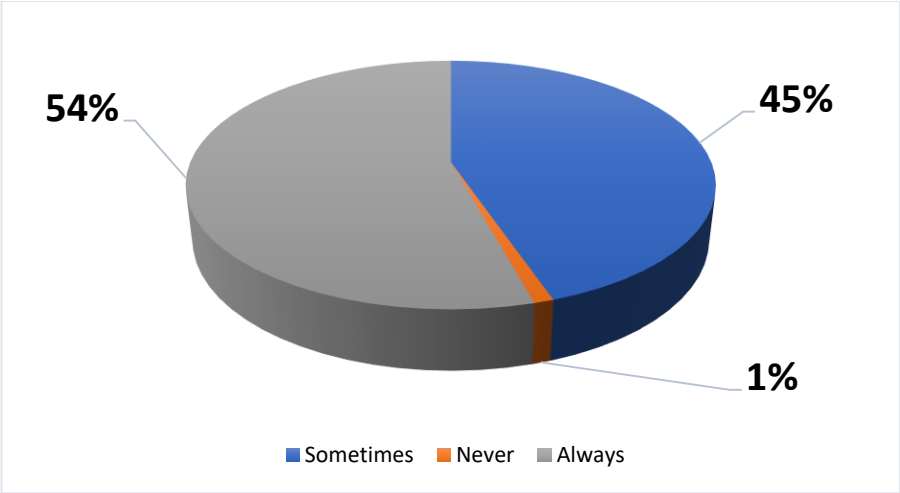


Figure 4. Result of applying digital skills to linguistic competences in university students
s

Interpretation: Table and Figure 4 reflect that university students possess knowledge about the use of digital tools to improve their language skills. The results show that 54% of respondents indicate that they always use these tools, while 45% indicate that they use them sometimes. This suggests that more than half of the students use technology to enrich their language grammar and consult databases such as Scopus, EBSCO, and academic repositories to find information related to oral and written expression.

	Frequency	Percentage	Valid percentage	Cumulative percentage
Sometimes	104	51	51	51
Never	5	3	3	54
Always	93	46	46	100
Total	202	100	100	

Table 5. Results of applying digital skills to oral comprehension in university students

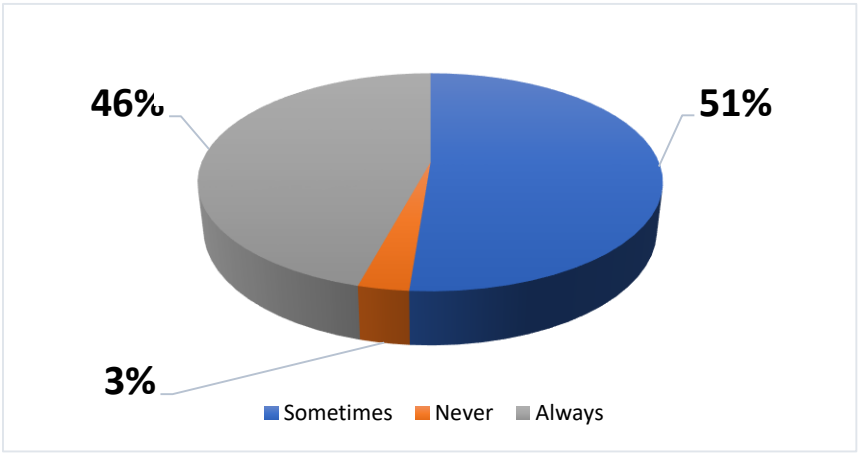


Figure 5. Result of applying digital skills to oral comprehension in university students

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Interpretation: Table and Figure 5 reflect that university students use digital tools to improve listening comprehension. The results show that 51% of respondents indicate they use them sometimes, while 46% indicate they use them always. This suggests that some students use videoconferencing programs, such as Google Meet, Zoom, Cisco Webex, Skype, and Microsoft Teams, to communicate with their classmates and work teams. Furthermore, they use online audio sources to analyze and synthesize academic texts.

	Frequency	Percentage	Valid percentage	Cumulative percentage
Sometimes	63	31	31	31
Never	1	1	1	32
Always	138	68	68	100
Total	202	100	100	

Cuadro 6. Resultado de aplicación las habilidades digitales en la comprensión escrita en estudiantes universitarios

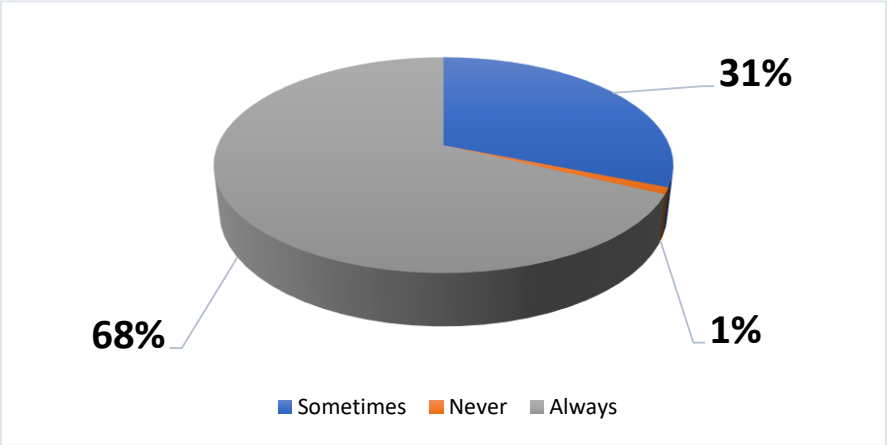


Figure 6. Result of applying digital skills to reading comprehension in university students

Interpretation: Table and Figure 6 reflect that university students use digital tools to improve reading comprehension. The results show that 68% of respondents indicate they always use them, while 31% indicate they use them sometimes. This suggests that the majority of students use applications such as Excel, Canva, PowerPoint, and Microsoft Word, among others, to understand digital texts rationally, with appropriate content, standard vocabulary, and a clear, precise, and concise structure.

	Frequency	Percentage	Valid percentage	Cumulative percentage
Sometimes	76	38	38	38
Never	4	2	2	40
Always	122	60	60	100
Total	202	100	100	

Table 7. Results of applying digital skills to oral expression in university students

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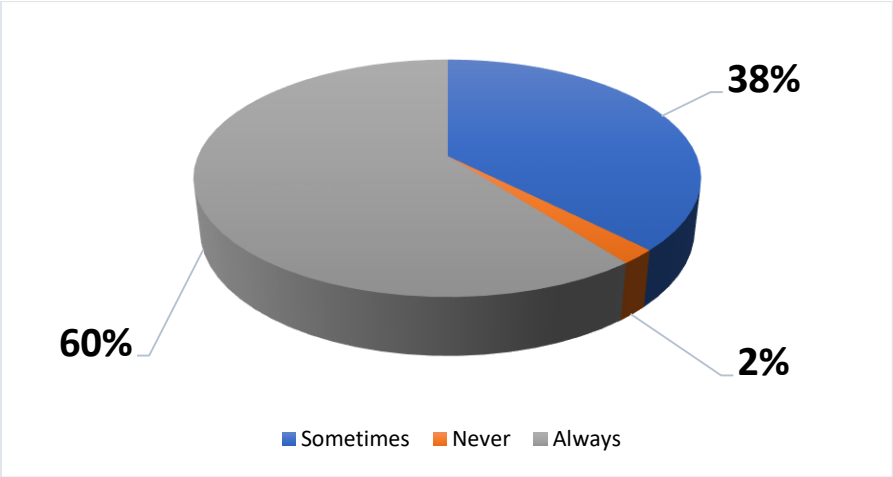


Figure 7. Result of applying digital skills to oral expression in university students

Interpretation: Table and Figure 7 reflect that university students use digital tools to enhance their oral expression. The results show that 60% of respondents indicate they always use them, while 38% indicate they use them sometimes. These results demonstrate that the students have an adequate level of oral expression, using a firm, confident, and clear tone of voice, as well as simple language that facilitates the understanding of the message by their intended audience.

	Frequency	Percentage	Valid percentage	Cumulative percentage
Sometimes	109	54	54	54
Never	5	2	2	56
Always	88	44	44	100
Total	202	100	100	

Table 8. Results of applying digital skills to written expression in university students

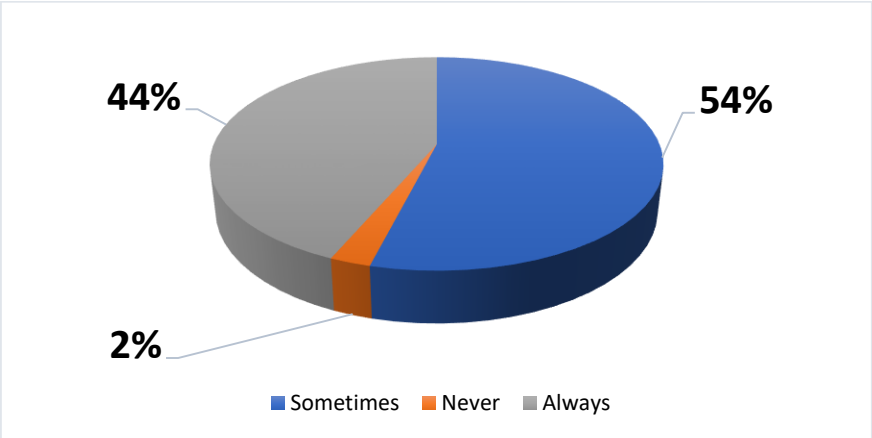


Figure 8. Result of applying digital skills to written expression in university students

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Interpretation: Table and Figure 8 reflect that university students use digital tools to enhance their written expression. The results show that 54% of respondents indicate they use them sometimes, while 44% indicate they always use them. This suggests that some students use artificial intelligence to write their academic papers with objective information, free from emotion, fanaticism, and passion. Furthermore, they search the web for information that reflects reality and rely on spelling and grammar checkers to achieve greater clarity in their writing.

4.1 Normality test: Kolmogorov – Smirnov

The goodness-of-fit test allows us to determine if the data come from a normally distributed population. In this study, the null hypothesis (H_0) was that digital skills do not significantly influence the linguistic competencies of students at the Federico Villarreal National University in 2024; and the alternative hypothesis (H_1) was that digital skills significantly influence these competencies.

Likewise, for the normality test, the null hypothesis (H_0) was that the data have a normal distribution, and the alternative hypothesis (H_1) was that the data do not have a normal distribution. A significance level of 0.05 was considered. The scores corresponding to the variables digital skills and linguistic competencies were entered into the SPSS statistical software, from which the following results were obtained:

		Digital skills	**Linguistic skills**
N		202	202
Normal parameters (a,b)	Mean	38.89	75.28
	Standard deviation	5.792	11.023
Most extreme differences	Absolute	.107	.050
	Positive	.055	.050
	Negative	-.107	-.042
Z de Kolmogorov-Smirnov		1.519	.704
Sig. asintót. (bilateral)		.060	.705

Table 9. Kolmogorov-Smirnov test results

Interpretation: Based on the results obtained using the Kolmogorov-Smirnov test, the data were analyzed to determine whether or not they followed a normal distribution. For the digital skills variable, a p-value of 0.060 (two-tailed significance) was obtained, while for the linguistic competence variable, a p-value of 0.705 (two-tailed significance) was obtained. Since both values are greater than the significance level of 0.05, it is concluded that the data follow a normal distribution.

Consequently, hypothesis tests were performed using Pearson's r correlation statistic, as the data for the variables meet the assumption of normality.

4.2 Pearson correlation coefficient (r)

Pearson's correlation coefficient (r) is a correlation method for variables measured by intervals or ratios and for linear relationships. It is calculated from the scores obtained in a sample with two variables. The scores obtained for one variable are related to those of the other, using the same participants or cases.

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		Digital skills	Linguistic skills
Digital skills	Pearson Correlation	1	.695(**)
	Sig. (2-tailed)		.000
	N	202	202
Digital skills	Pearson Correlation	.695(**)	1
	Sig. (2-tailed)	.000	
	N	202	202

Table 10. ** Correlation is significant at the 0.01 level (two-tailed)

According to the table shown, the Pearson correlation coefficient r = 0.695, for the general hypothesis (Ha): it is determined that digital skills significantly influence linguistic competencies in UNFV students, 2024, according to Sampieri's table is a medium or moderate positive correlation.

		Digital skills	Linguistic skills
Digital skills	Pearson Correlation	1	.669(**)
	Sig. (2-tailed)		.000
	N	202	202
Listening comprehension	Pearson Correlation	.669(**)	1
	Sig. (2-tailed)	.000	
	N	202	202

Table 11. ** Correlation is significant at the 0.01 level (two-tailed)

According to the table shown, the Pearson correlation coefficient r = 0.669, so for Specific Hypothesis 1: it is determined that digital skills significantly influence oral comprehension in UNFV students, it has a medium or moderate positive correlation.

		Digital skills	Linguistic skills
Digital skills	Pearson Correlation	1	.691(**)
	Sig. (2-tailed)		.000
	N	202	202
Listening comprehension	Pearson Correlation	.691(**)	1
	Sig. (2-tailed)	.000	
	N	202	202

Table 12. ** Correlation is significant at the 0.01 level (two-tailed)

According to the table shown, the Pearson correlation coefficient r = 0.691, then for the specific hypothesis 2: it is determined that digital skills significantly influence written comprehension in UNFV students, it has a medium or moderate positive correlation.

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		Digital skills	Linguistic skills
Digital skills	Pearson Correlation	1	.499(**)
	Sig. (2-tailed)		.000
	N	202	202
Oral expression	Pearson Correlation	.499(**)	1
	Sig. (2-tailed)	.000	
	N	202	202

Table 13. ** Correlation is significant at the 0.01 level (two-tailed)

De acuerdo con el cuadro mostrado, el coeficiente de correlación de Pearson *r* = 0.499, entonces, para la Hipótesis especifica 3: se determina que las habilidades digitales influyen significativamente en la expresión oral en estudiantes de la UNFV, posee una correlación positiva media o moderada.

		Digital skills	Linguisti c skills
Digital skills	Pearson Correlation	1	.452(**)
	Sig. (2-tailed)		.000
	N	202	202
Written expression	Pearson Correlation	.452(**)	1
	Sig. (2-tailed)	.000	
	N	202	202

Table 14. ** Correlation is significant at the 0.01 level (two-tailed)

According to the table shown, the Pearson correlation coefficient r = 0.452, therefore, for Specific Hypothesis 4: it is determined that digital skills significantly influence written expression in UNFV students, has a medium or moderate positive correlation.

5. Discussion

The results obtained stem from the formulation of the problem, the establishment of general and specific objectives, hypotheses, and the comparison of existing theories with the new proposal. The researchers' perspective is also crucial; they possess critical thinking skills and are committed to honesty in presenting the results truthfully, without distortion or bias. The study aimed to determine the influence of digital skills on the linguistic competencies of first- and second-year students enrolled at the Federico Villarreal National University in 2024. Regarding the assessment of digital skills, 63% of the students consistently demonstrated knowledge, aptitude, and proficiency in using virtual tools. In accordance with this, Salguero et al. maintain that it is important to employ diverse digital strategies to ensure students demonstrate adequate academic performance; they also indicate that if these strategies are used appropriately, the cognitive level will be higher (Salguero, 2024).

The proposed dimensions were as follows: a) fundamental digital skills, in which 54% of students indicated they sometimes use them, while 43% indicated they always use them. These results demonstrate that students know and understand how the digital environment works. In this regard, Morduchowicz states that the virtual environment facilitates the understanding of reality from a critical, analytical, and creative perspective, which allows

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for understanding and evaluating the content circulating on the internet (Morduchowicz, 2021); b) instrumental digital skills, a dimension in which 79% of students stated they are always accustomed to the constant use of virtual tools. According to Morduchowicz, this skill facilitates the creation of PowerPoint presentations and videos, as well as providing access to devices, templates, and platforms through which the individual completes specific tasks (Morduchowicz, 2021).

Regarding linguistic competence, 54% always use technological means to understand, practice, and evaluate the grammar of their language, while 45% do so sometimes. The data indicates that social media enhances language skills, suggesting that it contributes to language use in different communicative situations (Dos Santos, 2021). The dimensions were: a) oral comprehension, with 51% sometimes and 46% always using digital tools to improve oral expression. Gómez and Meza, in their research, promote the development and improvement of oral comprehension skills, which are enriched and strengthened through videos, training, conferences, and seminars presented online. Furthermore, they reinforce active listening, reflection, teamwork, and questioning (Gómez & Meza, 2022). b) written comprehension, with 68% always using digital tools to enhance textual comprehension.

There are various references available in the technological world. According to Padilla et al., a competent student can interpret statements and situations from the digital world and adapt them to a real and natural context (Padilla et al., 2008). c) Oral expression: 60% always seek to master grammatical vocabulary through digital content. According to Menéndez et al., adequate language training facilitates fluid, correct, and clear communication. Furthermore, it strengthens debate, the exchange of ideas, and interaction with peers in the technological environment (Menéndez et al., 2024). d) Written expression: 54% sometimes use digital tools for writing, and 44% always do. According to Carlino (2013), writing is a social practice and fundamental for constructing learning at the university level.

In this regard, the results are consistent with the literature and the comparative analysis with other international and national studies that have reached similar or comparable results. For example, Macías et al., in their study on developing linguistic competencies through the use of digital media, mention that students and teachers must adapt to advances in science and technology, which contribute to motivational development and enhance linguistic competencies (Macías et al., 2022). Therefore, this research demonstrates the influence of digital skills on the linguistic competencies of students at the Federico Villarreal National University in 2024, as shown by the verification of the hypotheses, the tables and figures developed for the study, and the applicability of the instrument to other state or private research projects seeking to enhance oral and written comprehension and expression using digital media.

6. Conclusion

The influence of digital skills on linguistic competencies was determined using Pearson's correlation coefficient (r), where r = 0.695, indicating a moderate positive correlation. The p-value (sig.) is less than 0.05, thus confirming the alternative hypothesis. The implementation of digital skills in the university setting highlights the evolution of reading, expressive, and written skills. It reflects the influence of digital skills on oral comprehension, where the Pearson test result r = 0.669, indicating a moderate positive correlation. The p-value (sig.) is less than 0.05, confirming specific hypothesis 1 (Ha): students demand

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interactive resources to enhance oral comprehension and enrich their vocabulary through the use of knowledge found on the internet.

The results also demonstrate the influence of digital skills on written comprehension. Pearson's correlation test yielded an r value of 0.691, indicating a moderate positive correlation. Furthermore, the p-value (sig.) was less than 0.05; therefore, specific hypothesis 2 (H_a) is confirmed. This allows us to conclude that digital resources available on the internet promote reading, analysis, and synthesis. In addition, they expose students to real and fictional content, enabling them to critically discriminate and select reliable information that benefits their learning.

Similarly, the results reflect the influence of digital skills on oral expression. Pearson's correlation test yielded an r value of 0.499, demonstrating a moderate positive correlation. Likewise, the p-value (sig.) was less than 0.05; consequently, specific hypothesis 3 (H_a) is confirmed. In this sense, the student uses technological resources to enhance oral expression and develop communicative reciprocity among internet users.

Finally, the results demonstrate the influence of digital skills on written expression. Pearson's correlation test yielded a value of r = 0.452, indicating a moderate positive correlation. Furthermore, the p-value (sig.) was less than 0.05; therefore, specific hypothesis 4 (H_a) is confirmed. These results suggest that students employ complex cognitive processes for writing, as it is not enough to know the grammar of the language; it is also necessary to use various digital resources that allow them to optimize time and stay up-to-date with information.

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Declaration of authorship-CRediT

DINA INGA-LINDO: Conceptualization, methodology, software, validation, data analysis, research, resources, data curation, writing (original draft), writing (revision and editing), visualization, supervision.

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Statement on the use of artificial intelligence

The authors declare that they did not use Artificial Intelligence (AI) tools at any stage of the manuscript's development. No scientific content, results, analyses, or interpretations were generated by artificial intelligence. All material was developed, reviewed, and validated by the authors, who assume responsibility for its accuracy, rigor, and academic integrity

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REVISTA CÁTEDRA

Associated factors and statistical analysis of alcohol consumption in university students

Factores asociados y análisis estadístico del consumo de alcohol en estudiantes universitarios

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Abstract

This research aimed to determine alcohol consumption patterns and evaluate the influence of the surrounding population on a sample of 1,045 university students, based on data collected at the University of Chimborazo, Ecuador. The main problem addressed is the lack of attention to and awareness of current alcohol consumption levels among students about to become education professionals. Based on this problem, the authors proposed a descriptive study with a quantitative approach, consisting of a structured questionnaire on alcohol consumption habits, associated factors, and their consequences. The results reveal a critical distinction regarding consumption rates: 57% of students do not consume alcohol regularly, and 30% lack parental support due to a lack of awareness. The results demonstrate that the family context does not act as a significant protective factor against alcohol consumption. In this regard, young people's decision to consume alcoholic beverages appears to be primarily associated with individual factors, such as their personal preferences, as well as external elements, including social pressure and the dynamics of the university environment. It is concluded that a significant portion of the sample does not consume alcoholic beverages regularly; therefore, preventive strategies should focus on raising family awareness, changing behaviors in social settings, and preventing the consequences associated with consumption.

Keywords

Alcohol, consumption, consequences, patterns, health, sociodemographic.

Resumen

Esta investigación tuvo como objetivo determinar los patrones de consumo de alcohol y evaluar la influencia de la población cercana en una muestra de 1045 estudiantes universitarios, a partir de datos recolectados en la universidad de Chimborazo-Ecuador. La principal problemática que se aborda es la escasa atención y desconocimiento de los niveles actuales de consumo de alcohol de los estudiantes que están próximos a ser profesionales de la educación. Con base en este problema, los autores proponen la ejecución de una investigación de tipo descriptivo con enfoque cuantitativo, que consta de un cuestionario estructurado sobre los hábitos de consumo de alcohol, los factores asociados y sus consecuencias. Los resultados revelan una distinción crítica respecto a los índices de consumo: el 57% de estudiantes no consume alcohol de forma regular, el 30% no cuenta con el apoyo o soporte de sus padres por desconocimiento. Los resultados evidencian que el contexto familiar no actúa como un factor de protección significativo frente al consumo de alcohol. En este sentido, la decisión de los jóvenes de consumir bebidas alcohólicas parece estar asociada, principalmente, a factores individuales, como sus preferencias personales, así como a elementos externos, entre ellos la presión social y las dinámicas propias del entorno universitario. Se concluye que una parte significativa de la muestra no consume bebidas alcohólicas de forma habitual; por ello, las estrategias preventivas deben enfocarse en la concientización familiar, el cambio de conductas en espacios de socialización y la prevención de las consecuencias asociadas al consumo.

