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Article

Transforming learning: Exploring the frontiers of educational innovation in the 21st Century

Transformando el aprendizaje: Explorando las fronteras de la innovación educativa en el Siglo XXI

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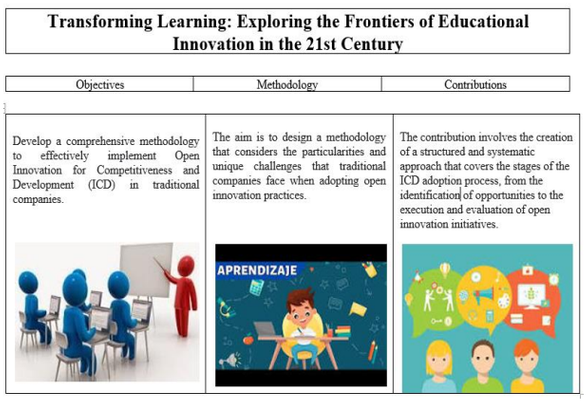
Abstract

The objective of this research is to develop a comprehensive methodology to effectively implement Open Innovation for Competitiveness and Development (ICD) in traditional companies. The aim is to design a methodology that considers the particularities and unique challenges that traditional companies face when adopting open innovation practices. The contribution involves the creation of a structured and systematic approach that covers the stages of the ICD adoption process, from the identification of opportunities to the execution and evaluation of open innovation initiatives.



Business growth, Improve competitiveness, Open innovation

Resumen

El objetivo de esta investigación es desarrollar una metodología integral para implementar eficazmente la Innovación Abierta para la Competitividad y el Desarrollo (ICD) en empresas tradicionales. Se busca diseñar una metodología que considere las particularidades y desafíos únicos que enfrentan las empresas tradicionales al adoptar prácticas de innovación abierta. La contribución implica la creación de un enfoque estructurado y sistemático que abarque las etapas del proceso de adopción de ICD, desde la identificación de oportunidades hasta la ejecución y evaluación de iniciativas de innovación abierta.

Crecimiento empresarial, Mejorar la competitividad, Innovación abierta

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Introduction

Transforming Learning involves taking a holistic, future-oriented approach to improving education and preparing students for today's challenges and opportunities. This requires a continued commitment to innovation, collaboration and the development of educational practices that are relevant, inclusive and effective.

Educational transformation involves adjusting teaching and learning methods to adapt to the demands and challenges of the 21st century. This encompasses the review and updating of curricula, teaching methods, assessments and educational infrastructure, ensuring their alignment with the changing needs of the modern world.

Educational innovation, on the other hand, involves the introduction of new ideas, approaches, technologies and practices in education to improve the quality and effectiveness of the teaching-learning process. This may include the adoption of digital tools, the design of flexible learning environments and the implementation of innovative pedagogical methodologies.

Technological tools such as computers, mobile devices, educational software, virtual and augmented reality are changing the way we teach and learn. Under this tenor, technology plays a crucial role in this transformation, offering opportunities to improve teaching, increase student engagement and personalize learning.

Under this context, traditional teacher-centered models are being replaced by student-centered approaches, which encourage active participation, collaboration, problem solving and creativity.

Contextualization and theoretical support

The educational context refers to the environment in which the teaching and learning process takes place. It includes a variety of factors that influence education, such as government policies, available resources, pedagogical practices, educational infrastructures, local communities, and student needs (Aaron, 2016).

The educational context involves a multifaceted environment that influences the teaching and learning process significantly. Understanding and addressing the various aspects of the educational context is essential to improve quality and equity in education

One of the main failures is the outdated curricula, where many study plans do not reflect the demands and changes of the 21st century. This can result in a lack of relevance of the content taught and a failure to prepare students for the challenges of the modern world.

Furthermore, a traditional teacher-centered teaching approach persists, limiting students' active participation and engagement in the learning process.

The lack of personalization in education is another challenge, as the "one size fits all" approach may not meet the individual needs of students, excluding certain groups and limiting their potential.

Educational infrastructure, both physical and technological, may also be obsolete and do not meet the needs of modern learning, making it difficult to effectively implement technology in the classroom and limiting access to adequate educational resources (Torres and Cobo, 2017).