Palabras clave

Alcohol, consumo, consecuencias, patrones, salud, sociodemográficas.

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1. Introduction

In theory, Pretel et al. explain that alcohol is one of the most widely consumed substances or drugs worldwide, both in terms of population and the length of time it has been affecting society. It is believed that its origins date back to religious ceremonies or rituals, where the activities themselves required its consumption (Pretel et al., 2014). However, the percentage of the population that consumed alcohol in these activities was not considered at-risk drinkers, but rather social drinkers who only consumed at public events or commemorations, unlike alcoholics who usually drink to the point of losing control and committing irresponsible acts. Alcohol consumption is understood as a very serious social problem related to a variety of economic, social, political, and cultural factors that generate a significant impact at all levels of society. Furthermore, the World Health Organization (WHO) identifies that 22 million people consume alcohol, even if it's just one drink, in many parts of the world. This is due to the increased availability of alcoholic beverages and the exceptions to laws in each specific context (WHO, 2024). Alvarado and Reyes point out that alcohol consumption is closely linked to the development of approximately 200 diseases and injuries, in addition to causing one death every 100 seconds and the loss of 274 million years of healthy life. In Europe, specifically, alcohol consumption is associated with around 10% of cancer cases in men and 3% in women. It also generates various long-term consequences, including violence, intoxication, cirrhosis, accidents, and family, work, and social conflicts (Alvarado and Reyes, 2025). The MedlinePlus scientific team briefly notes that some of the factors that can influence alcoholism in individuals include genetic predisposition, low self-esteem, social pressure, environmental influence, a desire for belonging, mental health problems (depression, bipolar disorder, anxiety, post-traumatic stress), poor interpersonal relationships, and severe stress (MedlinePlus, 2026).

This problem has increased over the last five years and has become a significant challenge for the medical field. However, Suárez-Ramos and Bonilla-Basantes point out that it still has low visibility within the current healthcare system due to the diversity of its causes and its biological and psychological consequences for the population (Suárez-Ramos and Bonilla-Basantes, 2022). Along the same lines, several authors analyze the main groups of alcohol consumers and identify that these primarily consist of adolescents and young adults undergoing personal transformation. This stage is characterized by changes in thoughts, emotions, and feelings, as well as increased vulnerability, a desire for social acceptance, and a search for a sense of belonging (Lopez-Cisneros et al., 2021; Zhou and Rodríguez-Mantilla, 2020).

Based on information from the WHO technical team, it is known that in 2019, at least 2.6 million people worldwide died due to alcohol-related causes. Of these, 1.6 million (approximately 62%) died from non-communicable diseases, 700,000 (27%) from injuries, and 105,000 (4%) from communicable diseases (WHO, 2024). These levels were high, especially in regions of Europe and Asia, with a rate of 53 deaths per 100,000 people; however, Latin America was no exception, ranking as the second region with the highest alcohol consumption worldwide.

Within this context, Méndez-Ruíz et al. mention that, during 2014, approximately 25% of the world's population consumed alcohol due to its easy availability, and that 16% developed addictive problems before reaching adulthood. It is worth noting that this situation was more pronounced in the Americas and Europe, where addiction rates were highest, representing 1.3% of the global population. (Méndez-Ruíz et al., 2018).

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Furthermore, at the global level, the WHO highlighted that, of all deaths attributable to alcohol consumption, 28% are due to injuries (vehicle accidents, bone trauma, or interpersonal violence), 21% to gastrointestinal or digestive diseases, 19% to cardiovascular diseases, and the remainder to mental illnesses, neoplasms, or general conditions or infections of any part of the body (WHO, 2024). At the national level, considering data obtained from reports by technical teams belonging to the National Institute of Statistics and Censuses (2013) and the Pan American Health Organization (2022), 5.9% of the world's population, corresponding to 3.3 million people, died from harmful alcohol consumption, of which 5.1% were due to injuries or morbidity attributed to alcohol abuse. Similarly, based on the same methodology, Ecuador ranked ninth globally in this regard. Regionally, there is a high rate of alcohol consumption at harmful levels; furthermore, it was identified that approximately 900,000 Ecuadorians exhibited abusive behavior regarding this substance, with 89% being men and 11% women, resulting in a higher prevalence among men. At the local level, a review of research conducted by Pilco et al. identified that approximately 18% of them are critical or at-risk drinkers, and 7% have physical and psychological problems related to drinking, making them subjects with probable alcohol dependence (Pilco et al., 2019). However, these findings cannot be considered fixed data or trends within the Latin American context, as they did not coincide with the results obtained by Esquivel-Paladines in Peru, who considered 62% to be low-risk consumers and 2% to be harmful consumers (Esquivel-Paladines, 2019).

Within the Ecuadorian university context, concern about this issue has motivated the development of the research project entitled Analysis This statistical study on alcohol consumption among students in the Faculty of Educational, Human, and Technological Sciences focuses on determining the factors associated with alcohol consumption in university students. Data was collected through surveys administered to a representative sample of students from this faculty. This approach not only identifies consumption patterns but also helps to understand the patterns, frequencies, familial and social factors, ages of onset, and subsequent symptoms associated with this practice.

It is worth noting that personality traits play a significant role among the causes associated with alcohol consumption in youth. These include behavioral patterns, ways of thinking, social interaction skills, and perception of identity. In this regard, McCrae and Costa proposed the Big Five personality traits model, which helps to understand how certain behavioral factors and habits influence the development, maintenance, or modification of healthy or unhealthy lifestyles (McCrae & Costa, 1991).

The central focus of this research is to examine, from a quantitative and descriptive perspective, the factors that influence alcohol consumption among university students, considering all the variables that may be involved, from sociodemographic to behavioral, social, and perceptual contexts. In short, it attempts to answer key questions such as: At what age do they begin consuming alcohol? How frequently do they consume it? Which alcoholic beverages do they consume most often? What physical consequences do they experience after consumption? In what situations do they consume alcohol? With whom do they drink? What role do their family and social environment play in the decision to consume alcohol? What perception do they have of people who choose not to consume alcohol?

However, it is worth noting that one of the main challenges of this research, which may be subject to bias, was obtaining valid information from the surveyed students about their drinking habits or preferences, due to social factors such as fear of being judged, the

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normalization of the behavior, and a lack of awareness about the problem itself. Even so, the research makes a significant contribution, as it brings to light a problem that is often underestimated. Furthermore, it provides valuable input for designing intervention strategies within the university setting. The study is limited to the analysis of data collected through a questionnaire administered exclusively within a university in Chimborazo during the 2024–2025 period. However, it may be necessary at some point to consider and statistically verify whether the data can be extrapolated to the entire university community, given its current broad and diverse nature.

To achieve this objective, the manuscript is structured into four sections. First, a brief theoretical overview of the most relevant concepts is presented. Second, the methodological design is developed, detailing the scope, approach, sample selection, questionnaire parameters, and data processing techniques. Third, the results and discussion are presented, considering the empirical findings, the level of consumption, family factors, the environmental impact, and the interpretation of the results. Fourth, the conclusions, based on the findings, are presented, along with recommendations for future interventions.

2. State of the question

This section reviews research related to the topic; these studies are no more than five years old and are comprised of literature reviews or field research, available on open platforms, providing a general overview of the patterns, causes, consequences, outcomes, and levels of alcohol consumption among university students, the educational community, and staff in recent years.

Suárez-Ramos and Bonilla-Basantes conducted applied research on the relationship between individual personality traits and alcohol consumption among university students. The study's initial objective was to determine whether this relationship exists or is merely a perception held by the environment in which the consumers find themselves. The main finding was to refute the initial hypothesis, identifying that these two variables are not directly related, that 27% of the consuming population drinks due to anxiety, and that the remaining 40% drinks in risky situations (Suárez-Ramos & Bonilla-Basantes, 2022).

Lopez-Cisneros et al. conducted a study to determine the relationship between personality traits and alcohol consumption levels among university students in Carmen, Campeche, Mexico. Using a quantitative, descriptive-correlational approach with a sample of 238 university students, they found that the past prevalence of alcohol consumption (85.3%) was higher than the current and immediate prevalence (61.5%), indicating a direct relationship. This finding highlights the importance of implementing timely interventions to significantly reduce or eliminate harmful habits or unhealthy lifestyles (Lopez-Cisneros et al., 2021). Alvarado and Reyes developed a research project whose main purpose was to establish the relationship between alcohol consumption and its correlation with personality traits. Although this may seem like just another research project, the instruments used in its execution were the alcohol consumption disorders identification test and the five-factor personality inventory, which among its main findings revealed that the majority of women have a low rate of alcohol consumption, corresponding to 84%, compared to men (Alvarado and Reyes, 2025).).

Del Ángel-García et al. conducted a systematic review of research related to the factors influencing alcohol consumption among university students. Their objective was to investigate the most important personal factors influencing alcohol consumption among university students. Using the methodology outlined in the Cochrane Handbook and the

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PRISMA database, they critically appraised 29 studies, employing methodologies that allowed them to correlate biological factors (sex, age, genetics), cognitive factors (abstinence self-efficacy, impulsivity, self-esteem), and affective factors (life satisfaction, stress, religiosity, anxiety) with alcohol consumption. The results showed that all factors related to the genetic, psychological, and emotional characteristics of individuals influence alcohol consumption among young university students (Del Ángel-García et al., 2024).).

3. Conceptual approach to alcohol consumption

Alcohol consumption is one of the most frequent public health problems among young people today. Its use and abuse generate high social and health costs, in addition to significantly affecting people's quality of life. Furthermore, alcohol is considered one of the most impactful psychoactive substances due to the toxic effects it can produce in the body and its relationship with various physical and psychological disorders. Throughout history, people have always sought to improve themselves, and in some cases, they have sought substances that, despite being harmful, allow them to increase their potential to perform different tasks such as fishing, fighting, and hunting.

Even so, as Águila points out, these substances do not always produce serious effects on the functional and structural characteristics of their characteristics; for this reason, it is considered an addictive substance or drug that, when ingested, stimulates the central nervous system, generating a type of inhibition or distortion of its functions (Águila, 2011). From a practical point of view, Monzón et al. (2023) indicate that alcohol, or rather, alcohol consumption, can be categorized into three types of patterns, as mentioned below:

- **Abstinence:** This refers to the stage or lifestyle in which students, young people, or adults do not consume alcohol, thus coping with social pressure or seeking acceptance within their peer groups.
- **Social drinker:** This is someone who only consumes alcoholic beverages at festive or social events (such as baptisms, weddings, birthdays, town festivals, etc.). Their consumption is limited to one or two drinks per event, and the number of such events or celebrations should not exceed five per year.
- **Moderate drinker:** This refers to someone who does not consume alcoholic beverages every day, but rather during the week, and does not exceed a quarter of a bottle of hard liquor or a liter of wine, whether red, white, Sauvignon Blanc, or others.
- **At-risk consumer:** This is a drinker who is already considered an alcoholic or a severe consumer, as they have developed a dependence on the substance itself; that is, they cannot live without it and ingest it daily.

Furthermore, the effects or consequences of alcohol on the health of consumers are numerous. As highlighted by Hyun et al., 2021; Piano et al., 2025; D. Solís et al., 2020; and Sordo et al., 2020, it forms the basis for developing more than 200 medical problems and causing more than 40 deaths, including: liver cirrhosis, cardiovascular conditions (heart attack), acute pancreatitis (leading to cancer), withdrawal syndrome, alcoholic hallucinosis, alcoholic amnesia, problems with intellectual retention, personality changes, and social conflicts with personal or moral repercussions.

3.1. Factors associated with alcohol consumption

Several authors indicate that some of the factors associated with alcohol consumption among university students stem from low self-esteem, family problems, and economic,

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social, work-related, and academic difficulties (Betancourth-Zambrano et al., 2017; Jiménez-Franco and Fonseca-Fernández, 2025; Solís et al., 2022). In this regard, the factors associated with alcohol consumption, according to the theories of the aforementioned authors, are presented below:

Dimension	Identified factor	Reported frequency	Author
Psychological	Low self-esteem	64%	Solís et al. (2022)
Social	Stress	78%	
	Depression	42%	
Academic	Social belonging	90%	
	Relationship problems	48%	
Family	Workload	78%	
Economic	Family problems	48%	
Sociodemographic	Financial problems	24%	
Psychological	Age	77%	Jiménez-Franco y Fonseca-Fernández (2025)
	University life	71%	

Table 1. Shows the most common factors associated with alcohol consumption

In summary, the factors that have the most relationship with alcohol consumption are age (between 21 and 23 years), the academic year in which they are (beginning of university life and third semester), gender (greater consumption in men), social dilemmas (problems with fitting in or being accepted by their group), dating problems (crisis, fights or breakups), mental problems (depression, stress or anxiety), academic situations (too much schoolwork, pressure from their university friends, difficulty in understanding or passing subjects), family problems (parental rejection, absence of family, separation between relatives), among other.

4. Methodology

This research focused on descriptively analyzing the prevalence of alcohol consumption and the factors associated with this behavior, identifying the influence of the social context and family environment within the student population. To this end, the study employed a quantitative approach, using a non-experimental, cross-sectional design with an explanatory and descriptive scope. This methodological approach was considered the most important due to the way it obtains, processes, and analyzes numerical data in a natural setting where variables are not manipulated and only survey data is collected through objective and measurable responses to the questions.

The study was conducted using a cross-sectional design, in which data collection was carried out during a single period, 2024-2025. Its scope is descriptive-explanatory, as it

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focused solely on evaluating the participants' capacity and the factors associated with their alcohol consumption.

4.1. Participants and sample size

The initial target population for this study consisted of the entire student body of the faculty under investigation at the University of Chimborazo, which had an official record of 14,895 students enrolled during the 2024-2025 academic year. From this population, a purposive non-probability sampling method was used, in which the selected personnel met the following criteria: a) being legally enrolled in a single semester (all courses), b) having no relationship with the researchers (student, family member, or relative by marriage), c) having been affiliated with the institution for more than one year, and d) being of legal age. Thus, a total sample of 2,000 individuals eligible to participate voluntarily in the data collection process was considered, of whom only 1,045 agreed to participate after signing an informed consent form regarding the survey to which they would be subjected.

This sampling strategy was considered the most viable methodological option in the present study due to logistical, temporal, and budgetary constraints that limited the application of probabilistic random sampling. It ensured an ethical environment that promoted honesty and voluntary participation regarding consumer behavior. Some of the inherent limitations of this type of sampling were the representativeness and generalizability of results. As a non-probabilistic sample, it carries a risk of self-selection, where only students who signed the consent form could answer the questionnaire, thus restricting the impact of the findings to the subpopulation.

To mitigate all coverage limitations in the analysis, this research ensured that all programs offered by the university were adequately represented and included in the sample. The following table summarizes the most important demographic characteristics and the percentage distribution of participants.

Characteristic - Gender	N	%
Male	257	24.59
Female	783	74.92
Other	5	0.5
Total	1045	100

Table 2. Shows the sociodemographic characteristics of the student sample

It is important to note that the final participation of the people involved in the sample was entirely voluntary, consented to and informed by each of them, considering their confidentiality and anonymity at all times.

4.2. Instruments

The instruments used to conduct this research consisted of a survey administered to students at a university in Chimborazo, which assessed alcohol consumption patterns and the factors within their environment. This instrument has only been recognized for its design in measuring variables such as consumption habits, physiological effects, quantity consumed, type of beverage, and the influence of their surroundings.

This questionnaire includes all the necessary dimensions, from sociodemographic characteristics and alcohol consumption preferences to physical symptoms after consumption and the factors within their socio-personal and family environment that

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influence these symptoms. The ranges, categories, indicators, and scales of the aspects evaluated in this research are presented in Table 3.

Category evaluated	Indicators	Scale
Consumption preferences Frequency	Gender	Female, Male, or Other
	Type of beverage	Absolute Frequency
	Age of onset	Chronological Age
Physical symptoms	Amount consumed	Ordinal Scale
Family context	Physical consequences	Rating Scale
	Family attitude towards consumption	Nominal
	History of loss of objects due to consumption	Nominal
Consumption preferences	Type of companions	Multiple Choice
	Physical spaces for consumption	Multiple Choice

Table 3. Shows the categories evaluated in the student sample

The structured questionnaire has items organized and designed with the intention of measuring the behavior, consumption habits and daily life of students belonging to the higher education system through the social, personal, emotional, family and work competencies of their environment.

4.3. Data Analysis

The first phase of this study consisted of implementing the data collection instrument with the student sample from the University of Chimborazo during the 2024-2025 academic year. Subsequently, the information collected in the surveys was processed, tabulated, and statistically analyzed using the SPSS software package, supplemented by automated spreadsheets to consolidate the data. In the data analysis, a descriptive statistical process was implemented to characterize the sociodemographic profile of the sample and determine the prevalence of the phenomenon, including factors such as gender, types of beverages consumed, post-drinking psychological symptoms, and the physical spaces/environments in which these occur. Absolute frequencies and percentages were calculated for each variable.

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5. Results

5.1. Prevalence of alcohol consumption and characterization of the habit.

The first element analyzed was the alcohol consumption pattern of the students studied. It was noted that the sample was predominantly male (***η*** = 783; 74.9%), followed by female (***η*** = 257; 24.6%), with a small number opting for other beverages (***η*** = 5; 0.5%), resulting in a total sample size of N = 1045 students.

Figure 1 presents the data obtained and summarized in this section regarding the consumers' preferred beverage and their gender

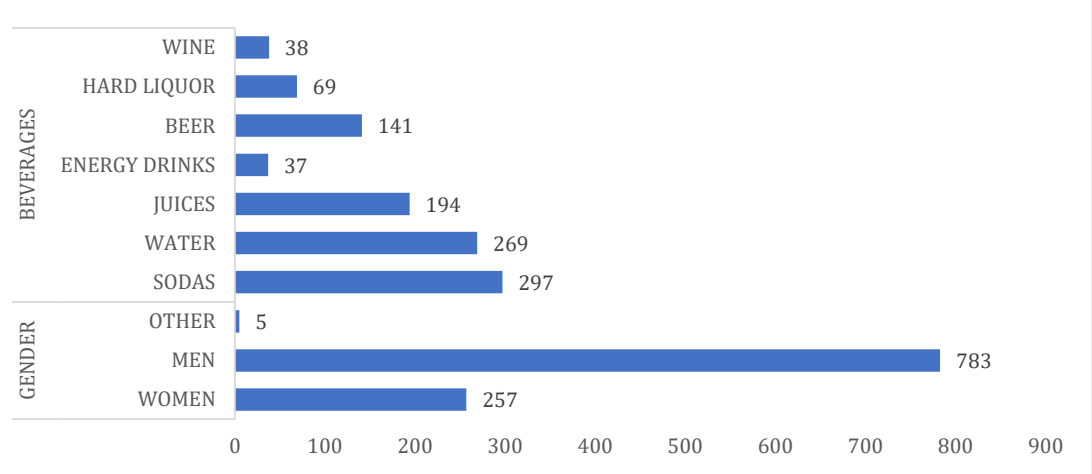


Figure 1. Shows the prevalence of consumption

Regarding consumption preferences, as shown in Figure 1, it was found that non-alcoholic beverages had the highest frequencies, starting with references such as soft drinks (n = 297; 28.42%), water (n = 269; 25.74%), juices (n = 194; 18.56%) and energy drinks (n = 37; 3.54%); while, within alcoholic beverages, beer ranked first (n = 141; 13.50%), followed by hard liquor (n = 69; 6.60%) and wine (n = 38; 3.64%).

5.1.1. Alcohol consumption on regular days (usually)

- 817 respondents demonstrated a state of generalized non-consumption on weekdays, representing 78.2%. This indicator shows the prevalence of intermittent or permanent abstinence during regular academic days, prioritizing their tasks or responsibilities.
- 178 students, approximately 17% of the total sample, reported low consumption on academic days, consuming at most one bottle of beer (105), one glass of liquor (43), and one glass of wine in other cases (30).
- 50 people in the total sample revealed high consumption, that is, in large quantities on typical academic days, representing 4.8%. These individuals, while having to fulfill their academic obligations, also have high consumption, reaching more than one glass of liquor (22), more than one glass of hard liquor (13), more than one bottle of beer (11), and even more than one glass of wine (4)..

5.1.2. Alcohol consumption on weekends

- 602 students reported not consuming alcohol on weekends, representing 57.6%, which indicates that the majority of the sample maintains abstinence even during

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leisure time or academic breaks. Comparing this value with the previous indicator suggests that regular consumption occurs more frequently during the week than on weekends or holidays.

- 266 students, approximately 25–26%, indicated that they do consume alcohol on weekends, but in moderation, in some cases up to one bottle of beer (178), one glass of hard liquor (46), and one glass of wine (42).
- 177 of the respondents, approximately 16.94% of them, indicated that they do consume alcohol on weekends, identifying consumption of: more than one bottle of beer (8.5%), more than one glass of wine (1.4%), more than one glass of hard liquor (3.8%), and more than one glass of strong liquor (3.1%).).

5.1.3. Start of consumption

- 349 people surveyed reported complete abstinence; that is, 33.3% indicated they had never consumed alcohol in their lives. Based on the factors mentioned above, this reflects a completely healthy lifestyle within the studied population.
- 675 students reported having already begun consuming alcohol and being active in this environment. The youngest age of initiation was an average of 16.8 years (μ = 2.4). The peak of vulnerability identified was early initiation at ages 15 (97), 17 (114), 18 (94), 19 (95), and 20 (94), respectively.
- 21 of the students surveyed did not answer the question, which may represent a limitation within the present study, since we will not be able to consider their answers in the following questions regarding the symptoms that alcohol consumption generates in physical health, the preferred drink, their company during consumption or the places in which they prefer to do it.

5.1.4. Post-consumption symptomatology

- A total of 578 students reported experiencing dizziness, representing 55% of the sample. This result demonstrates that dizziness is the most prevalent clinical symptom among alcohol consumers, with 440 affirmative responses and 138 responses indicating "sometimes." This highlights the significant impact of the substance itself on the individual's central nervous system and the vulnerability of those exposed.
- 412 respondents reported experiencing digestive issues, particularly nausea, after consuming alcohol, representing 39.4% of consumers. Regarding gastric intolerance, 304 students responded "yes" and 108 indicated "sometimes," demonstrating a physiological reaction of the body to the ingestion of a potentially harmful substance.
- Approximately 409 people, or 39.1% of the sample, reported episodes of vomiting, with 304 responding "yes" and 108 responding "sometimes." This suggests patterns of heavy consumption or acute intoxication from the ingested beverage in the gastrointestinal tract.
- 397 students reported experiencing general malaise throughout their bodies, meaning 38% of the analyzed sample reported persistent side effects, such as a hangover, after consumption. Of these, 67% responded "yes," while 33% indicated this only happened "sometimes." This can have a significant impact on academic performance and the ability to carry out daily activities.
- 220 individuals, or 21% of the sample, reported experiencing temporary loss of consciousness during consumption episodes, due to the intoxication caused by the substance's effects on the body. 133 subjects responded "yes" and 87 responded "sometimes." While this factor represents another symptom associated with alcohol

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consumption, the risk it poses to physical well-being and vulnerability within the social environment is significant.

- 201 people, representing 19.2%, reported experiencing acute abdominal and digestive problems. 150 individuals responded "yes" and 51 responded "sometimes." This can often be caused by alcoholic beverages with a high alcohol content or risky combinations that can affect the digestive tract. • 45 of the respondents reported organically generated seizures, of which only a small part warned of suffering critical and dangerous neurological responses in the consumption population, with 23 people saying “yes” and 22 saying “sometimes””.

5.2. Social environment and family atmosphere

In the second section, within the results, the analysis focused on identifying the factors associated with alcohol consumption and the influence of different community groups on this process. When examining the perception or position of the family unit regarding consumption, a restrictive trend was identified. Within households, 53% disapprove of alcohol consumption, 23.6% do not interfere or comment on it, 16.4% accept that their children or relatives consume it, and 7.1% report not knowing if their children engage in this practice.

Regarding the variables of social interaction, the following summary table presents the frequency and percentage of the analyzed sample regarding drinking companionship, the motivators or social reasons for doing so, and the environments or physical spaces where consumption occurs.

Social Indicator Category	Type of indicator	Frequency	Percentage
Social motivators	Sharing with friends/partner	360	34.4%
	Get-together or party	455	43.5%
	Celebrating an achievement	170	16.3%
	Completion of academic activities	24	2.3%
Physical consumption environments	Financial problems	5	0.5%
	Academic problems	12	1.1%
	Family problems	19	1.8%
	Around the university	30	2.9%
	Friends' house	340	32.5%
	Parties	260	24.99%
	Walk	35	3.3%
	Park	13	1.2%
	Other	367	35.1%
Consumer company	Friends	572	54.7%
	Alone	49	4.7%

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	Family	363	34.7%
	Strangers/Other	61	5.8%

Table 4. Consumption Indicators. The table shows the social consumption indicators evaluated in the student sample.

In summary, after statistically processing the data, it was observed that, according to the interactions detailed in Table 4, simply being accompanied by friends or peers plays a primary role in the development of alcohol consumption, establishing itself as the core social group for consumption, at 54.7%, significantly surpassing family members by approximately 20%. Regarding the motivations or reasons that promote alcohol consumption, it was identified that 75.6% of cases refer to celebrations shared with peers, while various economic, academic, and family stresses represent a very small proportion, with a total of 36 incidents corresponding to 3.4% of the motivations.

Finally, regarding the environments or physical spaces, it is found that the trend leans towards consumption in friends' houses, with a percentage of 32.5%, and establishments such as nightclubs or parties, with a portion of 24.9%, which shows that this behavior often occurs in environments of external validation and away from the environment of relatives..

6. Discussion of results

The state of the art presented at the beginning of this article reflects the importance of expanding our existing knowledge on the number of studies related to consumption patterns or habits within higher education, demonstrating not only descriptive approaches to consumption and the variables that can temporarily or permanently influence the development of this habit. In this study, the results related to the sex or gender of the consumers showed that 74.9% of the population are male, which differs from the findings of the research presented by Gómez-Tejeda et al., 2021 and Parra-Soto et al., 2023, who demonstrated a predominance of females with results of 66% and 74%, respectively. This represents a significant shift in the association between alcohol consumption and related factors. This difference may be due to the culture of the society in which the students develop or the social pressure exerted on some individuals more than others.

Furthermore, factors related to the epidemiological understanding of this phenomenon were identified, allowing for its temporal segmentation. This analysis revealed that 78.2% of the abstinence reported by students is directly related to their normal weekly routine, while 57.6% of those evaluated abstain on weekends, meaning they are part of the percentage who do not drink at all. This finding demonstrates that students' alcohol consumption behavior is not chronic, but rather reflects a lifestyle in which the vast majority prioritize meeting the demands of academic life over having much leisure time.

In line with Solís et al., who determined that young people are more vulnerable during the early transition years, the main results showed that the ages at which they began drinking were: 12 years old (1 person), 14 years old (2 people), 15 years old (7 people), 16 and 17 years old (8 individuals each), and 5 subjects who started at 18 years old (Solís et al., 2022). The findings collected in this study agree with the actual age at which the surveyed students began consuming alcohol, which has a marked mean of 16.8 years and a range of initiation between 15 and 20 years old. This age, more often due to domestic, economic, or family problems, stems from adolescent self-discovery.

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Considering the increase in young alcohol consumers and the importance of proposing alternatives to address this issue, it is essential to understand the social factors or events that motivate alcohol consumption, which in this particular research are characterized as follows: Sharing with friends or partners, parties or meetings, celebrating achievements, completing academic activities, or dealing with family, economic, and academic dilemmas; this is verified in other research, such as that carried out by Solís et al. (2022), who states that the factors associated with the consumption of this substance are divided into: mental problems, low self-esteem, family or economic dilemmas, social pressure, completion of school work, or problems with their partners or boyfriends..

Regarding the environment or physical space where alcohol is preferred, following the theory cited by Betancourth-Zambrano et al. (2017), students most often prefer to consume alcohol at a friend's house, in bars, clubs, discos, or at their own home, due to its social acceptance by their family or social group. However, this also presents a risk in the eyes of parents, as a kind of consequence that is passed down from generation to generation due to the maturation process and decision-making.

Finally, when discussing the clinical symptoms that the human body presents after consumption, it is necessary to refer to the effects of the alcohol that has been ingested and processed by the body's fluids or blood. As Arias indicates, some of the most common conditions related to alcohol consumption originate in the respiratory system (pneumonia, abscesses, laryngitis, bronchitis) and the digestive system (esophagitis, ulcers, gastritis, halitosis, hepatitis, pancreatitis, etc.) (Arias, 2025). This coincides with the physical consequences found in this research, which include hangovers, dizziness, abdominal pain, vomiting, general malaise, and loss of consciousness; these effects gradually lead to the aforementioned problems.

7. Conclusions

In the sample studied, the pattern of alcohol consumption among university students was not reflected as a chronic attitude or behavior, but rather as an adaptive phenomenon to the time period in which they are developing. They exhibited significant abstinence during the week (normal academic routine) at 78.2%, and less restriction on intake on weekends at 57.6%. This demonstrates that students have the capacity to discern between the activities they must fulfill to meet their academic demands, disregarding common theoretical approaches that portrayed alcohol as a constant risk throughout the university community.

Among the most relevant associated factors related to alcohol consumption, peers or friends played a very significant motivational role, more so than the family environment. Furthermore, their main social motivations were the culture of celebration and social gatherings, the search for social acceptance, economic, family, or academic pressures, and spending time with friends or partners. Regarding the physical environment, the findings align with normal parameters, as consumers prefer to consume alcoholic beverages in private or public spaces such as friends' or their own homes, nightclubs, bars, clubs, or during outings.

Finally, the appearance of post-consumption physical and social symptoms acts as a deterrent to the habit of drinking alcohol; therefore, it is pertinent to briefly mention it in conclusion. These factors include parental disapproval of alcohol consumption, the presence of adverse physiological responses, and general malaise, which can manifest as dizziness, nausea, vomiting, hangovers, body aches, loss of consciousness, seizures, abdominal pain, and other symptoms.

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Declaration of authorship-CRediT

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Statement on the use of artificial intelligence

The authors report that they used the ChatGPT tool – GPT-4 model (OpenAI), July 2025 version – partially during the manuscript preparation stage, specifically for: (1) support in the syntactic restructuring of some paragraphs; (2) the creation of alternative versions of titles and subtitles; and (3) the generation of preliminary examples that were subsequently reformulated manually. AI was not used to draft sections related to the methodological design, data analysis, interpretation of results, or academic discussion. All content suggested by the tool was critically reviewed, verified, and modified by the authors, who assume full responsibility for the final text, its accuracy, and its scientific rigor. No data, documents, or sensitive information were entered into the tool during its use.

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REVISTA CÁTEDRA

Interactive applications as a strategy for socio-emotional development in primary school students

Aplicaciones interactivas como estrategia para el desarrollo socioemocional en estudiantes de educación primaria de escuelas

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Abstract

The objective of this study was to propose the integration of free interactive applications to strengthen the development of socio-emotional skills in primary school students in rural schools. Their use allows for the creation of dynamic, participatory, and contextualized learning experiences focused on emotion recognition, self-regulation, empathy, assertive communication, and peaceful conflict resolution. In rural contexts, where access to specialized educational resources and psychosocial support may be limited, these tools offer new possibilities to complement teachers' work and promote inclusive school environments. The research was conducted using a mixed-methods approach and a concurrent triangulation design. For data collection, observation sheets were used with 22

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students, surveys were administered to 2 teachers, and interviews were conducted with 3 experts. The results demonstrated the pedagogical and technical feasibility of implementing applications such as Smile and Learn, Respira, Juega, Actúa (Breathe, Play, Act), and Invasión Zombi (Zombie Invasion). These applications stand out primarily for their offline accessibility, cultural relevance, and capacity to promote social skills such as empathy, emotional self-regulation, and assertive communication. Furthermore, a favorable predisposition among teachers toward the use of technologies and digital applications was identified, although the need for institutional strengthening for their systematic adoption is evident. It is concluded that the proposal constitutes an innovative and contextualized alternative to contribute to reducing educational and socio-emotional gaps in rural environments

Keywords

Socio-emotional development, interactive applications, rural education, emotional self-regulation, educational technologies

Resumen

El objetivo de este estudio fue proponer la integración de aplicaciones interactivas gratuitas para fortalecer el desarrollo de habilidades socioemocionales en estudiantes de educación primaria de escuelas rurales. Su utilización permite generar experiencias de aprendizaje dinámicas, participativas y contextualizadas, orientadas al reconocimiento de las emociones, la autorregulación, la empatía, la comunicación asertiva y la resolución pacífica de conflictos. En los contextos rurales, donde pueden existir limitaciones de acceso a recursos educativos especializados y acompañamiento psicosocial, estas herramientas ofrecen nuevas posibilidades para complementar la labor docente y promover ambientes escolares inclusivos. La investigación se desarrolló mediante un enfoque mixto y un diseño de triangulación concurrente. Para la recolección de información se aplicaron fichas de observación a 22 estudiantes, encuestas a 2 docentes y entrevistas a 3 expertos, de manera que, los resultados evidenciaron la factibilidad pedagógica y técnica de implementar aplicaciones como Smile and Learn, Respira, Juega, Actúa e Invasión Zombi, las cuales se destacan en lo principal por su accesibilidad offline, pertinencia cultural y capacidad para promover habilidades sociales como la empatía, la autorregulación emocional y la comunicación asertiva, por otra parte, se identificó la predisposición favorable de parte de los docentes hacia el uso de tecnologías y aplicaciones digitales, aunque es evidente la necesidad de que exista fortalecimiento institucional para su adopción sistemática. Se concluye que la propuesta constituye una alternativa innovadora y contextualizada para contribuir a la reducción de brechas educativas y socioemocionales en entornos rurales.

Palabras clave

Desarrollo socioemocional, aplicaciones interactivas, educación rural, autorregulación emocional, tecnologías educativas.

1. Introduction

The socio-economic skills allow students to understand, regularly and express their emotions in the context. Aristulle and Paoloni indicate that emotions are subject to emotional influence and influence in which people perceive and respond to situations, personas and objects (Aristulle and Paoloni, 2019, p. 7). Therefore, it is vital that students

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learn to develop skills that facilitate an adequate emotional development that promotes personal well-being, social adaptation and significant learning.

From receiving UNESCO thanks to a study carried out in the year 2019 with the aim of promoting the teaching of socio-economic skills in educational systems, the module is based on consideration of very socio-economic skills: empathy, awareness of diversity and self-regulation school. In relation to empathy, the results obtained from the various participating countries show that the students report their conduct, emotions or feelings that are based on empathy on repeated occasions with moderate frequencies of 55% and only 15% declares a low frequency of this type of behavior, if Cuba is a country that has a higher average than other participating countries in this category. On the other hand, UNESCO indicated that 85% of students from the participating countries declared a favorable activity, although only 6% reported feeling much dissatisfaction among their distinct people, whether in Costa Rica or Cuba who found their most positive points in this area. Finally, in terms of automatic school regulation, the 74% of responses indicate that students are aware of the fact that they are capable of ejecting automatic actions in the school environment and only 5% report that this type of conduction occurs with a low frequency. non-existent, new Cuba has seen a major point that the rest of the participating countries, Brazil reveals a lower point, but it has a positive level (UNESCO, 2024, p. 22-27).

In the current situation, the socio-economic development has been consolidated as an essential component in basic education, especially in the rural sectors of Ecuador, where the social, economic and technological conditions present limited variations and strengthen the socio-economic skills that can mark a positive difference. in the general well-being and academic despair of children. La presente investigación trata sobre la problemática relacionada con la utilización de recursos tecnológicos interactives orientados al desarrollo socioemocional en estudiantes de educación primaria de escuelas rurales. The root of the problem is the limited availability of innovative teaching methods adapted to the economic needs of students, which restricts their educational potential and negatively affects their overall well-being.

One of the main issues identified is the limited access to technology in rural areas, which has a direct impact on the viability of digital strategies applied in the classroom. According to data from the National Institute of Statistics and Censuses (INEC), digital analysis in the rural sector reaches 14.1% in people between 15 and 49 years old, including those who do not have an active cell phone, do not use a computer or have access to the internet in it last year (INEC, 2024, p. 20).

This situation is based on various factors, among them the resistance or the scarce interests of some educational documents related to the change processes, the lack of capacity in the pedagogical use of interactive applications and the limitation of the existence of local studies in this topic. In conjunction, these conditions make it difficult to effectively implement technological strategies oriented toward the growth of socio-economic development in childhood. Emotional education constitutes an important pillar in the development of children, particularly in early childhood. Ignoring this aspect can generate negative consequences in your self-esteem, academic coexistence and learning ability. In this context, Garofalo and Villao identify multiple applications in the rural educational system, stories such as the lack of understanding of the educational use of technology, the lack of access to teaching courses, the precariousness of basic services, and the adverse geographic conditions that make assistance to classes difficult, and the limited orientation of education towards technical productive development (Garofalo and Villao 2018, p. 156). In this

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situation, we recognize the urgent need to integrate digital networks with interactive applications, those which are demonstrated to be effective in fostering skills such as empathy, emotional regulation and communication, through educational and accessible activities in the context. pedagogical.

The idea of this research consists of proposing a didactic guide: discovering socio-economic skills through collaborative games without connectivity. The proposal is supported by a framework of research with mixed methodology, which combines quantitative and qualitative instruments with a predominance of qualifications, allowing for a more profound understanding of the phenomenon studied.

The suggestions that this is your study: can free interactive applications be offered to help you learn socio-economic skills in general basic education at a rural school? Do free and accessible technological options currently exist to serve this purpose in rural educational contexts? Do you have the digital skills level of this institution? Are there educational and teaching benefits offered to improve socio-economic skills in basic general education students? As it answers to these questions, this plant studio offers free interactive APPS for the development of socio-economic skills in primary education students of rural schools, so it is also hoped that it can be replicated or adapted to other similar contexts, providing a contextualized solution to the existing economic and technological gap.

This proposal responds to a concrete educational need and offers a relevant pedagogical alternative to reduce inequalities in access to emotional and digital resources in rural areas. To integrate technological tools into the classroom in an intentional and context-sensitive manner, it contributes to a more inclusive, equitable and humanized education of the first and second students.

This article is organized into five epigraphs. In the first section we describe the introduction that addresses the antecedents, the justification of the study and the questions of the investigation; In section 2 we will discuss the revision of the literature that theoretically funds the study, mainly in the socio-economic development, the pedagogical use of information technology and communication and interactive educational applications. In section 3 we describe the methodological design, explaining the mixing process, the type and the investigation design, the population and the data, the data collection instruments and the analysis procedure. In section 4 we present and discuss the quantitative and qualitative results, and incorporate the didactic proposal based on interactive applications to promote socio-economic skills in rural contexts. In the last section 5 we explain the conclusions derived from the main conclusions obtained from the study.

2. Literature Review

2.1 Definition of socio-emotional development

Diehl and Gómez state that socio-emotional development refers to the set of cognitive and emotional skills that a person can acquire and strengthen to act in ways that promote both their own well-being and that of others (Diehl & Gómez, 2020, p. 6). These skills allow individuals to achieve positive outcomes in their health, interpersonal relationships, and academic and professional goals, as well as facilitating positive participation in society.

2.1.1 Importance of socio-emotional skills

The Ministry of Education indicates that social-emotional education is a comprehensive process through which children and adolescents acquire and apply knowledge, values, attitudes, and skills essential for understanding themselves and others, making responsible

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decisions, and facing challenges ethically (Ministry of Education of Ecuador, 2020, p. 3). Its purpose is to develop tools that promote personal and social well-being, in accordance with the recommendations of organizations such as the WHO, PAHO, and UNICEF, which highlight the importance of fostering life skills as a protective factor for emotional and mental health. Within the framework of Ecuador's National Education System, five fundamental skills for students' social-emotional development have been identified: empathy, understood as the ability to put oneself in another person's shoes, understand their emotions, and accept differences; self-awareness, which allows one to recognize emotions, thoughts, strengths, and areas for improvement; emotional management, related to the ability to identify, express, and manage feelings such as anger, sadness, or frustration, avoiding impulsive responses; Conflict resolution, which promotes a peaceful, dialogical, and constructive approach to disagreements; and decision-making, which enables informed and responsible choices among various alternatives, considering their consequences, the context, and one's own and collective well-being (MINEDUC, 2020, p. 4).

2.2 Principles of the pedagogical use of ICT

Based on the following principles, the importance of a reflective and contextualized integration of ICT in education can be highlighted, considering not only its presence in the classroom, but also its function and the way in which it is used to improve teaching and learning processes.

a. Transformation of organizational structures

The implementation of ICTs in Ecuadorian public schools has modified the organizational structures of educational centers, although it has not substantially altered educational practices in the classroom (Gallego et al., 2010, p. 5).

b. Fostering student motivation

The use of ICTs has been shown to foster high student motivation to learn, suggesting a positive impact on the teaching-learning process (Gallego et al., 2010, p. 8).

c. Digital Competencies and Teacher Training

The effective incorporation of ICTs in education requires that teachers be adequately trained and equipped to integrate these technologies into their pedagogical practices (Gallego et al., 2010, p. 13). Therefore, teachers' digital competencies consist of the effective use of technological tools for pedagogical purposes, beyond their instrumental function (Guevara, 2024, p. 104).

d. Curricular Integration of ICTs

For ICTs to have an impact on education, it is essential that they be integrated into the curriculum and not used in isolation or as a supplement (Gallego et al., 2010, p. 17).

e. Continuous Evaluation and Adaptation

It is important to continuously evaluate the use of ICTs in the educational environment and adapt them according to the specific needs and contexts of each institution and educational community (Gallego et al., 2010, p. 15).

2.3 What are interactive educational applications?

“Interactive applications designed for educational purposes allow students to interact dynamically with diverse multimedia resources such as text, graphics, audio, video, and links” (Salazar et al., 2025, p. 868). These types of applications do not simply present information passively, but rather invite the user to actively participate in their learning process.

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Based on an analysis of López-Peñalver's work (2023), several types of applications specifically aimed at emotional development are identified:

a. Mindfulness Applications
According to López-Peñalver (2023), these consist of breathing exercises, guided meditations, and relaxation activities (p. 9). Students learn to manage stress and anxiety, improving their emotional well-being and concentration in the school environment, as exemplified by the app "Breathe, Play, Act."

b. Interactive Role-Playing Games
Role-playing games allow students to assume different characters and situations, facilitating the understanding and expression of their own and others' emotions (López-Peñalver, 2023, p. 20). A recommended application that incorporates this methodology is called "Mathematics: Zombie Invasion."

c. Digital simulations
López-Peñalver (2023) defines them as simulation applications that offer virtual environments where students can experience various social and emotional situations in a safe context (López-Peñalver, 2023, p.16), such as the “Smile and Learn” application.

Implementing these applications in the primary education curriculum would contribute to students' holistic development by combining academic learning with the strengthening of emotional and social skills. Furthermore, the strategic use of ICT in the classroom fosters a more interactive and participatory learning environment, preparing students to face the challenges of an increasingly digital and complex world.