Lack of teacher training is another problem, as many educators may not be equipped with the skills necessary to adapt to the changing demands of the educational environment, affecting the quality of teaching.

Low motivation and high school dropout rates are persistent problems, related to the lack of relevance of the content taught, the lack of emotional and socioeconomic support, and the disconnection between education and job opportunities (Masjuan, Elias, and Troiano , 2009).

The digital divide also widens educational disparities between students from different socioeconomic backgrounds, limiting equitable access to technology and Internet connectivity, and affecting the availability of online educational resources and digital skills development opportunities (Torres and Cobo, 2017).

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Addressing these failures in the current educational context requires a comprehensive approach that involves curricular reforms, updating pedagogical methodologies, investment in educational infrastructure, continuous teacher training, and measures to promote equity and inclusion in education.

Under this panorama, it is essential to talk about a change in educational design which must reflect innovation and must be characterized by its flexibility, adaptability and student-centered approach, as well as its ability to effectively integrate technology, promote collaboration and learning. social, and skill development. This is critical to creating effective and meaningful learning experiences that prepare students to succeed in an ever-changing world. True innovation in education is not always found in creating new ideas from scratch, but in the way existing ideas are combined, adapted and applied to continually improve the learning process and meet the changing needs of students and society.

Margalef, Arenas, Andoni, (2006), defines innovation as a series of interventions, decisions and processes, with a certain degree of intentionality and systematization that try to modify attitudes, ideas, cultures, contents, models and pedagogical practices.

Some ways in which innovation can manifest itself in the concepts discussed are:

1. Integrated and holistic approach: Innovation can come from the integration of multiple educational approaches, technologies and methodologies into a cohesive and holistic framework. This involves creating educational systems that leverage emerging technologies such as artificial intelligence to personalize learning, while fostering social and emotional skills through experiential learning and collaboration.
2. New implementation models: Innovation can arise from the implementation of new educational models that challenge established norms and provide alternative solutions to existing problems. For example, entirely new schools or educational programs could emerge that take a radically different approach to learning, such as game-based education or self-directed learning.
3. Adaptation to changing needs: Innovation can manifest itself in the ability to quickly adapt to the changing needs and challenges of the educational environment. This involves the ability to leverage new technologies and methodologies as they emerge, as well as continually adjust educational approaches based on student feedback and outcomes.
4. Creativity in implementation: Innovation can come from creativity in the way existing ideas are implemented and adapted. For example, an innovative approach could be the integration of emerging technologies such as augmented reality into project-based learning projects, giving students a more immersive and immersive experience.

Education must transcend borders, understood not as divisions, but as spaces for encounter, transit and exchange. There are educational themes that develop precisely on these borders, shared between school, society and family.

In this sense, some frontiers that could be explored in terms of educational innovation are:

1. Integration of emerging technology: The adoption of advanced technologies such as artificial intelligence, virtual reality, augmented reality and data analytics in the educational process to improve the personalization of learning, provide immersive learning experiences and facilitate taking data-based decision making.

2. 21st century skills-based learning: The design of curricula and teaching methods focused on the development of skills such as critical thinking, problem solving, collaboration, communication, creativity and digital literacy, which are essential for success in the 21st century.

3. Experiential and hands-on learning: Promoting more hands-on and experiential learning by implementing approaches such as project-based learning, service learning, internships, and learning experiences in real-world settings.

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4. Innovations in assessment and feedback: Exploring new approaches to learning assessment that go beyond standardized testing and include formative assessment, self-assessment, peer assessment, and competency-based assessment.

5. Exploration of new educational models: Research and experimentation with alternative educational models, such as personalized education, hybrid learning, self-organized learning and disruptive education, that challenge established norms and respond to the changing needs of students and society.

Speaking of this last point, it is important to mention the design of curricula and pedagogical approaches as a fundamental part of educational innovation, since these define how the teaching and learning process is structured and delivered (Fernández and Calzado, 2018). Some key areas within this aspect of educational innovation:

1. Student-centered pedagogical approaches: Educational innovation promotes pedagogical approaches that put the student at the center of the learning process. This involves moving beyond traditional teacher-centered teaching toward more active and participatory methods where students are co-constructors of their own knowledge. Examples of these approaches include project-based learning, cooperative learning, experiential learning, and problem-based learning.