2.3 1 Characteristics of an effective educational app

The use of mobile technologies has become increasingly important as a support tool in teaching and learning processes, and the incorporation of mobile applications opens up new possibilities for personalizing teaching, motivating students, and facilitating access to knowledge. However, for these technological tools to be truly effective, they must meet certain pedagogical, technical, and contextual quality criteria, such as:

a. Meaningful Pedagogical Integration
Vera and Cárdenas indicate that these tools should be aligned with curricular objectives and facilitate teacher mediation, not replace it (Vera & Cárdenas, 2021, p. 112). Their use should respond to the real needs of the teaching-learning process, promoting active and student-centered methodologies.

b. Accessibility and Adaptability
Vera and Cárdenas state that it is essential for them to be accessible to diverse educational contexts (Vera & Cárdenas, 2021, p. 113), considering factors such as connectivity, device availability, and users' digital skills.

c. Ease of Use and Intuitive Design
Vera and Cárdenas affirm that a user-friendly interface and intuitive design (Vera & Cárdenas, 2021, p. 115) allow both teachers and students to use the application without technical difficulties, enabling them to focus on the educational content.

d. Fostering Autonomy and Motivation
Vera and Cárdenas state that successful applications promote student autonomy, offering opportunities for self-directed learning and self-assessment (Vera & Cárdenas, 2021, p. 116). They also incorporate elements that increase motivation, such as immediate feedback and rewards for achievements.

e. Teacher Training and Technical Support

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Vera and Cárdenas mention that the effective implementation of educational applications requires training programs for teachers (Vera & Cárdenas, 2021, p. 118), enabling them to critically and reflectively integrate these tools into their teaching practice.

f. Evaluation and Continuous Improvement

Vera and Cárdenas indicate that it is necessary to establish evaluation mechanisms to measure the application's impact on learning and gather user feedback (Vera & Cárdenas, 2021, p. 121). This allows for adjustments and continuous improvements.

2.4 Pedagogical Foundations

a. Daniel Goleman's Theory of Emotional Intelligence

Emotional intelligence is "the set of skills that allow one to recognize, express, and manage emotions appropriately, both personally and socially" (Caputi, 2024, p. 48). Emotions such as self-motivation, perseverance, empathy, and mental agility can be strengthened with the help of interactive apps that contribute to students developing a resilient and socially adaptive character.

b. Ausubel's Theory of Meaningful Learning

Meaningful learning occurs when new information is linked in a non-arbitrary and substantive way to the student's prior cognitive structure through advance organizers that prepare the conceptual groundwork (Pinzón, 2024, p. 8860). Interactive apps promote and facilitate deep understanding, lasting retention, and the development of critical thinking by allowing students to actively reason, analyze, and evaluate the content.

c. Vygotsky and Piaget's Constructivism and Technology-Mediated Learning

According to Rodríguez, Jean Piaget conceives of constructivism as a process of progressive cognitive development, where the individual assimilates new knowledge through pre-existing mental schemas. He also posits that learning occurs through exploration of the environment, and that the processes of assimilation and accommodation allow for the attainment of complex states of thought. On the other hand, Lev Vygotsky considers learning to be a social process mediated by language and interactions with others (Rodríguez, 1999), particularly with those who possess greater knowledge. Therefore, in both processes, interactive apps allow students to explore, experiment, and collaborate on activities that promote socio-emotional development through technology as a mediator of learning.

3. Methodology

This work is based on the pragmatic paradigm, understood as the capacity of an idea or proposal to generate practical, useful, and beneficial results in addressing a specific problem (Arias, 2023, p. 15). In accordance with this paradigm, a mixed-methods approach is adopted, defined as the set of systematic processes for collecting, analyzing, and integrating quantitative and qualitative data within a single study, with the purpose of providing a broader and deeper response to the research question (Hernández-Sampieri et al., 2014, p. 532). The choice of this paradigm and approach directly responds to the overall objective of proposing the implementation of interactive applications aimed at strengthening the socio-emotional development of students in rural areas.

3.1 Approach

The present research employs a mixed-methods approach, with a predominance of qualitative elements, allowing for a deep and contextualized understanding of the

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contribution of interactive applications to the socio-emotional development of primary school students in rural environments. From the qualitative perspective, this approach is recognized as enabling the formulation and refinement of questions and hypotheses before, during, and after data collection and analysis (Hernández-Sampieri et al., 2014, p. 7). In this sense, semi-structured interviews were used to explore the perceptions, experiences, and meanings constructed by experts regarding the importance of socio-emotional development in rural areas; the influence of applications on learning breathing and self-regulation techniques; their feasibility of implementation in contexts with technological limitations; the methodological challenges associated with the use of interactive games; their impact on the understanding and management of emotions, as well as on motivation toward school subjects; and the didactic elements that promote socio-emotional learning. In addition, the quantitative approach, which allows for data collection to test hypotheses based on numerical measurement and statistical analysis (Hernández-Sampieri et al., 2014, p. 4), is implemented through Likert-type surveys for teachers and Likert-type observation checklists for students, in order to identify observable changes in socio-emotional competencies. This methodological articulation allows for the validation of qualitative findings with empirical evidence, thus providing a comprehensive, rigorous perspective adapted to the rural context in which the study is conducted.

3.2 Type of research

This study falls under the category of applied and participatory research, as it seeks to achieve relevant knowledge and address a general problem (McMillan & Schumacher, 2005, p. 24) through a specific educational intervention based on the implementation of interactive applications that promote the socio-emotional development of elementary school students in a specific rural context. It is also classified as exploratory and descriptive research, given that its purpose is to examine a research topic or problem that has received little attention (Hernández-Sampieri et al., 2014, p. 91) and to characterize the experiences and perceptions of teachers and students regarding the pedagogical use of these technological tools, as well as to identify observable changes in skills such as empathy, emotional self-regulation, and communication.

3.3 Research Design

The research was conducted using a Concurrent Triangulation Design (DITRIAC), characteristic of a mixed-methods approach, which allows for the simultaneous collection and analysis of qualitative and quantitative data. Although the data obtained simultaneously are analyzed separately (Hernández-Sampieri et al., 2014, p. 557), the results are subsequently integrated in the interpretive phase to establish convergences, complementarities, or discrepancies. The triangulation process included comparing the teachers' quantitative perceptions, obtained through surveys, with classroom observations of students; validating the findings with expert opinions; and cross-referencing the data with the theoretical framework, thus strengthening the internal coherence and interpretive rigor of the research:

- **Phase 1: Quantitative Instrument**

  Likert-type surveys will be used with teachers, and Likert-type observation checklists will be used with students to evaluate teachers' digital competence levels and students' progress in socio-emotional skills.

- **Phase 2: Qualitative Instrument**

  Structured interviews will be conducted with experts in educational psychology and technologies applied to education. The purpose is to deepen our understanding of

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the pedagogical use of interactive applications and their contribution to children's socio-emotional development.

• **Phase 3: Integration of Results**

In this stage, the qualitative and quantitative results will be triangulated and integrated. The findings will be compared and interpreted together, using a side-by-side approach (Hernández-Sampieri et al., 2014, p. 557). The quantitative results are presented first, followed by the qualitative categories and relevant quotes from experts, to determine convergences, divergences, or complementary contributions.

3.4 Sample population

The sample population is defined as a subgroup of the universe or population from which data are collected and which must be representative of it (Hernández-Sampieri et al., 2014, p. 173). In this study, it consists of students in Basic General Education at a public school located in a rural area. This sample includes both the students and the teachers who actively participate in the teaching-learning process within the classroom, constituting the focus group on which the data collection techniques and instruments were applied.

Level	EGB
Parallel	A
Conference	Morning
Students	22
Teachers	2
Experts	3
Grand Total	27

Table 1. (Granda, 2025).

The selected sample consists of the 3 experts, a total of 22 students and 2 teachers from a small rural school characterized by a low socioeconomic level. All attend the morning session, so the small population is accessible and manageable; therefore, we will work with all participants.

3.5 Correlation of Instruments

The integration of both approaches, qualitative and quantitative, will be achieved through methodological triangulation. The findings from the numerical data of the personal surveys and observation sheets will be compared with the numerical results obtained through the surveys. This correlation will allow:

- Validate the internal consistency of the data by comparing participants' subjective perceptions with quantifiable indicators.
- Identify and explain in detail how interactive applications would contribute to specific aspects of socio-emotional development.
- Delve deeper into the analysis of the benefits and challenges associated with integrating technologies, which will facilitate the development of improvement strategies adapted to the rural educational context.

Therefore, to determine the reliability of the results, Cronbach's Alpha was applied. This tool measures the internal consistency or reliability of the test-type data collection instrument, producing values between zero and one (Hernández-Sampieri et al., 2014, p. 295). The validation of the surveys administered to teachers yielded a very positive Cronbach's Alpha reliability coefficient of 0.973, while the observation checklists

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administered to students showed a Cronbach's Alpha reliability coefficient of 0.953, indicating completely reliable responses.

On the other hand, the process that allowed for the validation of the proposal, where the interviewed experts indicated that interactive applications do indeed contribute to socio-emotional development provided they are implemented with teacher mediation, adaptations, teacher training, and institutional support, was carried out using MAXQDA software. This is a definitive qualitative data analysis software that allows for the organization, analysis, and interpretation of a variety of data, and its functions include coding, categorization, data visualization, text search, and quantitative content analysis (VERBI Software, 2025). The experts agreed that the collaborative games approach fosters student motivation and the acquisition of soft skills.

3.5.1 Operationalization of the study variables/categories

The operationalization of the study variables on interactive applications and socio-emotional development is established below, in order to collect, analyze, and interpret data. This operationalization is directly aligned with the study objectives and the selected instruments.

Independent Variable	Study Category	Dimensions	Observable Indicators	Technique and Instrument	Unit of Analysis
Interactive Apps.	Pedagogical integration of the app.	Use in activities - Curriculum relevance.	Frequency of app use in the classroom – Relationship to educational objectives.	Likert scale survey / Structured interview.	Teachers/Experts.
	Accessibility and adaptability.	Offline use - Context adaptation.	Ease of access to the app – Suitability to the rural environment and children's abilities.	Likert scale survey.	Teachers.
	Usability and design.	User-friendly interface - Navigation.	Opinion on ease of use and interaction.	Likert scale survey.	Teachers/Students.
	Acceptance and continued use.	Overall assessment - Willingness to continue.	Intention to continue using the app – Perceived usefulness.	Likert scale survey.	Teachers/Students.

Table 2. (Granda, 2025). Study variables/categories, independent variable.

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Independent Variable	Study Category	Dimensions	Observable Indicators	Technique and Instrument	Unit of Analysis
Socio-emotional Development.	Empathy.	Comprensión emocional- Cooperación.	Interés por las emociones ajenas- Colaboración en actividades con otros.	Encuesta likert.	Docentes / Estudiantes.
	Emotional self-regulation.	Impulse control - Emotional recognition.	Use of emotional control strategies - Verbal identification of emotions.	Likert survey.	Teachers / Students.
	Assertive communication.	Expression of ideas - Social interaction.		Likert survey.	Teachers.
	Application in daily life.	Transfer of learning.	Clarity in communicating emotions - Participation in group activities.	Likert survey.	Teachers.

Table 3. (Granda, 2025). Study variables/categories, dependent variable.

4. Discussion and Results

The percentages obtained in the quantitative analysis were calculated using SPSS v.25 statistical software. Likert-type observation sheets were applied to 22 students, allowing the collection of data on their performance in different socio-emotional skills. Likert-type surveys were also administered to 2 teachers to obtain a complementary perspective from pedagogical practice. The results obtained from these quantitative instruments revealed clear trends in the development of the evaluated competencies, facilitating the identification of strengths and areas for improvement within the process of implementing the activities aimed at the students.

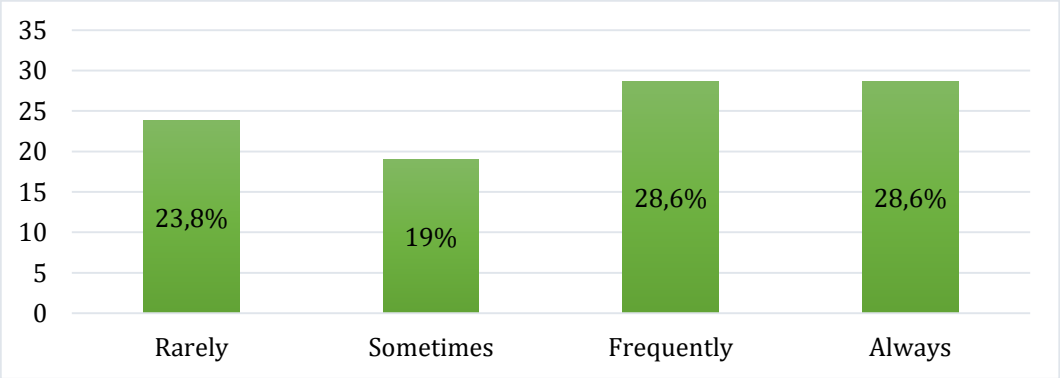


Figure 1. Responses regarding students' awareness of their abilities and limitations.

57.2% of the students showed a high level of self-awareness, with 28.6% indicating this "frequently" and 28.6% "always." Betina and Contini indicate that social skills influence areas such as school and family life, since children who show difficulties in relating to others tend to experience long-term problems such as school dropout, violent behavior, and psychopathological disturbances as adults (Betina & Contini, 2011, p. 161). Therefore, this skill, fundamental for self-regulation and self-esteem, is fostered by reflective activities that

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promote the recognition of emotions, achievements, and areas for improvement. The app played a significant role in this by allowing children to self-evaluate in playful environments.

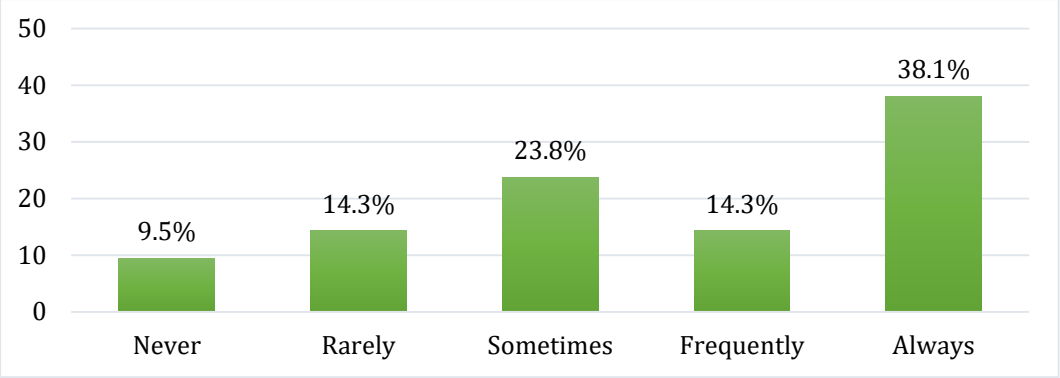


Figure 2. Responses regarding the appropriate management of student frustration.

Although 38.1% indicated that they "always" succeed, a significant group falls into medium or low levels, with 23.8% reporting "sometimes" and 14.3% "rarely." This suggests that, while progress has been made, difficulties in emotional control when faced with frustration persist. It should be noted that low frustration tolerance is linked to emotional situations such as negative events involving aggression, desolation, maladjustment, apathy, and anxiety, triggering an emotional imbalance in the student (Degante & Caselin, 2022, p. 342). Therefore, this skill needs to be reinforced through breathing exercises, mindfulness, and problem-solving activities, which are integrated into the dynamics of the application used.

On the other hand, the results of the surveys administered to teachers indicate a favorable disposition toward the use of technology for socio-emotional purposes, despite the structural limitations of the rural environment.

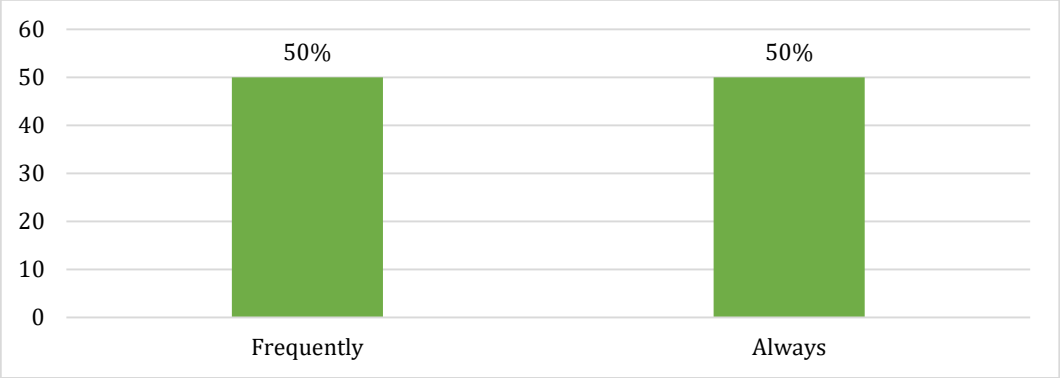


Figure 3. Teacher surveys. I use digital tools to work on socio-emotional aspects such as empathy, self-regulation, and conflict resolution.

One hundred percent of the participants reported using digital tools to work on aspects such as empathy, self-regulation, and conflict resolution, at levels of "frequently" and "always," agreeing that technology has the potential to strengthen emotional development in rural contexts. As Borja and Carcausto state, "Digital tools in education can be defined as the set of applications and platforms that can help both teachers and students in their academic work" (as cited by Echeverría and Molina, 2022, p. 3), the teachers indicated that they do indeed use these tools, with one frequently and the other always. This is a very positive

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result, as it demonstrates a clear appropriation of the emotional approach through digital resources. This favorable attitude constitutes an essential pillar for implementing innovative, technology-based strategies in the classroom.

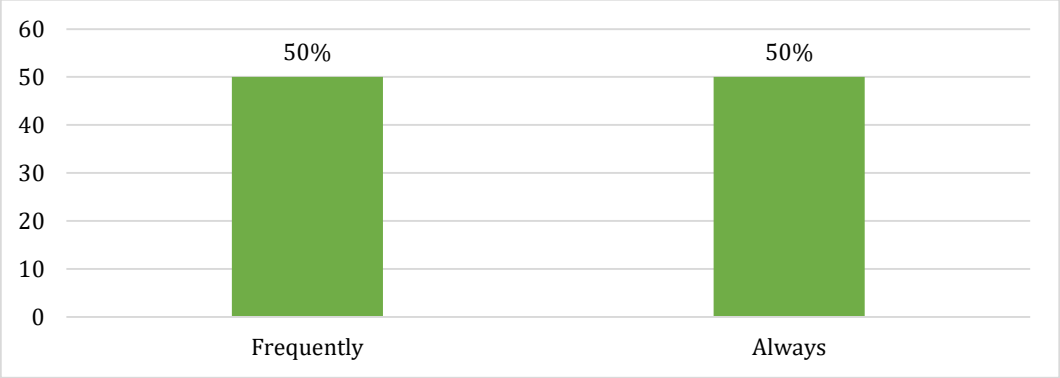


Figure 4. Teacher surveys. I have received training in the use of technologies to work on socio-emotional skills.

Both teachers indicated that they had received training 50% "frequently" and 50% "always." This training is key to the sustainability of initiatives such as the incorporation of interactive apps with an emotional focus. Authors like Espinoza and Rodríguez (2017) suggest that "new technologies available to children offer new possibilities for accessing information and communication, and also new paradigms for relating to the social context, through the modification and generation of socio-affective skills" (p. 6).

Now, from the qualitative analysis, carried out using the MAXQDA software, which allowed the identification of emotional categories such as emotional self-regulation, empathy, and collaborative work, based on interviews with the experts, the main findings are presented below. Activities such as "Breathe, Play, Act" strengthened emotional self-awareness, "Smile and Learn" facilitated the identification of one's own emotions and those of others through interactive stories, and the role-playing game "Zombie Invasion" promoted team decision-making, shared leadership, and cooperation among peers.

Experts emphasized that the use of educational technologies for socio-emotional purposes is not only relevant but also viable, provided there is teacher guidance and pedagogical contextualization. The use of MAXQDA allowed for the organization and validation of these perceptions, supporting the effectiveness of the proposal as an innovative and accessible alternative for emotional education in rural settings.

Expert Response 1	Expert Response 2	Expert Response 3	Analysis and Interpretation
Breathing and relaxation are processes that help us with emotional self-regulation, allowing us to better manage and control our emotions, as well as adapt better to different situations,	Digital breathing and relaxation techniques help students calm down, identify their emotions, and respond better to stress. Being interactive and accessible, they promote emotional	I've seen that there are apps for self-regulation, for both children and adults, and that would make it much easier for us to reduce stress and anxiety.	According to López-Peñalver (2023), digital breathing and relaxation techniques help manage stress and control emotions, facilitating healthy habits. Experts agree that these techniques promote

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so their influence on our nervous system and the physiological responses in our body are very positive.	self-regulation in a practical and consistent way.		emotional self-regulation by reducing stress and anxiety, highlighting their practicality and accessibility, which allow for consistent and engaging implementation for students. Furthermore, they not only improve immediate emotional responses but also develop healthy habits for long-term stress management.
		CODING (TR)	
TR-1: Emotional self-regulation. **TR-2:** Adaptation. **TR-3:** Influence on the nervous system. **TR-4:** Physiological responses.	**TR-1:** Relaxation Techniques **TR-2**: Identifying Emotions **TR-3:** Responding to Stress **TR-4:** Ongoing Encouragement.	**TR-1:** Reduce stress and anxiety.	

Table 4. Expert Interviews. How can the use of digitized breathing and relaxation techniques influence the student's emotional self-regulation??

Expert Response 1	Expert Response 2	Expert Response 3	Analysis and Interpretation
Any reward obtained through pleasurable motivation generates interest, which can be favorably applied to subjects like mathematics.	Yes, because it transforms learning into a fun and practical experience, sparking interest and commitment in students.	Yes, in fact, it's always important to make the class interactive and fun; this greatly helps student learning.	Gallego et al. (2010) point out that educational games motivate students by making classes dynamic and engaging, improving their performance and commitment. Experts agree that these activities increase motivation and interest, even in subjects perceived as difficult, fostering engagement and academic achievement
	CODING (MA)		
MA-1: Reward obtained. **MA-2:** Pleasurable motivation. **MA-3:** Favorable application.	**MA-1:** Playful experience. **MA-2:** Practice. **MA-3:** Interest and commitment.	**MA-1:** Interactive Class **MA-2**: Learning Support	

Table 5. Interviews with experts. Do you believe that this type of game can improve student motivation towards areas such as mathematics or other subjects?