2. Personalization of learning: Educational innovation seeks to provide more personalized learning experiences that adapt to the individual needs of each student. This involves using technology to collect data about students' interests, abilities, and learning styles, and then using this information to adapt the content, methods, and pace of instruction to each student's individual needs.

3. Integration of technology in the classroom: Educational innovation promotes the effective use of technology in the classroom to improve the teaching and learning process. This may include the use of mobile devices, educational applications, online platforms, educational games, and simulations to enrich educational content, increase student engagement, and provide immediate, personalized feedback.

4. Development of 21st century skills: Educational innovation recognizes the importance of developing key skills and competencies for success in the 21st century, such as critical thinking, problem solving, effective communication, collaboration and digital literacy. Innovative curricula seek to explicitly integrate the development of these skills across all areas of study.

5. Authentic and formative assessment: Educational innovation seeks more authentic and meaningful ways to assess student learning. This may include project-based assessment, peer assessment, self-assessment, and formative assessment that provides ongoing, specific feedback to guide learning and performance improvement.

The design of curricula and pedagogical approaches within the framework of educational innovation seeks to create more relevant, personalized and meaningful learning experiences that prepare students to succeed in a constantly changing world. It focuses on adopting student-centered pedagogical approaches, using technology effectively, developing skills, and improving assessment processes to promote deep and lasting learning.
Educational design is a crucial aspect of educational innovation and refers to the planning and creation of effective and meaningful learning experiences (Fernández and Calzado, 2018). Since the topic is educational innovation, a pedagogical approach that would be especially relevant and effective is the constructivist approach. Constructivism is a learning theory that holds that students actively construct their own knowledge through interaction with the world and reflection on those experiences. This approach aligns well with the idea of educational innovation, as it promotes the active participation of students in building their understanding and skills (Serrano and Pons 2011).

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This represents that the constructivist approach offers a solid foundation for educational innovation by promoting critical thinking, collaboration, personalization of learning and intrinsic motivation of students. By encouraging students to actively construct their own knowledge through exploration and reflection, this approach can help cultivate the skills and competencies necessary to thrive in an ever-changing world (Serrano and Pons 2011).

Some reasons why the constructivist approach would be appropriate for the topic of educational innovation are the following:

- Encourages critical thinking and problem solving: Constructivism emphasizes the importance of students being active participants in their own learning process. By challenging students to reflect on their experiences, ask questions, and seek solutions, it promotes the development of critical thinking and problem-solving skills, essential skills in an innovative learning environment.

- Promotes collaboration and social learning: Constructivism recognizes the value of collaborative learning and the exchange of ideas among students. In an innovative educational environment, where experimentation and exploration are encouraged, collaboration between students can be especially beneficial for the generation of new ideas and creative solutions.

- Supports personalization of learning: Constructivism recognizes that each student is unique and has his or her own set of experiences, prior knowledge, and learning styles. By allowing students to construct their own knowledge through exploration and reflection, the learning process can be adapted to the individual needs of each student, which is essential in an innovative educational environment.

- Promotes autonomy and intrinsic motivation: By giving students an active role in their own learning, constructivism promotes autonomy and responsibility, which can increase students' intrinsic motivation to learn.

In an innovative educational environment, where experimentation and creativity are encouraged, intrinsic motivation can be a key factor for success.

However, to talk about educational innovation and transformation, we must propose a new pedagogical approach that integrates key elements of constructivism with additional principles that reflect the demands and opportunities of the digital era and the 21st century.

Methodology applied in research

Research Objective

The objective of this research is to analyze how the adoption of a student-centered pedagogical approach and the integration of emerging technologies can transform education to prepare students for the challenges and opportunities of the 21st century. This includes evaluating the effectiveness of new teaching methodologies, the personalization of learning, and the impact of innovation on infrastructure and teacher training.

Methodological approach

A descriptive qualitative methodology will be used to explore and understand the perceptions, experiences and practices related to educational transformation and pedagogical innovation. This approach will allow us to obtain a deep and contextualized understanding of the changes and challenges in the current educational field.

Data collection techniques: Document analysis

Document analysis is a central technique in this research. This method involved a comprehensive review of a variety of documentary sources relevant to understanding innovative educational practices and their impact on learning transformation.

1. Selection of Documents:

- Primary Sources: Official documents such as study plans, educational policies, reports of innovative educational projects and methodological guides will be included.

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- Secondary Sources: Academic articles, case studies, theses, books and publications specialized in education and educational technology will be reviewed.
- Digital Resources: Blogs, webinars, and other online resources produced by education and technology experts will also be analyzed.

2. Selection Criteria:

The selected documents had to meet the following criteria:

- Relevance: They must be directly related to educational innovation and the transformation of learning.
- Current affairs: Preferably published in the last five years to ensure relevance to current trends.
- Credibility: From recognized and reliable sources in the educational field.

3. Analysis Procedure:

Document analysis was carried out through the following steps:

- Exploratory Reading: A first reading to become familiar with the content of each document and select the most relevant segments.
- Thematic Coding: Identification of recurring themes and subthemes related to innovative pedagogical practices, the use of emerging technologies and student-centered approaches.
- Interpretive Analysis: Interpretation of data through a theoretical lens based on contemporary educational approaches, such as constructivism and connected learning.
- Triangulation: Comparison of findings obtained from different sources to ensure the validity and reliability of the results.
- Synthesis of Results: Preparation of a detailed report that integrates key findings and provides a comprehensive view of innovative practices in education.

Proposal for an innovative pedagogical approach: Connected and Student-Directed Learning Approach (ACDE)

The Student-Directed and Connected Learning (ACDE) approach integrates elements of constructivism with additional principles that reflect the demands and opportunities of the digital age and the 21st century. This approach promotes meaningful, personalized and collaborative learning, as well as creativity and innovation, preparing students to succeed in an ever-changing world.

This approach recognizes the importance of connecting learning to the real world and the student's experiences. It focuses on establishing meaningful connections between curricular content and contexts relevant to students, such as their interests, cultures, communities, and the world of work. The integration of learning is encouraged through interdisciplinary projects and authentic experiences that involve collaborations with the community and the practical application of knowledge.

It places the student at the center of the learning process, recognizing their ability to direct and control their own learning. Student autonomy and responsibility are promoted, as well as self-regulation and metacognition. Students have the opportunity to explore their interests and passions, make decisions about their learning, and participate in the co-creation of curriculum and assessment.

Recognizes the diversity of students and their individual learning needs. Personalization of learning is promoted through differentiation and adaptation of curriculum, resources and pedagogical strategies to meet the needs of each student. Educational technologies and learning data are used to provide personalized feedback, progress tracking and learning recommendations. Collaborative learning and the social construction of knowledge are encouraged in a networked learning environment. Students have the opportunity to work together on collaborative projects, participate in communities of practice, and connect with external experts and resources through social media and communication technologies.

The exchange of ideas and the collective construction of knowledge is valued. Promotes creativity, curiosity and problem solving as drivers of learning.

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Exploration, experimentation, and critical thinking are encouraged in an environment that values diversity of perspectives and solutions. Students are encouraged to take risks, learn from failure, and be innovative in finding solutions to real-world challenges.

This approach is based on the premise that effective learning occurs when students are connected to the world around them, have control over their own learning process, and are immersed in meaningful and relevant experiences.

In this sense, the Student Connected and Led Learning (ACDE) approach promotes meaningful, personalized, collaborative and real-world oriented learning, as well as creativity and innovation. By providing students with opportunities to connect with the world around them, take an active role in their own learning, and collaborate with others in finding solutions to real problems, this approach prepares students to succeed in an ever-changing world change.