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Expert Response 1	Expert Response 2	Expert Response 3	Analysis and Interpretation
Consider criteria that ensure adaptability and effectiveness. Aspects such as accessibility, culturally relevant content, usability, security, and integration with the local educational community should be evaluated.	Offline accessibility, simplicity, cultural relevance, ease of use for teachers, and local technical support.	Having an attractive interface and, above all, having tools that are useful and at the same time optimized and easily accessible, meaning that the app is not too difficult to use.	According to Vera and Cárdenas (2021), apps must be accessible, relevant, and easy to use to be effective in rural contexts. The experts emphasize the importance of offline accessibility, simplicity, and cultural relevance, since in rural areas the selection of tools must respond to local and technical conditions to guarantee their effectiveness and sustainability.
	CODING (CSA)		
CSA-1: Adaptability and effectiveness**.** **CSA-2:** Cultural content. **CSA-3:** Accessibility, usability, security, and integration.	**CSA-1:** Accessibility. **CSA-2:** Simplicity. **CSA-3:** Cultural Relevance. **CSA-4:** Technical Support**.**	**CSA-1:** Attractive interface. **CSA-2:** Useful tools. **CSA-3:** Optimization. **CSA-4**: Easy access.	

Table 6. Expert interviews. What criteria would you recommend considering when selecting an educational app with an emotional focus for rural contexts?

The responses provided by the experts strengthen the relevance of the pedagogical proposal formulated in this research, whose content consists of a didactic guide: Development of Socio-emotional Skills through Collaborative Games without Connectivity, aimed at primary education students in rural schools.



Figure 5. (Smile and Learn, 2025)

This guide proposes the intentional integration of interactive applications such as Smile and Learn, Breathe, Play, Act, and Zombie Invasion. These applications were selected due to their offline accessibility and cultural relevance, as well as their ability to promote empathy, emotional self-regulation, and communication through playful and collaborative activities.

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The proposal, based on the Technological Pedagogical Content Knowledge (TPACK) model, which focuses on "articulating technological, pedagogical, and curriculum content knowledge to achieve the integration of ICT in teaching practice" (Salas-Rueda, 2019, p. 4), allowed us to understand that the applications were analyzed not only for their technological potential but also for their alignment with socio-emotional learning objectives and their suitability for the specific content of primary school students in rural areas.

Finally, the process carried out using the MAXQDA software allowed for the validation of the proposal, where the experts interviewed indicated that interactive applications do indeed contribute to socio-emotional development, provided they are implemented with teacher mediation, adaptations, teacher training, and institutional support. They also agreed that the collaborative games approach fosters student motivation and the acquisition of soft skills.

5. Conclusions

First, the selection of the applications is justified by their technical and pedagogical characteristics, such as user-friendly design, cultural relevance, and ease of use. These factors facilitate student participation and strengthen emotional understanding and expression, which aligns with the theoretical framework and Goleman's emphasis on developing emotional competencies, especially for students with less exposure to innovative resources. Second, despite the identified technological limitations, such as unstable connectivity and a scarcity of devices, these do not preclude the proposal; rather, they condition its reach and impact. The offline accessibility of the selected applications becomes a key element in overcoming these barriers, as it allows their use without internet access, thus mitigating the effects of the digital divide that characterizes rural areas.

Third, it is concluded that the integration of interactive applications such as "Smile and Learn," "Breathe, Play, Act," and "Zombie Invasion" constitutes a highly relevant pedagogical approach for strengthening socio-emotional skills such as empathy, emotional self-regulation, and assertive communication in elementary school students. This is supported by the TPACK model, as the apps not only possess adequate technological potential but also align with pedagogical objectives and curricular content that promote socio-emotional learning in the rural context.

Fourth, the findings show that the effectiveness of these tools depends directly on teacher mediation, appropriate pedagogical contextualization, and ongoing professional development. Teachers expressed a positive predisposition toward the use of technology but recognize the need for greater institutional support. Therefore, it is recommended that implementation include training workshops focused on the practical use of applications, emotional mediation strategies based on Goleman's framework, and guided activities to inform lesson planning. Fifth, the methodology based on data triangulation confirmed the coherence and robustness of the results, integrating teacher perceptions, student observations, and expert validation. This convergence demonstrates that the proposal is viable, contextualized, and innovative for reducing educational and emotional gaps in the rural school studied, constituting a formative strategy that promotes meaningful, equitable learning adapted to the needs of the educational community.

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Declaration of authorship-CRediT

MARÍA GRANDA-MORENO: State of the art, related concepts, data analysis, validation, conclusions, final review.

DIANA CEVALLOS-BENAVIDES: State of the art, related concepts, methodology, validation, data analysis, writing.

Statement on the use of artificial intelligence

The authors declare that they used the ChatGPT tool – GPT-4 model (OpenAI), June 2025 version, exclusively to support language improvement. None of the scientific content, results, analyses, or interpretations were generated by artificial intelligence. All material was written, reviewed, and validated by the author, who is responsible for its accuracy and rigor.

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REVISTA CÁTEDRA

Impact of musical learning on the development of socio-emotional competencies in first-year high school students: a quasi-experimental study

Impacto del aprendizaje musical en el desarrollo de competencias socioemocionales de estudiantes de bachillerato: un estudio cuasi experimental

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Abstract

This research addresses the problem of the limited integration of music as a pedagogical resource in the classroom for improving the socio-emotional skills of first-year high school students, which hinders their adaptation to the inherent changes of adolescence. This problem is relevant because the development of young people requires cognitive development and the strengthening of certain socio-emotional skills necessary for their growth. For this reason, the main objective of this research was to analyze the impact of

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musical learning on the development of socio-emotional skills through the use of pedagogical methodologies and strategies.

A quasi-experimental methodology was applied, including the implementation of a pre-test and post-test with a control group that received traditional musical instruction and an experimental group that participated in directed musical activities. To ensure consistency with the methodology, the Bar-On ICE inventory was administered to measure the impact of the musical intervention. The findings demonstrate significant improvements within the experimental group, highlighting an increase in the ability to identify and manage emotions, as well as a reduction in stress, which tends to foster teamwork. The control group, on the other hand, showed no relevant changes, supporting the effectiveness of music as a tool for students' socio-emotional development.

Previous research demonstrates that socio-emotional learning is fundamental in the classroom, although its implementation is challenging due to limited institutional interest and curriculum constraints regarding the application of music. Therefore, a structured musical intervention designed to strengthen these competencies is proposed.

Keywords

Adaptability, musical learning, Bar-On, emotional development, musical education.

Resumen

Esta investigación aborda el problema de la poca integración musical como un recurso pedagógico dentro del aula de clase para la mejora de las competencias socioemocionales de los estudiantes que cursan el primer año de bachillerato, lo que los limita en la adaptación a los cambios inherentes de la adolescencia. Este problema es relevante pues la formación de los jóvenes requiere del desarrollo cognitivo y el fortalecimiento de ciertas habilidades socioemocionales necesarias para su desarrollo, por esta razón, el objetivo principal de esta investigación fue el analizar el impacto del aprendizaje musical en el desarrollo de las competencias socioemocionales mediante el uso de metodologías y estrategias pedagógicas.

Se aplicó una metodología cuasi experimental que incluye la implementación de un pretest y postest a un grupo de control que recibió instrucción musical tradicional y otro experimental, el cual realizó actividades musicales direccionadas. Para ser consecuentes con la metodología se aplicó el inventario de Bar-On ICE y así medir el impacto generado por la propuesta musical. Los hallazgos demuestran la presencia de mejoras significativas dentro del grupo experimental, destacando un aumento en la capacidad de identificación y gestión de emociones, así como en la reducción del estrés, lo que tiende a fomentar el trabajo grupal. Por su parte, el grupo de control no presentó cambios relevantes, lo que respalda la efectividad de la música como una herramienta que permite el desarrollo socioemocional de los estudiantes.

Investigaciones anteriores demuestran que el aprendizaje socioemocional es fundamental dentro del aula, a pesar de que su implementación es un desafío debido al escaso interés institucional y las limitantes del currículo frente a la aplicación de la música. Por ello, se propone implementar una intervención musical de forma estructurada, diseñada para el fortalecimiento de estas competencias.

Palabras clave

Adaptabilidad, aprendizaje musical, Bar-On, desarrollo emocional, educación musical.

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1. Introduction

Currently, education faces the challenge of developing students cognitively while emphasizing their socio-emotional skills, recognizing that these skills enable them to interact consciously with their environment, improve their interpersonal relationships, and regulate their emotions. Music emerges as an alternative for stimulating these fundamental aspects, which together contribute to the effective social functioning of young people. However, despite advances in pedagogy, certain difficulties hinder the integration of innovative strategies in the classroom, creating gaps in student education. In this context, music, recognized as a universal language that transcends cultural and emotional boundaries, appears as an optimal tool for strengthening socio-emotional skills, although its implementation within the Ecuadorian education system is limited, often confined to fulfilling the traditional curriculum.

The main problem addressed by this research focuses on the limited integration of music as a pedagogical resource in the socio-emotional development of high school students, which hinders the promotion of skills such as empathy and emotional regulation. This creates obstacles in social interaction and group work among young people. Therefore, it is crucial to address this issue given the need to develop resilient individuals with the ability to manage their emotions and adapt to change, which, in the medium term, can guarantee academic, personal, and professional success.

This research proposes to analyze how education in collaboration with music can enhance socio-emotional competencies in high school students by evaluating pedagogical methodologies adapted to this context and proposing strategies to strengthen these competencies. In this sense, the research questions focus on identifying the skills most favored by the implementation of music and how these skills influence the strategies adopted. It is important to note that the limitations of this study are centered on a sample of students from a specific educational institution, as well as the application of an adapted instrument for quantifying competencies. The aim is to contribute empirical evidence regarding the effectiveness of music as a tool to guide the implementation of applicable classroom strategies.

In this context, Troya-González et al. (2023) state that "music is a tool that can provide a sense of individual and group well-being; currently, it is considered by many to be an art form that can offer multiple benefits to society" (p. 117). Similarly, Pérez-Escoda and Filella-Guiu (2019) mention that "carrying out varied activities that allow for alternating moments of personal reflection with group work sessions, in which sharing, expressing, and contrasting points of view are excellent for fostering emotional development" (p. 38). However, despite current advances in pedagogy and its many innovative strategies, educational institutions face difficulties integrating them into the classroom. This situation becomes more evident at the high school level, where young people go through a crucial stage in their emotional and social development, which in the medium term creates gaps in their overall development.

Therefore, this study aims to analyze how musical learning enhances socio-emotional competencies, evaluate pedagogical methodologies adapted to this theme, and propose educational strategies to strengthen these competencies. To this end, the skills most affected by musical practice were identified, allowing for a quantitative approach to this issue. Data collection included the application of an assessment instrument. Furthermore, the research seeks to answer the following research questions: What socio-emotional competencies are affected by musical practice? What strategies based on musical

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instruction are most effective in enhancing each dimension? Are there significant differences in the results depending on the type of musical intervention applied?

This article is organized into four main sections. It begins with a review of the literature that establishes the relationship between music and socio-emotional competencies. Next, the methodology used to achieve the study's objective is described. Finally, the results are detailed, discussed, and the findings are concluded.

2. Literature review

2.1 Music and socio-emotional skills

Belay and Dejene (2024) point out that "social-emotional learning is widely recognized for fostering students' social-emotional skills, which are essential for academic and personal growth" (p. 2). Music, being considered a universal language, has the capacity to transcend the cultural and reach the emotional, making it an ideal tool for individual personal development. In this sense, Albornoz (2009) considers that "educational music therapy, under the guidance of qualified professionals, motivates academic growth because it embraces the emotional dimension, which contributes to developing the motivation to learn" (p. 70). Therefore, it is important to consider that, within the educational field, the influence of music goes beyond the artistic or technical aspects, as it contributes to strengthening social-emotional competencies, which is evidenced by the empathy generated by the group when working together.

From the perspective of Jolay et al. (2023) These activities "are implemented not only in schools but also in different spaces, with different age groups, and in diverse contexts of vulnerability, risk, and emergency. This is partly because socio-emotional skills are malleable throughout life" (p. 373). This implies that proper emotional management can foster a healthy, strong, and mature individual by enabling them to manage their feelings effectively.

2.1.1 Importance of socio-emotional learning in education

Students spend most of their time at school, so their actions, personal relationships, and acquired knowledge are directly linked to academics, generating feelings and emotions that they may remember throughout their lives. In this context, Ferreira et al. (2023) comment that "schools will better fulfill their educational mission by integrating social-emotional learning into students' educational experience, maximizing their potential and facilitating future success in their personal and professional lives" (p. 54). When these programs are implemented correctly, they tend to enhance certain emotional skills and students' academic performance. For this reason, these skills are important when seeking to build a solid foundation that allows them to face challenges with resilience and adaptability.

Similarly, Treviño et al. (2020) agree that:

> Specifically, emotions are embedded in the school environment and influence how students learn. It has been noted that experiencing positive emotions could help them solve problems, develop skills, and promote self-regulation; however, if they manifest in the opposite way, it would hinder their academic performance (p. 33).

From this arises the notion of emotional intelligence (EI), which is considered the capacity a person has to control their own emotions or those of others, differentiate between them, and use this information to their advantage to provide feedback on the learning process.

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Thus, Jambrina (2010) considers that "in this way, individuals with a weak personality would be able to awaken their latent energies, and impulsive individuals, channel their unleashed forces" (p. 340). This, taken together, develops mechanisms and capacities that influence students' development in the sensory, social, emotional, and affective domains.

2.2 Music as an educational tool

The Constitution of the Republic of Ecuador (2008), in Article 27, states that "education shall be centered on the human being and shall guarantee their holistic development, within the framework of respect for human rights, a sustainable environment, and inclusive and diverse democracy, of quality and warmth" (p. 33). Therefore, due to the need to explore pedagogical aspects that meet the current demands of music education, this research seeks to contribute empirical evidence on how learning music influences the emotions of students in the first years of high school.

Over time, Creech et al. (2013) have shown that "the greater subjective well-being observed among participants in musical activities could be due to their potential to provide a sense of purpose through musical progress and expression" (p. 42). Therefore, it is important to foster an inclusive learning environment, thus promoting comprehensive learning and cognitive development in students.

Meanwhile, Intriago-López and Zambrano-Loor (2023) mention that:

> In Ecuador, there is little interest in implementing music as a pedagogical resource in classrooms due to various factors. Educational units limit themselves to complying only with what is indicated in the curriculum regarding the subject of Cultural and Artistic Education and music, so its contribution to improving the teaching and learning process, since it is not used as a pedagogical resource, is low (p. 1518).

However, practice has shown that when used, it proves to be a valuable resource that contributes to the educational process, allowing students to reach favorable levels for the development of their learning, skills, and abilities, in addition to successfully achieving the established pedagogical objectives. Therefore, it is understood that music pedagogy considers various aspects of learning, since by using audible and rhythmic teaching resources, students are encouraged to interpret and analyze them, thereby improving their academic performance based on the experiences and activities within the classroom.

2.2.1 Cognitive and emotional benefits of musical learning

According to Koelsch et al. (2010), "emotion assessments obtained during the sessions suggest that this positive change in mood was accompanied by an increase in positive emotions, as well as a decrease in negative emotions" (p. 313). This confirms that music naturally regulates people's mood, reducing their stress or anxiety while improving their self-esteem.

Furthermore, this type of stimulation can promote synapses, leading to new learning that motivates neuroplastic changes in brain functions. In other words, neurons send information in the form of signals to each other, intertwining until they produce a behavior. Thus, Cuervo and Ordóñez (2021) state that "these cognitive processes constitute our memory capacities. We receive information through sensory, verbal, or semantic stimuli and perceive it depending on the attention paid and the concentration employed" (p. 340).

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2.2.2 Impact of music on student development

The evidence from the research conducted by López and Salcedo (2021) shows that "since collaborative work is the hallmark of this discipline, students can improve their behavior, empathy, and creativity, leading to increased academic performance" (p. 18). Given these qualities of music, its inclusion should be mandatory at all levels of education, with a minimum of four hours per week, where young people are included regardless of gender or social class.

In this context, Sigueñas et al. (2024) mention having observed that "affective activities were essential for children's learning, since they experience emotions and sensations from an early age. Furthermore, an affective bond was established between the teacher and the children" (p. 533). Therefore, successful work will depend largely on the time the teacher dedicates to practicing with the students.

2.3 cio-emotional Competencies

Murillo et al. (2018) explain that "a few years ago, higher education prioritized academic training over social and emotional development" (p. 136). However, today the importance of implementing transversal competencies is recognized, from which programs that foster the socio-emotional area can be developed. Over the years, emotions have been of interest to various scholars, who have evolved their concepts, defining them as a complex state that an individual experiences when subjected to arousal or disturbance due to their environment.

Similarly, Gómez et al. (2024) point out that:

> Socio-emotional skills in face-to-face communication are essential tools for personal and social adjustment from an early age. While it is recognized that their characteristics require specific skills, there is a scarcity of studies that analyze the relationship between generally acquired socio-emotional skills and those necessary for online communication (p. 81).

Morlett (2023) points out that "in adolescence, individuals can achieve a better understanding of abstract concepts and reflect on facts; moreover, they begin to make decisions that involve greater risk" (p. 3). Experience dictates that an individual's social competence and adaptation to the academic and emotional environment during adulthood are interrelated, especially when interacting with others, generating positive or negative consequences that can affect their surroundings.

2.3.1 From unitary intelligence to emotional intelligence

Currently, stigmas still exist surrounding the concept of intelligence and who is truly considered intelligent; that is, intelligence is often reduced to a person's capacity to think, speak, or calculate. In this context, Barría et al. (2023) mention that "it was thought that there was a unitary intelligence capable of being measured by pen-and-paper tests, casually known as IQ or intelligence quotient tests, which, when solved, provided an indicator of the individual's intelligence" (p. 3).

Similarly, Pillajo (2024) states that:

> Intelligence was generally measurable and at the same time linked to the application of brain functions that promote problem-solving through the reception and interpretation of information from the senses. This theory

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> was accepted for many years and during this time it was the only theory of intelligence (p. 37).

Velásquez et al. (2024) state that "human beings possess the innate characteristic of expressing diverse emotions that arise spontaneously in response to stimuli received, and they have the ability to develop their cognitive capacity, that is, actions related to reasoning and intelligence" (p. 20). These concepts must be developed to enhance contemporary education, which means that teachers must appropriately employ strategies in these areas to foster their students' socio-emotional competencies. Therefore, prioritizing aspects such as emotional intelligence, cognition, and motivation is complex because they are interconnected; this leads to the understanding that emotional intelligence can be summarized as the management and handling of the individual's human aspects and how their responses to positive or negative stimuli allow them to recognize the emotions they experience.

In other words, theories of intelligence have evolved from a unitary concept, where intelligence was seen as a single, measurable capacity of each individual, generally represented by IQ, to much more complex models of multiple intelligences that integrate emotional, social, musical, and intrapersonal intelligence. This has laid the foundation for its development, recognizing that socio-emotional skills are important for an individual's personal success.

2.3.2 Theory of emotional intelligence according to Mayer and Salovey

Mayer et al. (2000) define it as "the capacity a person possesses for the perception and regulation of their own and others' emotions and considers four axes: perception, facilitation, understanding, and emotional regulation" (p. 273). According to Fragoso-Luzuriaga (2015), "different models emerged, shaped according to the particular vision of their authors" (p. 120). Taken together, these skills allow a person to make decisions about managing different situations they encounter at any given time, always seeking a balance between reason and emotion. This model clearly indicates that emotional intelligence is comprised of information processing rather than competencies, establishing a separation between them.

Similarly, Tituaña (2022) considers that:

> The importance of EI in the school setting lies in breaking all alliances with the constructs of the intelligence quotient (exclusively educational centers focus on developing linguistic, logical-mathematical skills), as the sole predictor of academic performance; on the contrary, EI uses individual, emotional, and social factors that facilitate the improvement of attitudes, aptitudes, and the ability to understand and comprehend others, thus making it possible to predict the academic and professional success of all individuals involved in educational change (p. 21).

Therefore, due to its emphasis on the skills it measures, this model is considered a rigorous approach to the study of emotional intelligence. This is validated by various studies demonstrating that these competencies are related to improvements in academic performance. In the educational field, this model provides a theoretical framework for integrating pedagogical strategies to foster students' emotional development.

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2.4 Music as a catalyst for emotional skills

Music impacts people's emotions while facilitating their expression and self-regulation. Therefore, Bruna et al. (2022) argue that:

> Emotional processing would be an integral part of cognition, affecting the degree to which emotions influence ongoing activities and behaviors, with increasing evidence supporting the view that cognition and emotion are linked in a highly complex way (p. 4).

It can be said, then, that through listening to or interpreting music, individuals process their complex emotions to develop greater awareness of their emotional state. This is relevant in the educational field, as students can use music as a tool to better manage stress and improve their emotional well-being. Furthermore, Troya-González et al. (2023) emphasize that "formal and structured music education, in addition to being an instrument that enhances an individual's personality, is a powerful tool for developing students' socio-communicative skills, giving them the opportunity to express their ideas artistically" (p. 130).

Therefore, this shared responsibility begins with the teacher, who is in charge of implementing educational planning that reinforces instruction with a focus on a particular area within the curriculum, considering the necessary resources to achieve the stated objectives. For this reason, it is necessary to reflect on the relevance of music in student development across different modalities and areas, unlocking their potential and thus improving their quality of life.

2.5 Role of teachers in socio-emotional development through music

Music pedagogy is a valuable tool in developing adolescents' skills, as it instills in them the motivation to participate in the process. Musical training potentially develops their intellectual capacities. To this end, teachers must engage in self-preparation regarding possible strategies to consider for promoting the musical components related to the activities to be carried out, according to the skill that needs to be developed in the classroom. As an example, Miñan and Espinoza (2020) maintain that teachers "need to seek appropriate methodological strategies that allow them to awaken students' interest, thus contributing to ensuring the success of the teaching-learning process, making it an enriching, fun, and highly productive experience" (p. 455).

Previous studies demonstrate that joint participation between teachers and students in musical activities reduces participants' stress levels, showing improvements in certain tolerant behaviors such as solidarity and respect, and enhancing self-esteem and empathy. For example, Chao et al. (2015) confirms that "music can improve behavior, since, after employing appropriate strategies, it can be used to enhance tolerant behaviors" (p. 1).

Likewise, Gutiérrez and Buitrago (2019) state that "school is the primary setting for the individual's development and socialization. It is there that students' perceptions, realities, subjectivities, and behaviors are consolidated. Consequently, the role of teachers is fundamental, as they act as guides" (p. 167). The creation of bonds in the classroom depends on this, since it is thanks to the teacher and their management of socio-emotional skills that this space becomes an environment of harmony, coexistence, and peace.

Thus, by applying structured pedagogical strategies in music, teachers create an inclusive environment that fosters emotional expression along with teamwork. This not only improves relationships among classmates but also boosts self-esteem and confidence.

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Furthermore, teachers serve as emotional role models for their students, providing guidance in managing complex situations through empathy and self-control. When they incorporate music into their teaching practices, they can implicitly share certain skills, which helps students develop essential competencies.

2.5.1 Pedagogical strategies for musical integration in the classroom

Integrating music requires teachers to apply appropriately designed pedagogical strategies to maximize its educational impact, as Linares et al. (2018) argue that:

> Songwriting provides students with the opportunity to put new experiences into practice. Through diverse stimuli, both physical and cognitive, that highlight their artistic and creative side, communication and collaborative work are facilitated, making learning easier. Thus, the use of songs in the classroom can be considered an appropriate resource for lasting learning, since, through the combination of rhythms, verses, and repetitions, students better assimilate new knowledge (p. 16).

Another effective strategy is the implementation of group singing, fostering community work and communication skills. It is also suggested to include simple instruments in musical practice to teach rhythm and melody concepts while simultaneously promoting motor and coordination skills.

Its development considers ethical aspects that are fundamental for the manipulation of variables and the joint participation of students. Prior to implementation, representatives of the participating students were informed about the objectives, procedures, and potential benefits of the project, thus ensuring informed consent. Additionally, students who no longer wished to participate in the program could withdraw voluntarily without incurring academic penalties.

Consequently, adolescents forge their identity under the influence of agents that shape their way of thinking, acting, and interacting within their social group. Therefore, the application of self-esteem through the implementation of a musical project within the classroom, where they are the protagonists, becomes a tool that generates a favorable and democratic work environment. This helps the group overcome conflicts and improve self-esteem, as well as enhance the final product of the project.

3. Methodology

This research employs a quantitative approach with a quasi-experimental design, utilizing a pre-test and post-test, to analyze the impact of a music teaching strategy on the development of socio-emotional competencies in first-year high school students at the Jim Irwin Private School during the 2023-2024 academic year. The study allows for the objective observation of educational phenomena occurring in the environment of the participating students, thus justifying the need for intervention in socio-emotional development through music.

The study population consisted of 42 high school students aged 15-16 years from section C, which has 22 students (control group with 52% participation), and section D, with 20 students (experimental group with 48% participation). The selection of the working groups was based on the feasibility of integrating music into the curriculum to implement the innovative teaching method in the experimental group. This allowed for a comparison of

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results before and after the music-based intervention. No specific exclusion criteria were used for the research, as the entire available population participated.

The socio-emotional competencies for each dimension are then established for each group. Table 1 summarizes each dimension with its respective variables, from which the corresponding affirmative hypothesis (Hi) and null hypothesis (Ho) are derived.

Dimension	Independent Variable	Dependent Variable
Intrapersonal	Participate in musical activities	Improved emotional regulation among students
Stress Management		Improved stress management strategies among students
Mood		Improved mood among students
Interpersonal		Promotes interpersonal skills among students
Adaptability		Increased adaptability among students

Table 1. Formulation of variables and hypotheses according to the dimension.

- Affirmative hypothesis (Hi): Participation in musical activities contributes to the development of students' socio-emotional skills.
- Null hypothesis (Ho): Participation in musical activities does not contribute to the development of students' socio-emotional skills.

3.1 Instrument

To measure participants' socio-emotional competencies, an adaptation of the Bar-On Emotional Quotient Inventory (EQ-i) was used. This inventory was designed to assess individuals' emotional intelligence from a socio-emotional competency perspective. The original questionnaire consists of 133 questions grouped into five dimensions: intrapersonal, stress management, general mood, interpersonal, and adaptability. However, when applied in a more specific context, it was reduced to 85 items using an adapted five-point Likert scale, selecting those items most relevant to the educational context.

This adaptation of the instrument is based on the need to focus the assessment on the most important or relevant dimensions for the research purposes, as well as considering the time required for its administration. Therefore, items related to the subcomponents of assertiveness, self-concept, self-actualization, interpersonal relationships, and reality testing were removed, while those that allow for reliable measurements to validate socio-emotional skills related to musical learning were retained. This instrument is complemented by the following Likert scale: 1 = N (Never), 2 = PV (Rarely), 3 = AV (Sometimes), 4 = MV (Often), 5 = S (Always). With this information, clear instructions were provided to the students, ensuring their understanding of the activity.

Reliability was established using Cronbach's alpha coefficient, obtaining 77% for the pretest and 82% for the posttest, respectively, indicating acceptable and high consistency. Validity was verified through significant correlations between the total test score and each of its dimensions for both the pretest and posttest, guaranteeing that the instrument is reliable for the accurate measurement of socio-emotional components.

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4. Results

This section interprets the results obtained after applying the research instrument to high school students. These results are presented as a summary of the frequencies obtained for each of the analyzed dimensions, according to the response options selected on the corresponding Likert scale.

Table 2 details the frequencies for each dimension for both the pretest and posttest. In general, it can be observed that before the intervention, the options with the highest number of responses were "never," "rarely," and "sometimes," while after the intervention, this pattern changed, with "always" becoming the most frequently selected option.

	PRETEST					POSTEST				
Intrapersonal dimension										
Pregunta	**N**	**PV**	**AV**	**MV**	**S**	**N**	**PV**	**AV**	**MV**	**S**
P-1	2	4	11	2	1	1	1	2	13	3
P-2	0	4	4	8	4	1	1	2	7	9
P-3	8	6	4	2	0	0	2	8	10	0
P-4	0	3	10	5	2	1	1	6	8	4
P-5	8	4	5	3	0	1	4	4	9	2
P-6	1	1	9	5	4	0	0	2	9	9
P-7	0	3	8	5	4	0	1	2	10	7
P-8	3	4	9	2	2	1	1	5	10	3
P-9	4	4	6	5	1	1	2	4	8	5
P-10	1	4	7	7	1	0	1	7	9	3
P-11	0	0	2	9	9	0	1	2	2	15
P-12	0	0	6	10	4	0	0	4	6	10
P-13	2	0	7	8	3	0	0	4	10	6
P-14	0	2	3	9	6	0	0	1	10	9
P-15	0	3	4	10	3	0	1	1	11	7
Stress management dimension										
P-16	0	2	11	5	2	0	0	2	11	7
P-17	0	6	5	5	4	0	2	4	6	8
P-18	0	6	9	4	1	0	1	4	4	11
P-19	2	1	9	8	0	0	8	2	5	5
P-20	0	4	5	10	1	0	0	1	11	8
P-21	0	3	9	3	5	0	0	3	4	13
P-22	0	2	7	9	2	0	3	4	6	7
P-23	1	1	5	9	4	0	2	5	8	5
P-24	1	7	7	2	3	0	1	4	8	7
P-25	2	3	7	7	1	0	4	3	7	6
P-26	0	3	7	8	2	0	3	5	7	5
P-27	1	3	6	9	1	0	4	2	4	10
P-28	2	5	4	6	3	0	1	6	7	6
P-29	4	7	4	4	1	0	4	3	6	7
P-30	1	3	7	6	3	0	0	3	11	6
P-31	2	4	8	5	1	0	3	5	3	9

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P-32	1	1	4	6	8	0	1	1	9	9
P-33	0	1	12	5	2	0	2	6	6	6
P-34	1	5	4	7	3	0	2	2	6	10
Mood Dimension										
P-35	2	1	6	6	5	1	1	5	4	9
P-36	3	4	4	4	5	0	2	2	4	12
P-37	1	4	7	4	4	0	1	1	10	8
P-38	1	2	5	7	5	0	0	2	7	11
P-39	1	4	7	3	5	0	0	4	7	9
P-40	1	2	6	8	3	0	0	2	11	7
P-41	0	0	5	5	10	0	3	3	4	10
P-42	1	2	3	6	8	0	0	1	7	12
P-43	0	1	4	3	12	0	0	1	3	16
P-44	0	1	7	8	4	0	0	2	8	10
P-45	0	1	10	5	4	0	1	4	4	11
P-46	1	0	7	9	3	0	0	3	9	8
P-47	0	2	3	12	3	0	1	2	2	15
P-48	1	2	9	4	4	0	0	5	8	7
P-49	0	4	6	7	3	0	1	5	5	9
P-50	1	0	11	4	4	0	0	2	10	8
P-51	3	3	7	5	2	0	1	2	10	7
Interpersonal dimension										
P-52	3	2	7	6	2	0	2	3	12	3
P-53	0	4	4	10	2	0	3	6	8	3
P-54	3	1	6	8	2	0	0	6	8	6
P-55	0	3	6	6	5	0	1	6	3	10
P-56	1	4	3	4	8	0	0	5	8	7
P-57	2	7	5	2	4	1	2	4	10	3
P-58	3	4	5	4	4	2	2	4	6	6
P-59	0	1	7	7	5	0	4	2	11	3
P-60	0	1	4	5	10	0	3	1	8	8
P-61	4	0	5	6	5	0	2	6	5	7
P-62	4	2	5	8	1	1	3	4	7	5
P-63	0	2	7	5	6	0	1	6	2	11
P-64	2	3	4	6	5	0	3	2	6	9
P-65	1	3	6	7	3	1	2	5	5	7
P-66	0	1	2	13	4	0	1	4	7	8
P-67	1	7	4	5	3	0	1	7	7	5
P-68	0	0	3	10	7	0	0	1	7	12
P-69	2	4	6	4	4	0	0	5	10	5
Adaptability dimension										
P-70	0	2	6	6	6	0	1	5	8	6

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P-71	3	3	2	3	9	0	1	3	7	9
P-72	1	1	1	9	8	0	0	3	7	10
P-73	0	3	5	6	6	0	0	6	5	9
P-74	1	0	5	6	8	0	3	4	3	10
P-75	2	7	6	4	1	2	2	5	9	2
P-76	0	1	7	6	6	0	1	5	6	8
P-77	1	2	7	9	1	0	3	7	4	6
P-78	2	4	7	6	1	1	1	5	6	7
P-79	1	5	3	10	1	0	5	3	6	6
P-80	2	7	5	6	0	3	2	6	8	1
P-81	1	6	6	6	1	0	3	6	6	5
P-82	1	3	8	5	3	0	3	4	5	8
P-83	1	2	7	4	6	0	4	4	5	7
P-84	3	3	7	4	3	0	4	2	9	5
P-85	3	5	5	3	4	3	3	5	5	4

Table 2 Frequency table according to dimension

Table 3 summarizes the results obtained by the Student's t-test performed in the SPSS statistical software for each dimension, showing the data for each group, mean value, standard deviation and significance or p-value.

Dimension	Group	Media	x	σ	Sig
Intrapersonal	Experimental	-9,5	7,29	1,63	<,001
	Control	3,091	6,015	1,282	0,025
Stress Management	Experimental	-13,45	11,381	2,545	<,001
	Control	-0,227	9,008	1,92	0,907
Mood	Experimental	-11,75	10,647	2,381	<,001
	Control	1,318	7,699	1,641	0,431
Interpersonal	Experimental	-7,55	13,736	3,071	0,024
	Control	-2,045	9,907	2,112	0,344
Adaptability	Experimental	-6,4	9,616	2,15	0,008
	Control	-1,227	6,81	1,452	0,407

Table 3 Student's t-test results for each dimension

Figure 1 summarizes the frequencies of the responses provided by the students in the pretest, that is, before the intervention. It details the Likert scale values for each of the study dimensions.

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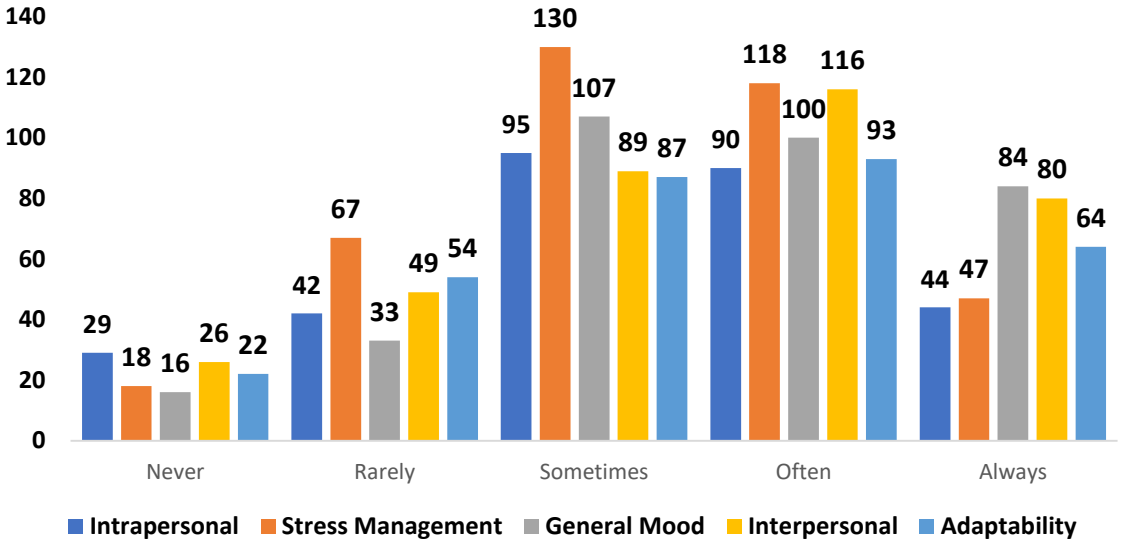


Figure 1 Comparison of response frequencies for each dimension for the pretes

Figure 2 shows the frequencies of the responses given by the students in the post-test, that is, after the academic intervention was implemented. It details the Likert scale values for each of the study dimensions.

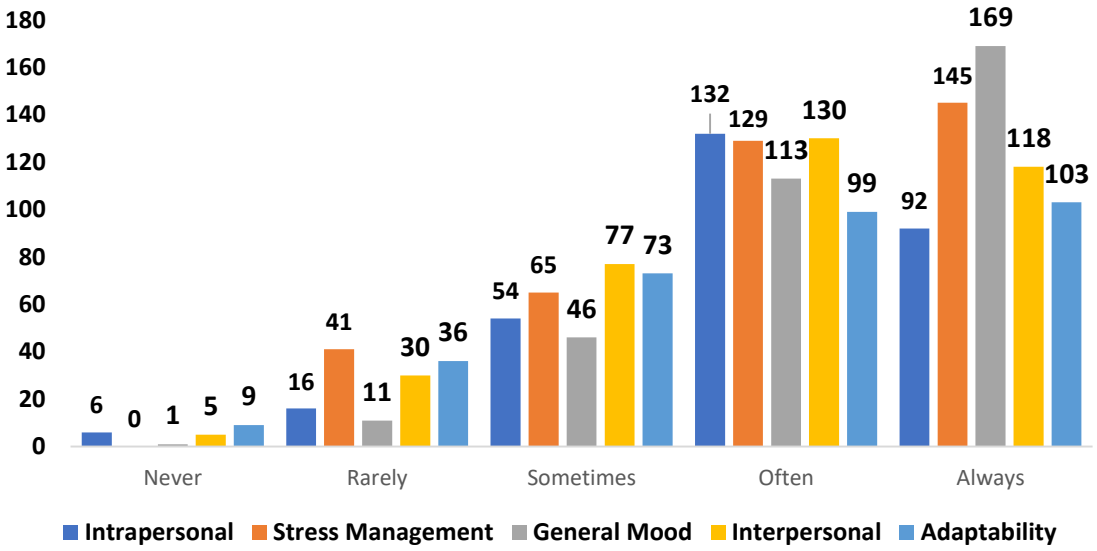


Figure 2 Comparison of response frequencies for each dimension for the post-test

4.1 Intrapersonal Dimension

The t-test summarized in Table 3 for the experimental group, within a 95% confidence interval, yielded a mean of -9.5 with a p-value < 0.05, indicating significant differences between the data obtained. Therefore, the hypothesis Hi is accepted as valid: participation in musical activities significantly improves the intrapersonal dimension of emotional regulation.

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Similarly, for the control group, with a 95% confidence interval and a mean of 3.091, a p-value < 0.05 was obtained, implying the presence of significant differences. Therefore, the hypothesis Hi is accepted: participation in musical activities significantly improves emotional regulation in the control group.

Figures 1 and 2 show a decreasing trend in response options considered negative, with 79.31%, 61.9%, and 43.16% for N, PV, and AV, respectively. Conversely, for the positive response options MV and S, an increase of 46.67% and over 100% is observed. It can be inferred, then, that this increase is due to the inclusive and collaborative environment in which the students find themselves when developing the musical activities planned by the teacher. In this sense, music not only encourages their expression but also allows them to explore their emotions within a space where they feel safe.

4.2 Stress management dimension

For the experimental group in its stress management dimension, Table 3 shows that within a 95% confidence interval, a mean of -13.450 was obtained with a p-value < 0.05, which implies the presence of significant differences between the data obtained. Therefore, the null hypothesis (Hi) is accepted: participation in musical activities significantly improves stress management strategies.

In turn, for the control group, within a 95% confidence interval, a mean of -0.227 was obtained with a p-value > 0.05, which means that there are no significant differences between the means of the values obtained. Therefore, the null hypothesis (Hi) is rejected, and the alternative hypothesis (Ho) is accepted: participation in musical activities does not significantly improve stress management strategies.

Figures 1 and 2 show a downward trend of 100%, 38.81%, and 50%, respectively, for the negative response options N, PV, and AV, while the positive options MV and S show an increase of 9.32% and 208%, which is interpreted as a considerable improvement. This indicates an improvement in coping strategies after the musical intervention, suggesting a decrease in perceived stress levels, a reduction in impulsivity and anxiety, and an increased ability to remain calm and manage difficult situations in the classroom.

4.3 Mood Dimension

For the mood dimension of the experimental group, Table 3 shows that the mean of the paired differences is -11.750 within a 95% confidence interval, where the p-value < 0.05; therefore, the null hypothesis (Hi) is accepted: participation in musical activities significantly improves mood.

While for the control group, a p-value > 0.05 is presented, with a mean of 1.318 within a 95% confidence interval; that is, there are no significant differences between the means of the data obtained; therefore, Hi is rejected and Ho is accepted: participation in musical activities does not significantly improve mood.

Figures 1 and 2 show a decreasing trend in the response options considered negative (N, PV, and AV) of 93.75%, 66.67%, and 57.01%, respectively, while the positive options (MV and S) show an increase of 13% and 101.19%. This means that students experience an improvement in their mood after participating in the planned musical activities. The results showed a reduction in symptoms associated with anxiety and depression. They also appeared more optimistic, motivated, and confident. In contrast, the control group did not show a significant change.

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4.4 Interpersonal dimension

For the interpersonal dimension of the experimental group, Table 3 shows that within a 95% confidence interval, the mean of the paired differences is -7.55 with a p-value < 0.05, therefore accepting H1: participation in musical activities fosters interpersonal skills.

Similarly, for the control group, the significance is shown with a p-value > 0.05 and the mean of the paired differences is -2.045, demonstrating that there are no significant differences between the means of the collected data; therefore, accepting H0: participation in musical activities does not foster interpersonal skills.

Figures 1 and 2 show a decrease in the response options considered negative (N, PV, and AV) of 80.77%, 38.78%, and 13.48%, respectively, while the positive options (MV and S) show an increase of 12.07% and 47.50%.

4.5 Adaptability Dimension

Analyzing Table 3, the results for adaptability in the experimental group, within a 95% confidence interval, show a mean of -6.4 for the paired differences with a p-value < 0.05. Therefore, the null hypothesis (H0) is accepted: participation in musical activities increases adaptability and flexibility.

For the control group, with a 95% confidence interval, the mean was -1.227 and a p-value of 1.227. Therefore, the null hypothesis (H0) is accepted: participation in musical activities does not increase adaptability and flexibility.

Figures 1 and 2 show a decreasing trend in the response options considered negative (N, PV, and AV) of 59.06%, 33.33%, and 16.09%, respectively, while the positive options (MV and S) show an increase of 6.45% and 60.94%. Among the items with the greatest variation was the ability to adapt easily to change, shifting from a high number of responses to "never," "rarely," or "sometimes" to "often" and "always." This suggests that the implemented musical activities were effective in the group, fostering greater openness to potential changes.

5. Discussion

After ten weeks of intervention, the results obtained from the Bar-On Inventory reveal an improvement in the skills of the experimental group compared to the control group. It is important to note that the control group did not receive any experimental intervention; in this case, they received traditional music education. The difference observed between these groups confirms that the applied pedagogical strategies are not only effective but also surpass the conventional methodology used in the classroom, reinforcing the idea that music allows students to develop emotional and social skills. To illustrate this, Cacñahuaray-Chumpitaz and Matalinares-Calvet (2024) state that it is important to "include emotional education programs in school settings, since their impact on overall well-being and on students' ability to relate constructively is evident" (p. 85).

The skills with the greatest impact in the research were self-awareness, where the experimental group showed a greater capacity for identifying and understanding their emotions. An improvement is noticeable in the ability to manage stressful situations and in interpersonal relationships, with an increase in empathy levels and the capacity for collaborative work. For example, Vizcaino et al. (2025) maintain that:

> The results obtained support the existence of seven factors associated with emotional self-regulation, interpersonal regulation, empathy,

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> motivation, conflict resolution, and teamwork. These factors explain a large part of the variance in the test, providing evidence of the instrument's validity (p. 137).

Based on the instruments applied to the students, it was observed that those who actively participated in musical activities showed a notable improvement in managing their emotions, as well as in teamwork, as noted by Troya-González et al. (2023), who conclude that music education "is the sphere that gives students, within the framework of their life vision, tools for their full and integral development and the possibility of their educational self-realization without any discrimination and with a true sense of inclusion" (p. 130).