To apply the Connected and Student-Directed Learning (SCLD) approach in curriculum design, it is necessary to adopt a series of strategies and principles that reflect the fundamental values of this approach. Here are some ways in which curriculum design can be adapted to align with the ACDE approach:

1. Identify relevant themes and problems: Instead of basing the curriculum on a predefined list of topics or subjects, curriculum design in the ACDE approach begins by identifying relevant and meaningful themes and problems for students. These topics may arise from student interests, community needs, or real-world challenges.
2. Integrate authentic projects and experiences: ACDE curricular design prioritizes the integration of authentic learning projects and experiences into the curriculum. This may include research projects, practical activities, community internships, or collaborations with local businesses. These experiences provide opportunities for students to apply what they are learning in real-world contexts and develop practical, transferable skills.
3. Promote student autonomy: The ACDE curricular design encourages student autonomy and responsibility in their own learning process. This may involve incorporating choice and flexibility into the curriculum, allowing students to choose the topics they want to explore, the activities they want to participate in, and the resources they want to use. Students can also participate in co-creating the curriculum, contributing their own ideas and perspectives.
4. Personalize learning: ACDE curriculum design recognizes the diversity of students and their individual learning needs. Therefore, we seek to personalize learning through differentiation and adaptation of the curriculum to meet the needs of each student. This may involve utilizing strategies such as flexible grouping, individualized tutoring, and using educational technologies to provide personalized feedback and progress monitoring.
5. Promote collaboration and social learning: ACDE curricular design promotes collaborative learning and the social construction of knowledge. This may include incorporating collaborative activities and projects into the curriculum, as well as creating opportunities for students to connect with others through online communities of practice or social media. Collaboration encourages the exchange of ideas, the collective construction of knowledge and the development of teamwork skills.
6. Stimulate creativity and innovation: ACDE curricular design seeks to stimulate creativity and innovation in learning. This may involve incorporating activities and projects that challenge students to think creatively, explore new ideas, and seek innovative solutions to real problems. Students are encouraged to take risks, learn from failure, and develop a growth mindset.

Therefore, curriculum design in the Student Connected and Led Learning (SCDL) approach focuses on identifying relevant topics and problems, integrating authentic projects and experiences, promoting student autonomy, personalizing learning, encouraging collaboration and social learning, and stimulate creativity and innovation.

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Doing so creates a curriculum that prepares students to succeed in an ever-changing world, while promoting engagement, motivation, and meaningful learning.

To successfully achieve the Student Connected and Led Learning (SCDL) approach, schools need to implement a series of changes at various levels, ranging from school culture to technological infrastructure. Some key elements schools need to consider:

- Change in school culture: Implementation of the ACDE approach requires a change in school culture toward one that values student autonomy, collaboration, and innovation. This may involve greater openness to experimentation, project-based learning, and shared decision-making between students and educators.

- Teacher professional development: Educators will need training and support in new pedagogical methodologies and the effective use of technology to facilitate connected and student-directed learning. Continuing professional development may include workshops, training courses, coaching, and opportunities to collaborate with other educators.

- Flexibility in curriculum and assessment: Schools will need to make curriculum more flexible to allow for the integration of projects and authentic learning experiences, as well as the personalization of learning to meet individual student needs.

- Adequate technological infrastructure: It is important that schools have the necessary technological infrastructure to facilitate connected and student-directed learning. This may include access to digital devices, reliable internet connectivity, online platforms for collaborative learning, and learning management tools.

- Flexible and collaborative learning spaces. Schools can consider creating flexible and collaborative learning spaces that encourage interaction, creativity and innovation.

- Community participation: It is important for schools to involve the community in the process of implementing the ACDE approach. This may include collaborating with local businesses, community organizations, and experts in different fields to provide authentic learning opportunities and connect learning to the real world.

The transition to a new teaching model such as the Student Connected and Led Learning (ACDE) approach does not have a defined time, as it will depend on a series of factors, including the specific context of each school, the disposition of educators, the available infrastructure and the level of support from the educational community in general. However, this transition can be expected to be a gradual process that could take several years. It is important to note that this process will require a long-term commitment and collaborative effort from all members of the educational community. Some factors that could influence the duration of the transition:

1. Staff Preparation and Training: It is essential to provide educators with the preparation and training necessary to successfully implement the ACDE approach. This can take time, especially if educators are used to more traditional teaching methods and need to acquire new pedagogical skills and knowledge.