A comparative analysis revealed that educational programs that integrate music have a positive impact on the development of emotions, especially on self-regulation and the social sphere of the participants, particularly when group activities are integrated into their routine, as Treviño et al. also observed. (2020) points out that "when students do not know how to control their emotions, their performance and academic achievement are affected; therefore, it is important to make students aware of the value of regulating these emotions in unexpected and/or significant situations" (p. 44).

This validates the integration of musical activities into the curriculum as a strategy to promote students' emotional and social well-being. In this sense, music is considered to foster personal and collective development within the classroom. From an educational perspective, Hallam (2010) mentions that "group musical performance benefits the development of social skills, which can contribute to health and well-being throughout an individual's life, thus contributing to community cohesion and benefiting society" (p. 22).

In summary, the results showed statistically significant differences favoring the experimental group after the intervention, demonstrating that when music is taught using innovative methodologies, it can enhance the development of students' socio-emotional skills. These findings support the importance of implementing music programs within secondary education, thereby strengthening the emotional well-being of young people. Thus, for example, Ruvalcaba et al. (2016) point out that "the effect of socio-emotional skills seems to be more evident in the educational sphere at home and at school, that is, the adolescent's immediate environment and not necessarily as an action of their community environment" (p. 85).

6. Conclusions

This research reveals significant findings that justify the stated objective. Through the application of a quasi-experimental design, it has been demonstrated that the implementation of pedagogical strategies based on musical learning improves the socio-emotional skills of the students participating in the experimental group, achieving a 78% increase in their ability to identify complex emotions and manage their responses effectively, especially in situations of academic stress.

The preliminary analysis highlights that the positive deviations of the experimental group after the implementation of musical activities progressively improve the students' socio-emotional skills. Furthermore, the calculated significances support its validity, demonstrating a real and measurable impact on the students' socio-emotional development. The control group, not being exposed to a direct intervention, did not experience significant changes in any of the evaluated skills. This divergence between the

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two study groups supports the hypothesis that music is a determining factor in developing skills such as emotional intelligence and empathy.

In this context, from an educational perspective, these results reinforce the importance of integrating approaches that range from the academic to the inclusion of socio-emotional dimensions by incorporating methodologies into the curriculum that consider music as a pedagogical tool. It has been demonstrated that music facilitates cognitive learning and acts as a bridge for addressing and resolving common emotional conflicts during adolescence.

Likewise, the research demonstrates that music acts as an artistic stimulus in strengthening socio-emotional skills. Thus, the members of the experimental group participated in strategically designed musical activities and showed superior performance compared to the control group. This confirms that using music as a pedagogical tool transforms the classroom environment, creating a space of inclusion and motivation, which promotes students' emotional well-being and academic performance.

Music activates various parts of the brain, a fact corroborated by the observation that anxiety and stress levels decreased in the experimental group, while self-esteem and teamwork skills increased. This implies that students' skills are malleable and can be stimulated through the use of appropriate pedagogical strategies.

The collected data not only indicates that music is an effective artistic tool, but also serves as a pedagogical resource that promotes socio-emotional skills in adolescents. Developing these skills not only improves students' social dynamics in the classroom, but also contributes to their overall well-being as part of an educational strategy implemented by the teacher. Therefore, the importance of teacher support for their students during this process is evident, as teachers must receive adequate information that allows them to implement music-based pedagogical strategies to maximize the socio-emotional impact..

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Authorship statement-Credit

JONATHAN PILLAJO-TITUAÑA: State of the art, related concepts, methodology, validation, data analysis, writing – first draft.

MARÍA GUACHO-MOREJÓN: State of the art, related concepts, data analysis, organization and integration of collected data, conclusions, final writing and editing.

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Statement on the use of artificial intelligence

The authors report that they used the ChatGPT tool (GPT-4 model, OpenAI; version June 2025) solely to assist in the rewriting and linguistic refinement of certain passages of the manuscript. No scientific components, results, analyses, or interpretations were produced by artificial intelligence. The authors reviewed and validated all content, assuming responsibility for its accuracy and rigor.

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REVISTA CÁTEDRA

Learning linear and quadratic functions through the use of artificial intelligence in higher education students

Aprendizaje de función lineal y cuadrática mediante el uso de la inteligencia artificial en estudiantes de educación superior

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Abstract

This article analyzes the integration of Artificial Intelligence (AI), based on Deep Learning and Machine Learning, for teaching linear and quadratic functions in higher education. The main objective is to evaluate the impact of AI on academic performance, comparing it with the traditional method and measuring student acceptance using a Likert scale. The research adopted a quantitative approach with a quasi-experimental design, working with a sample of two groups (40 students in section A and 41 students in section B). Data collection involved a satisfaction survey, a diagnostic assessment, and a final evaluation using dichotomous questionnaires. The results were analyzed using descriptive and inferential statistics (Student's t-test, after verifying normality) with the SPSS statistical software. The analysis determined that, while positive perceptions and areas for improvement in mathematical understanding were identified, the AI-based model did not significantly improve grades compared to the traditional method. However, a greater interest from students was evident through the use of AI, generating greater motivation and active

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participation, feedback, favoring the interaction of content for learning the subject of Mathematics.

Keywords
Machine learning, artificial intelligence, mathematics, academic performance.

Resumen
Este artículo analiza la integración de la Inteligencia Artificial (IA), fundamentada en el *Deep Learning y Machine Learning*, para la enseñanza de funciones lineales y cuadráticas en educación superior. El objetivo principal es evaluar la incidencia de la IA en el rendimiento académico, comparándola con el método tradicional y midiendo el nivel de aceptación estudiantil mediante el uso de la escala de Likert. La investigación adoptó un enfoque cuantitativo con un diseño cuasiexperimental, trabajando con una muestra de dos grupos (40 estudiantes paralelo A y 41 estudiantes paralelo B). Para la recolección de datos se empleó una encuesta de satisfacción, evaluación de diagnóstico, evaluación final mediante el uso de cuestionarios dicotómicos. A su vez los resultados fueron analizados mediante el uso de la estadística descriptiva e inferencial (prueba *t-student*, previa verificación de la prueba de normalidad) mediante el software estadístico SPSS, determinaron que, si bien se identificaron percepciones positivas y áreas de mejora en la comprensión matemática, el modelo basado en IA no mejoró significativamente las calificaciones en comparación con el método tradicional. Sin embargo, se evidenció un mayor interés por parte de los estudiantes mediante el uso de la IA, generando mayor motivación y participación activa, retroalimentación, favoreciendo la interacción de contenidos para el aprendizaje de la asignatura de Matemática.

Palabras clave
Aprendizaje automático, inteligencia artificial, matemática, rendimiento académico.

1. Introduction
It is essential to ensure that students receive an education adapted to their needs, based on the right to academic inclusion, comprehensive support, and equitable access to technology. However, limitations persist in teacher training regarding active methodologies and the availability of innovative resources. Specifically, there is a lack of curricular integration of Machine Learning and Deep Learning models, meaning that AI has not yet been consolidated as a tool for strengthening academic performance. In this context, the main objective of this research is to evaluate the impact of AI on the learning of linear and quadratic functions in higher education, as well as to determine the level of student satisfaction after its implementation in the classroom.

According to De León De Hernández, the modernization of mathematics teaching through the use of AI is a necessity in the current educational context. In this sense, the author maintains that the right to education is fundamental for the development of children and adolescents, making it essential to incorporate diverse learning technologies, including artificial intelligence, into academic training processes (De León De Hernández, 2024). It is important to adapt pedagogical strategies to the students' circumstances. In accordance with this approach in Ecuador, classrooms are part of the inclusive education model promoted by the Ministry of Education, which establishes the guidelines for the

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development of this modality that fosters the development of multiple intelligences in students (Ministry of Education of Ecuador, 2021).

Soledispa et al. argue that one of the main challenges in higher education is the teaching of mathematics, given that this discipline requires continuity, abstraction, and constant practice of each student's analytical and critical thinking. Furthermore, with the modernization of learning through the use of artificial intelligence, and despite efforts to guarantee equitable education, the implementation of specific strategies for teaching mathematics in these environments remains a challenge (Soledispa et al., 2024, p. 8). In this context, the main objective of this research is to evaluate the impact of using artificial intelligence in the classroom by comparing it with traditional teaching methods, as well as to establish a student satisfaction scale that allows for assessing students' perceptions of the implementation of this new technological methodology in the teaching-learning process.

Consequently, this research adopts a quantitative approach with an explanatory scope, employing hypothetico-deductive reasoning. Within this framework, technological tools were used to collect numerical data through satisfaction surveys and evaluation questionnaires (midterm and final), integrating Artificial Intelligence models, specifically Machine Learning and Deep Learning, into the teaching of linear and quadratic functions. The study has a comparative-explanatory scope, seeking to analyze the differences in academic performance between the experimental and control groups. The study's relevance lies in its ability to statistically measure the impact of technological innovation on the understanding of mathematical concepts. This allows us to determine whether the use of AI overcomes learning difficulties in the university environment and to identify significant differences in academic averages.

The article is structured as follows. The second part presents the theoretical background, a brief review of other research related to the application of artificial intelligence in mathematics education, and theoretical frameworks that explain a conceptual approach to the didactic resources used for learning mathematics with concepts from Machine Learning and Deep Learning. The third section details the research methodology, describing the approach, type, level, and design adopted. It also explains the process of administering the surveys and dichotomous evaluation questionnaires, concluding with an analysis of the reliability of the collected data. The fourth section presents the results derived from the descriptive and inferential statistical analysis. The parametric t-test was applied to analyze possible significant differences in academic performance when comparing the traditional method with the use of AI in the classroom. Finally, the fifth session presents the conclusions of the study, where the integration of AI in educational institutions is discussed and the need to strengthen the learning of Mathematics under a comprehensive pedagogical approach that transcends the use of the technological tool is emphasized.

2. Theoretical Background

In Mexico, following the research of Quiroz-Rosas (2023), it is important to point out that the integration of AI into mathematics education demonstrates how technology has become a fundamental support for human development, advancing rapidly in various areas of knowledge. Education is no exception; digital methodologies provide strategies and techniques that optimize the teaching-learning process, offering distinctive features such as adaptive learning and assessment. Among these tools, Script stands out, which solves complex mathematical problems by interpreting handwriting on mobile devices and offering real-time feedback with a step-by-step guide, as does Photomath, an application

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that uses the device's camera and an integrated scientific calculator to display detailed procedures and final results.

In Ecuador, the research of Tóala-Zambrano (2024) highlights that the use of AI simulators in mathematics education is a valuable tool, providing practical, dynamic, and engaging methods for experimenting with concepts such as the notion of number, thus facilitating their understanding through contextualization. The author emphasizes that AI has high potential to accelerate the achievement of global educational goals by reducing access gaps, automating management processes, and optimizing learning methodologies. According to the study's findings, the implementation of AI tools fostered a more dynamic and effective teaching model, adapted to the individual progress of students in the early years of Information Technology and Telematics programs. Furthermore, it was observed that students developed additional technological skills that strengthen their academic and professional profiles. Consequently, Tóala-Zambrano underscores the importance of designing policies that guarantee equitable access to AI, the implementation of which should be led by faculty across various university disciplines.

From Peru, and referencing the research of Rubina-López et al. (2025), it is important to note that AI has significantly transformed the landscape of higher education, especially in mathematical problem-solving. Thanks to its ability to process large volumes of data and provide real-time feedback, AI has fostered the development of advanced tools that facilitate the understanding of complex concepts. The study concludes that technologies such as Intelligent Tutoring Systems (ITS) are innovative resources that strengthen teaching and learning processes in mathematics. Adaptive learning platforms and machine learning algorithms are highly effective, offering flexible solutions that allow students to overcome the challenges of advanced mathematics. These tools stand out for their personalization capabilities, adjusting both the content and the pace of learning to the specific needs of each student, which positively impacts academic performance and promotes more efficient teaching.

2.1 Theoretical Framework

2.1.1 Mathematics in our culture

Based on the manuscript by Rivas-Díaz et al., it is important to note that mathematics constitutes a fundamental language for the development of science and technology. Mathematical work has required the construction of a system capable of representing complex reasoning and mental processes through symbols. In this sense, the symbolization of mathematical objects, which was initially limited to concepts associated with number and extension, has been progressively refined to translate increasingly advanced cognitive tasks. According to the authors, this language is based on the determination and verification of the relationships between the created symbols, which provides the precision and rigor necessary for the progress of other scientific disciplines (Rivas-Díaz et al., 2024, p. 10).

Furthermore, analyzing the manuscript by Heredia-Arias et al., it is important to suggest that mathematics is a rather playful activity, making it crucial to stimulate students through games, which can be intelligent systems that have accompanied humankind in a better cognitive learning process through graphs. However, over time, this practice has required powerful tools based on information technologies for its development and resolution that facilitate the understanding of a mathematical object in class (Heredia-Arias et al., 2024, p. 3).

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2.1.2 Influence of computers on learning mathematics

Addressing the manuscript by Machuca-Almeida et al., it is important to point out that the emergence of computers in the second half of the 20th century generated a technological revolution that has become integrated into all aspects of contemporary culture. This influence is strongly evident in our immediate environment, from the processing of banking data and business planning to the robotization of production and the control of air navigation. In the field of mathematical research, the influence of the computer has been decisive; an emblematic example is its fundamental role in the proof of the Four Color Theorem. This demonstrates the capacity of digital processing to solve problems of high numerical complexity, providing solutions that were previously unattainable (Machuca-Almeida et al., 2025, p. 12).

2.1.3 Programming Language

Analyzing the U.S. Department of Education's manuscript, it is important to note that the most widely used programming languages in education are those known as high-level languages. These allow for the development of programs using an accessible and user-friendly syntax, without requiring the user to master binary code or the machine's internal processes. Among the historically most used general-purpose languages are LOGO, BASIC, FORTRAN, and PASCAL, which were selected for their ability to enhance cognitive skills such as design and problem-solving. Under this approach, learning was not limited to acquiring coding techniques; rather, learning the specifics of a language was considered secondary to the development of higher-order thinking skills. In this way, programming became established as an effective means for learning mathematics (U.S. Department of Education, 2023, p. 112).

2.1.4 Artificial Intelligence

Reading Mohamed, it's important to note that AI refers to systems that exhibit intelligent behavior by analyzing their environment and executing actions with a degree of autonomy to achieve specific goals. This conceptualization refers to systems that demonstrate intelligent behavior, analyzing their environment and undertaking actions with a degree of autonomy to achieve specific objectives. This term is well-received by the scientific community. First, it distinguishes AI from the simple use of algorithms and digital technology in general, and second, it includes deep learning, also known as transversal learning (Mohamed, 2021, p. 22).

It's important to note that Deep Learning “is a field of machine learning. Initially, AI was conceived as the development of systems capable of solving complex tasks using a set of formal mathematical rules” (Alsharidah and Alkramiti, 2024, p. 45). From this perspective, AI was reduced to the simple execution of algorithms by a computer, which could not be considered intelligent. Because of this, AI began to be associated with the development of systems capable of solving problems considered intuitive for humans. However, problems such as recognizing objects in images or words in voice recordings are difficult to reduce to a set of formal rules.

Furthermore, according to González-Jiménez (2024), it is important to note within the analysis that “Artificial Intelligence is designed through Artificial Neural Networks (ANNs), which are mathematical models or computations composed of interconnected numerical processing units. Each processing unit is known as an artificial neuron” (p. 15). By manipulating the connections between neurons, the networks can be made to exhibit the desired behavior to be useful in solving complex problems, including classification and regression problems.

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In this sense, Figure 1 provides a concise visualization of the relationship between artificial intelligence, machine learning, and deep learning. As can be seen, AI constitutes a broad field that seeks to imitate human thought and action processes, while machine learning is based on previous experiences to generate predictions. Deep learning, in turn, employs neural networks with input data, hidden layers, and output data, demonstrating how artificial neural connections process information to solve specific problems. Therefore, the image complements the theoretical explanation by graphically showing how neural networks are structured within the learning processes of artificial intelligence.

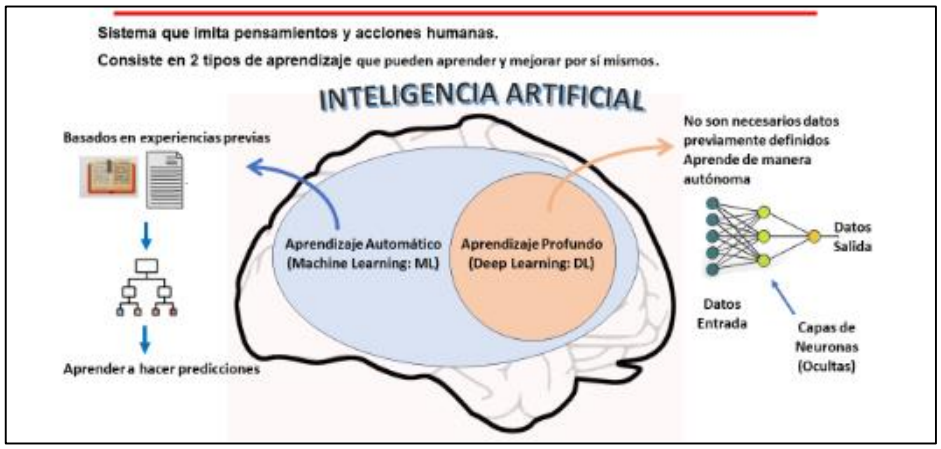


Figure 1. Supervised Learning Diagram using Artificial Intelligence. Artificial Intelligence System. Source: (González Jiménez 2024)).

2.1.5 Machine Learning

Studying Estrada-Oviedo's manuscript, it is important to note that data science is an eminently interdisciplinary field of knowledge, integrating methodologies and techniques from mathematics, statistics, and computer science. Its objective is to obtain useful information or new knowledge from enormous amounts of data that can be complex or inconsistent, dynamic, from multiple sources, and structured or unstructured. Within data science, we find machine learning and deep learning, which also fall under the field of AI (Estrada-Oviedo, 2025, p. 17).

In both cases, the goal is to build models capable of solving problems using a training dataset; that is, the aim is for the system to develop autonomous learning capabilities. This learning is primarily classified as supervised and unsupervised. Simbaña-Nauñay, for his part, explains that supervised learning starts with a set of pre-labeled data, which allows the model to know in advance the possible values and expected solutions for the problem posed. In contrast, unsupervised learning does not have these pre-labeled data, so the system must independently identify underlying patterns and structures in the data (Simbaña-Nauñay, 2025, p. 118).).

2.1.6 Deep Learning

In the analysis of the manuscript by Castillo Del Pezo et al., it is important to highlight that the design of artificial intelligence algorithms for feature extraction has the fundamental purpose of distinguishing the factors of variation that explain the observed data and, in turn, excluding those that are irrelevant to the process of modeling and interpreting the information. These factors affect each unit of information; therefore, if the factors of variation are modified, the observed data also change. An example of this is found in voice recordings, where the speaker's age, sex, and accent influence the data obtained. In this

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context, deep learning emerges as a solution to the problem of factors of variation, introducing representations expressed in terms of simpler ones. This allows the computer to identify complex concepts from elementary levels of abstraction. For example, when determining whether an image contains a car, the technique does not track elements such as wheels from the beginning; The process begins by identifying basic concepts such as straight lines to build more complex structures (corners or contours) and, finally, consolidate the concept of a car (Castillo Del Pezo et al., 2024).

2.1.7 Cognitive Learning

Addressing the manuscript by Bolaño-García and Duarte-Acosta, it is important to point out that metacognition structures, or rather, the knowledge that people construct about their own cognitive functioning. This involves mental operations of monitoring and regulation that individuals exert over their daily dynamics, allowing them to distinguish the awareness of their mental processes from personal content, beliefs, and motivations. These skills are essential for monitoring and regulating one's own thinking. In this sense, linking metacognitive strategies with learning allows us to diagnose the causes of academic performance in relation to educational quality. It also facilitates the design of techniques that promote autonomous and independent learning, ensuring that the process does not depend exclusively on the teacher. This approach is especially beneficial when the student is able to plan, regulate, and evaluate their own learning, applied in this case to the study of linear and quadratic functions (Bolaño-García and Duarte-Acosta 2025, p. 43).

3. Methodology

This section describes the quantitative approach of the research, which employs a quasi-experimental design with two working groups: a control group and an experimental group. The total sample consisted of 81 students selected through simple random probability sampling, ensuring the representativeness of the data. The control group (Parallel A) comprised 40 students, while the experimental group (Parallel B) had 41 participants. Furthermore, for the statistical analysis, Hernández-Sampieri et al. (2014) "established criteria for the Shapiro-Wilk normality test independently for each group; this statistic was selected because the size of each subsample is less than 50 subjects" (Hernández-Sampieri et al., 2014, p. 312). After confirming the normal distribution of the grades, the parametric Student's t-test for independent samples was used to compare the academic performance of the traditional method versus the innovative AI-based model.

3.1 Research Approach and Design

This research adopts a quantitative approach, based on the collection and analysis of numerical data obtained through satisfaction surveys and evaluation questionnaires. This methodological procedure allowed for the testing of both null and alternative hypotheses to determine the validity, significance, and consistency of the results obtained.

Likewise, hypothesis testing is a fundamental aspect of the research process, since the use of descriptive and inferential statistics enables the objective interpretation of the data and informed decision-making regarding the phenomenon under study. This facilitates the measurement of academic performance and the comparison of the traditional method with the new, innovative AI methodology and its academic impact.

According to Arias, the quasi-experimental design allows for the comparison of a previously established control group with an experimental group. This design allows the verification of one of the null hypothesis (Ho) or alternative hypothesis (Hn) on the impact on grades with the use of the artificial intelligence technological tool, through the analysis of the Type

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and Level of Research. The research adopts an explanatory approach, based on the technical measurement of academic performance and the determination of the influence of artificial intelligence use in the experimental group, compared to the control group.

A quasi-experimental design is also employed, which allows for the analysis of the influence of the independent variable on the dependent variable. The research has a longitudinal focus, as data collection was carried out at two points in time: an initial diagnostic assessment and a final assessment, with the purpose of comparing the results obtained before and after the intervention.

variations in grades in the two AI courses after the pedagogical intervention with the use of *Machine Learning and Deep Learning templates* (Arias, 2012, pp. 58-60).

3.2 Population and Sample

The population consists of 102 first-year higher education students majoring in Business Administration, divided into four sections at the Ibarra Higher Technological Institute. A simple random sampling method was used to determine the sample size, resulting in a sample of 81 students (45 men and 36 women) with an average age of 19 years. The following method was used to determine the sample size:

N = population size

e^2 = squared sampling error

Z^2 = squared confidence level

pq = population variance (constant of 0.25)

$$n = \frac{N}{1 + \left[\frac{e^2 * (N-1)}{Z^2 * pq}\right]}$$

$$n = \frac{102}{1 + \left[\frac{0.05^2 * (102-1)}{1.96^2 * 0.25}\right]}$$

$$n = 81$$

Ecuación 1

For the organization of the groups, a quasi-experimental design was implemented using simple random sampling, resulting in a sample of 81 students. The groups were organized as follows: the Control Group (Group A), consisting of 40 students, received instruction using the traditional method. The Experimental Group (Group B), consisting of 41 students, received instruction using the innovative methodology that integrates the use of AI (Machine Learning and Deep Learning).

To ensure the validity of the study, the instruments were validated by five academic experts in higher education. Inclusion criteria included legally enrolled students with a minimum of 80% regular attendance at scheduled sessions, voluntary participation, and attendance at individual and group workshops. Exclusion criteria included students who did not complete the final summative assessment or the satisfaction survey, including those who submitted blank instruments. Finally, students with advanced knowledge in programming languages (*Java, Python*) or development environments (*TensorFlow*) oriented to *Machine Learning*

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and Deep Learning were excluded, in order to avoid bias in measuring the impact of the intervention.

3.3 Research Technique and Instrument

In this research, a survey was used as the technique to determine the level of satisfaction with the use of artificial intelligence (AI) in the topic of linear and quadratic functions among higher education students. The instrument used was a dichotomous questionnaire with questions on subtopics such as quadrants of the Cartesian plane, increasing and decreasing functions, the quadratic formula, and concave and convex parabolas. An open-ended questionnaire with exercises was also used, where students developed solutions both manually and using the AI system. This was key to measuring the academic performance of higher education students.

First, the survey technique (ordinal qualitative variable; student satisfaction) was used to measure the perceptions of the 81 students who received technological intervention through the use of AI in the classroom. Regarding the instrument, the satisfaction survey was administered after the AI classes concluded. The items consisted of five Likert scale questions structured as follows: strongly agree, agree, neutral, disagree. The cognitive process, in turn, facilitated the evaluation of the use of the AI-powered templates in terms of mathematical problem comprehension, graphical representation, feedback, and self-learning. Furthermore, to assess academic performance, a pretest (diagnostic assessment) and a posttest (final assessment) were administered to both the experimental and control groups to compare performance before and after the intervention.

Secondly, an assessment questionnaire (academic performance variable) was used to measure the understanding of mathematical concepts. The instrument was used for summative assessment on the topic of linear and quadratic functions. The items consisted of ten questions with mathematical problems involving linear and quadratic functions, including subtopics related to the Cartesian plane, increasing and decreasing functions, the general formula of the quadratic function, manual problem-solving with verification, and structured academic support clues within the AI-powered templates. Regarding the cognitive process, this was developed through the resolution of mathematical problems related to linear and quadratic functions, combined with methods of logical and abstract reasoning, reading comprehension, and decision-making. In this way, cognitive skills oriented towards the analysis, interpretation, and solution of mathematical problems were strengthened..

3.4 Descriptive Statistics

It is important to mention that the descriptive analysis is structured around the ordinal qualitative variable corresponding to the satisfaction survey, using frequency tables based on the Likert scale (strongly agree, agree, neutral, disagree). Pie charts and bar graphs were used to represent the results, allowing for better visualization of the frequencies obtained. The median was also considered as a measure of central tendency, as it allows for identifying the central value of the averages achieved by each group: control and experimental (Maureira, 2025).

To determine the impact of AI use on student averages, a quantitative numerical variable was used to assess learning of linear and quadratic functions, recording the grades of the 81 students (section A and section B). The research focuses on the use of measures such as central tendency and the mean for both courses in terms of student averages, for both the control and experimental groups. That is, essential characteristics of the dependent and

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independent variables are presented by observing the total number of subjects structured as a sample, using percentages of valid and missing data.

3.5 Inferencial Statistics

The inferential statistics used in this research allow for comparing differences between groups within the studied sample by calculating the significance level (p-value) of the average scores of students in both groups (control and experimental) to determine the impact of using artificial intelligence compared to the traditional method. For the main experiment, a quantitative (numerical) variable was used, focusing on the data distribution and the significance level, which means that student scores are symmetrically clustered around the course mean. The categorical or ordinal component mentioned in previous sections was limited exclusively to the descriptive analysis regarding students' perceived satisfaction with the use of AI in the classroom, but not to verifying the hypothesis of academic performance.

To validate the impact of using artificial intelligence, the parametric Student's t-test was applied, which allows for comparing the means between the control and experimental groups. According to Gordillo-Armijos, this procedure requires that the data have a normal distribution, considering that the values tend to cluster around the mean or average of the course. Likewise, the significance level is expressed as a value between 0 and 1. In experimental studies, the most commonly used alpha levels are 0.05 and 0.01. In this sense, when the p-value is less than 0.05, the null hypothesis is rejected and the alternative hypothesis is accepted; whereas, if the p-value is greater than 0.05, the null hypothesis is not rejected, indicating that there is no statistically significant difference between the groups analyzed (Gordillo-Armijos, 2021, p. 52).

3.6 Results of Descriptive and Inferential Statistics

Question 1 is worded as follows: Does using Machine Learning software to graphically represent a linear function help you understand the class topic by fostering logical thinking?

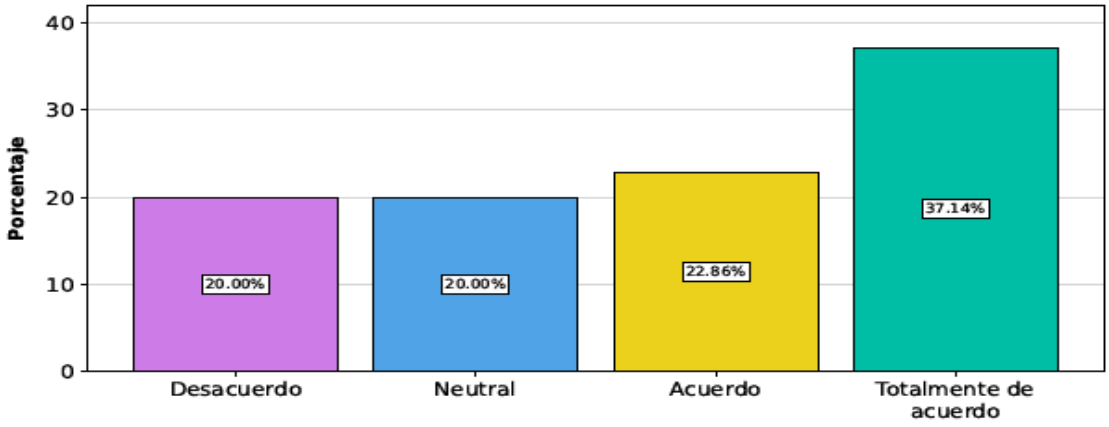


Figure 2. Percentages of responses in the acceptance of the template for graphical representation of the linear function.

According to the results, among the students of the Higher Education Institute, 37.14% strongly agree, 22.86% agree, 20% are neutral, and 20% disagree regarding the application of the machine learning template in the graphical representation of linear functions.

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Furthermore, it can be interpreted that 60% of the students in the entire course agree with the use of AI-powered templates to improve the learning process for linear and quadratic functions by fostering cognitive skills.

Question 2 is formulated as follows: Does using machine learning software in the graphical representation of quadratic functions help you understand the exercises proposed in class?

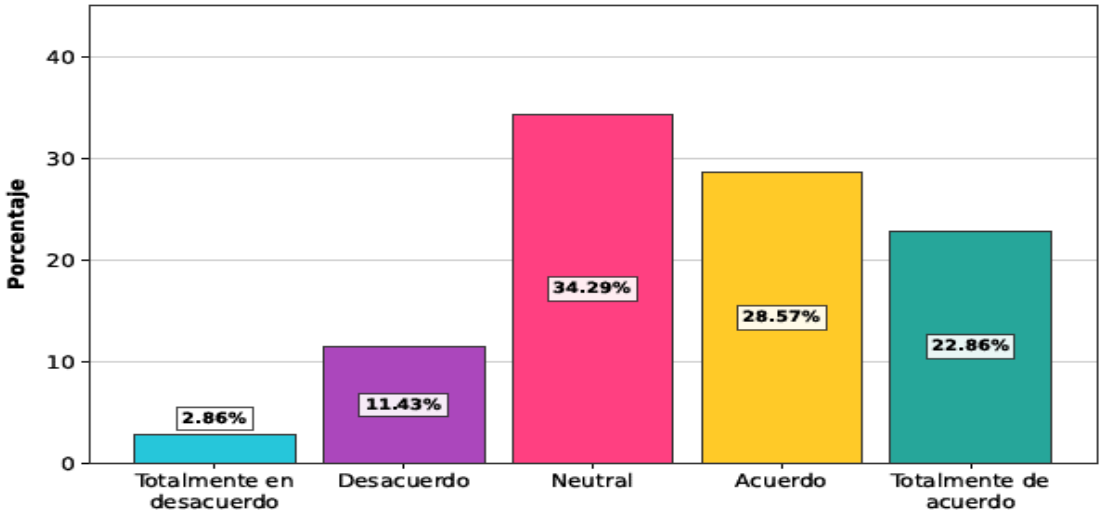


Figure 3. Percentages of responses in the acceptance of the template for graphical representation of the quadratic function

According to the results, among the students of the Higher Education Institute, 22.86% strongly agree, 28.57% agree, 34.29% are neutral, 11.43% disagree, and 2.86% strongly disagree. It is important to note that 34.29% of the class is neutral. Furthermore, the results indicate that 22.86% of the class strongly agrees with the application of the machine learning template for the graphical representation of the quadratic function. This perception demonstrates that the tool facilitates the understanding of the exercises developed in class, particularly those related to the algebraic determination of the parabola from two points located on the Cartesian plane. However, it is considered necessary to implement feedback processes to improve the template in those areas where students experience the greatest difficulties, with the aim of strengthening the teaching and learning process.

Question 3 is worded as follows: Does applying Deep Learning to the feedback boxes in the template help you develop cognitive skills such as logical reasoning?

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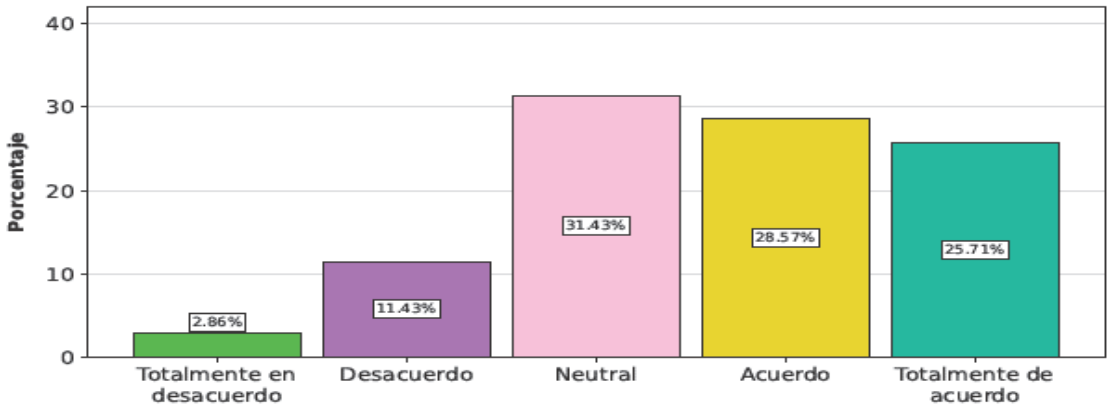


Figure 4, Percentages of responses in the acceptance of feedback boxes in the Deep Learning template

According to the results, among the students of the Higher Education Institute, 25.71% strongly agree, 28.57% agree, 31.43% are neutral, 11.43% disagree, and 2.86% strongly disagree. Furthermore, it can be interpreted that 54.28% of the students have a high acceptance of the application of Deep Learning in solving linear and quadratic function exercises using the feedback strategy. However, 45.72% of the students are skeptical about the application's potential to improve their learning, indicating the need for timely feedback during class time to help them solve algebraic expressions.

Question 4 is formulated as follows: Does entering values of the linear function into the Machine Learning template help you develop the algebraic solution of the equation of a line?

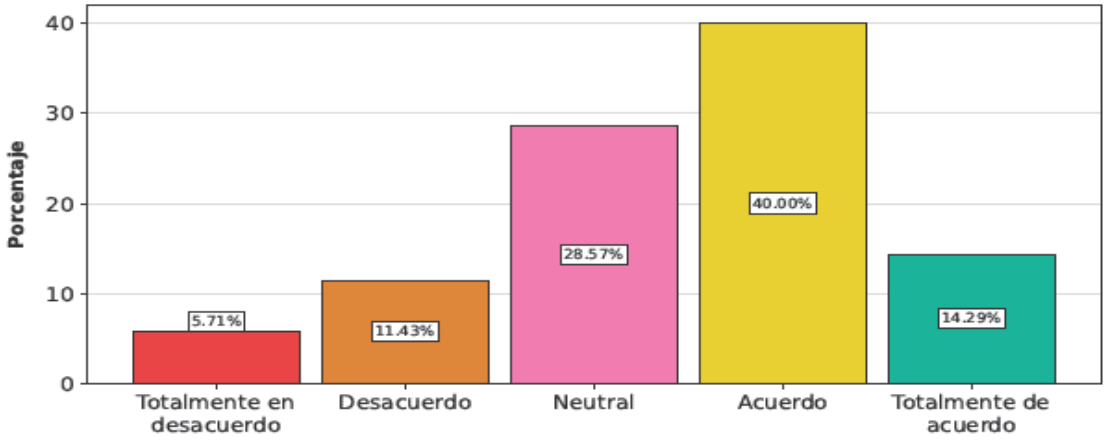


Figure 5. Percentages of responses in the acceptance of income values in the quadratic function in the Machine Learning template

Regarding the results, 14.29% of students strongly agreed; 40% agreed; 28.57% were neutral; 11.43% disagreed; and 5.71% strongly disagreed. These data show that 54.29% have a favorable view of using the Machine Learning template to determine the equation of a line in a linear function. However, the 28.57% of neutral responses reflect the need to strengthen support through demonstration classes and feedback in the areas of greatest difficulty.

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Question 5 is worded as follows: Did the deep learning template, by allowing peer feedback comments, help you understand the topic of linear and quadratic functions?

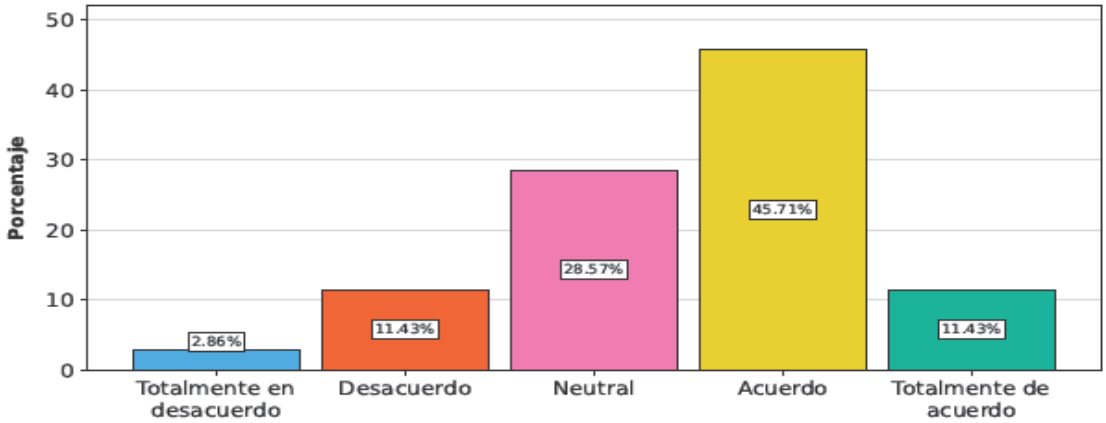


Figure 6. Percentages of responses in the acceptance comments on the quadratic function in the Deep Learning template

Regarding the results, 11.43% of the students strongly agreed; 45.71% agreed; 28.57% were neutral; 11.43% disagreed; and 2.86% strongly disagreed. These data show that 57.14% of the students have a favorable view of peer discussion as a feedback strategy for solving linear and quadratic function exercises. However, the 28.57% of neutral responses reflect the need to strengthen pedagogical support to consolidate learning. It is important to emphasize that a high percentage of the class was skeptical, so personalized feedback was necessary in areas such as the algebraic solution of a concave and convex parabola.

3.7 Normality Test

It is important to mention that the Shapiro-Wilk test was applied to assess normality, considering that the sample consisted of more than 30 and fewer than 50 students. The experimental group yielded a significance value of 0.138, while the control group yielded a significance value of 0.225. Since both values exceed the established significance level (α = 0.05), it is determined that both the experimental and control groups exhibit a normal distribution in their scores, as shown in Table 1..

Normality Test

	Kolmogorov-Smirnov			Shapiro-Wilk		
	Statistical	Gl	Sig	Statistical	Gl	Sig
Grades A	0.082	40	0.200	0,958	40	0.138
Grades B	0.077	41	0.200	0.964	40	0.225

This is a lower bound on true significance.
Lilliefors significance correction

Table 1. Normality test of the control and experimental groups using the SPSS statistical software.

3.8 T-Test for independent samples

It is important to mention that the parametric t-test for independent samples was used, given that there was a control group and an experimental group where the scores passed the normality test and the data were numerical. A p-value of 0.843 was obtained with a two-way p-value, given the significance level of α=0.05. The difference between the means was 0.267 units, and the difference in the standard error was 1.34 units. Furthermore, in the

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interpretation of the results, the null hypothesis was accepted, which states that there is no significant difference in the students' scores. Therefore, it was determined that academic performance did not show a statistically significant improvement after the application of artificial intelligence as a learning method, through the use of machine learning and deep learning templates.

In this sense, the results demonstrate that there is no significant difference between the means of the two working groups at the Higher Education Institute. The control group obtained an average of 8.25 points, while the experimental group reached an average of 8.52 points, which shows that, although there is a slight numerical difference between both averages, this is not statistically significant.

Independent Samples Test									
	Levene´s test for equality of variances		t-test for equality of means						
	F	Sig	T	Gl	Significance *P of a factor*	*Two-factor P*	Difference of Means	Standard Difference	Error
Equal variances are assumed	0.048	0.826	-1.99	0.79	0.421	0.843	-0.26707	1.34110	
Equal variances are not assumed			-1.99	78.999	0.421	0.843	-0.26707	1.43063	

Table 2. T-test for independent samples using SPSS statistical software

4. Discussion of Results

Quiroz-Rosas's research indicates that, although students recognize the transformative support that AI provides, many do not feel fully prepared to effectively integrate it into their teaching practices. The implementation of AI in education raises concerns about the potential for dehumanizing the educational process, as well as the possible excessive dependence this technology generates (Quiroz-Rosas, 2023, p. 18). In accordance with this, the present research shows that while Deep Learning and Machine Learning templates, consisting of continuous feedback charts, had a high acceptance rate among students (66.71% of the course), there is too much dependence on the solution software. Consequently, students did not develop broader cognitive skills in reasoning and critical and analytical thinking, resulting in poor integration into the pedagogical learning process.

Torres-Torres's research shows that the arithmetic mean of the experimental group was 7.71, while the control group obtained an arithmetic mean of 6.22. In turn, the standard deviation of the experimental group is 2.40 units and that of the control group is 1.66 units. A significant difference in the standard deviation between the performance of the experimental and control groups is observed (0.74). Therefore, it can be concluded that the experimental group, which used AI in the development of the classes, had higher academic performance than the control group (Torres-Torres, 2024, p. 35). In contrast, this research used the parametric Student's t-test for independent control and experimental groups with a p-value of 0.843 units, indicating that there is no significant difference between the means of the groups. The control group obtained a mean of 8.25 units and the experimental group 8.52 units, demonstrating that there is no significant difference in the averages.

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5. Conclusions

Students at the Higher Education Institute showed high acceptance of the application of artificial intelligence in the study of linear and quadratic functions. The results demonstrate that in the satisfaction survey, 57.14% of the sample was in favor of using AI in the classroom, while skepticism remained low or in the minority. It is important to note that more than half of the students found the feedback process helpful; peer discussions encouraged students to solve linear and quadratic function exercises. It is important to emphasize that a high percentage of the students were skeptical, so feedback was needed in specific areas such as the algebraic solution of concave and convex parabolas, and, in linear functions, the input of limits of an increasing function to solve the proposed exercises.

This research determined that there is no significant impact of AI application compared to traditional teaching methods. This was corroborated by the parametric t-test for independent samples (control and experimental groups), where the scores met the normality test requirements. The statistical analysis yielded a p-value of 0.843 with a two-way p-value, given a significance level of α=0.05, leading to the confirmation of the null hypothesis that there is no significant difference in student grades. Therefore, their performance does not improve when using AI with Machine Learning and Deep Learning templates as a learning method. Furthermore, there is no significant difference in the mean scores of either group of students at the Higher Education Institute.

This study highlights an important dichotomy: despite high acceptance among higher education students of AI as a teaching tool, it does not influence academic performance, as students' grades do not surpass those obtained with the traditional method. Detailing the opportunity to integrate artificial intelligence methodology into lesson planning, which requires high pedagogical feedback, this study integrates various skills within multiple intelligences to develop abstract and logical reasoning skills in proposed and developed exercises, along with assessments, highlighting difficulties in the areas of increasing and decreasing functions. As a future line of research, the need arises to delve deeper into the design and implementation of a hybrid teaching model that incorporates AI-supported diagnostics to address learning difficulties with functions. In this regard, it is pertinent to explore how teachers can leverage AI-generated feedback systems to focus their pedagogical intervention on the most complex areas, such as the algebraic solution of complex parabolas or the incorporation of the concept of limits.

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