2. Curriculum development and adaptation: Adapting curricula to align with the principles of the ACDE approach can be a complex process that requires time and collaboration between educators, administrators, and other school staff. This involves reviewing and modifying curricular standards, identifying relevant themes and issues, and designing authentic and meaningful learning experiences.

3. Implementing educational technology: Integrating educational technology into the classroom can also take time, as schools may need to acquire new devices, establish reliable Internet connections, and train educators in the effective use of digital tools to The learning.

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4. Change in school and community culture: The transition to a new teaching model also implies a change in school and community culture to align them with the values and principles of the ACDE approach. This may require time and effort to encourage greater student engagement, promote collaboration among educators, and build stronger relationships with the community.

The Student Connected and Led Learning (SCLD) approach offers a number of significant advantages to the teaching and learning process, including more meaningful and contextualized learning, the development of key skills, the promotion of student autonomy, the personalization of learning, collaboration and social learning, and the stimulation of creativity and innovation.

Therefore, designing academic programs that foster active learning and student engagement requires a combination of pedagogical approaches, experiential learning opportunities, and personalized support. By integrating research projects, internships, and problem-based learning experiences into the curriculum, academic programs can provide students with a relevant and meaningful education that prepares them for success in their future careers and contributions to society. society.

First conclusions

Educational transformation requires a comprehensive approach that combines student-centered pedagogical methodologies, the effective integration of emerging technologies, adequate infrastructure and continuous teacher training. Only in this way can students be prepared for the challenges and opportunities of a constantly changing world. Below are the first conclusions derived from the analysis of documents:

1. Effectiveness of the Student-Centered Approach:

- Adopting student-centered approaches, such as Student Connected and Led Learning (ACDE), encourages greater participation and engagement, developing critical and collaborative skills necessary for the 21st century.

2. Impact of Technology on Education:

- The integration of emerging technologies, such as artificial intelligence, augmented reality and online learning platforms, has been shown to improve the personalization of learning and offer more immersive and relevant educational experiences.

3. Importance of Teacher Training:

- Continuous training and support for educators are crucial for the successful implementation of innovative methodologies and the effective use of new technologies. Lack of training can limit the potential of these innovations.

4. Challenges of Educational Infrastructure:

- Educational infrastructure, both physical and technological, needs to adapt to support new teaching and learning methodologies. Limitations in this aspect can hinder the effective adoption of educational innovation.

5. Relevance of Personalization of Learning:

- Personalization of learning has been identified as a key factor in meeting the individual needs of students, improving their motivation and academic performance.

6. Collaboration and Social Learning:

- Encouraging collaboration and social learning inside and outside the classroom contributes to deeper and more meaningful learning, preparing students for teamwork and problem solving in real contexts.

In conclusion, to effectively transform education, an approach that integrates student-centered pedagogical methodologies, the appropriate use of emerging technologies, a robust infrastructure, and a continuous teacher training program is essential.

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Only through the consistent and coordinated implementation of these elements can students be adequately prepared to meet the challenges and seize the opportunities of an ever-changing world. This comprehensive approach will not only promote more inclusive and equitable education, but will also make it more relevant and adaptable to the demands of the 21st century.

Declarations

Conflict of interest

In relation to this article, the authors wish to emphasize that there is no conflict of interest that could influence the objectivity or impartiality of the results presented. We confirm that we do not have financial interests that compete with the topics discussed in this work, nor do we maintain relationships that could bias the interpretation of the data or the presentation of the conclusions.

Importantly, our priority is to maintain academic and ethical integrity in all our research. Therefore, any potential conflict of interest would be disclosed in a transparent and open manner. In this sense, we reiterate that there is no external influence that has impacted the writing or analysis of the content presented in this article.

We are committed to maintaining high standards of honesty and transparency in our investigative work, guaranteeing the reliability and credibility of the results presented. The absence of conflicts of interest reinforces our conviction in the veracity and relevance of the findings presented here, and reaffirms our commitment to scientific and academic integrity.

Author contribution

Ruiz-Valdés, Susana: Focused on educational terms, has provided the necessary theoretical framework, including learning theories and pedagogical strategies, which has been essential in the development and adjustment of the educational curriculum to effectively integrate the researched technology, allowing contextualization the findings within the educational landscape, identifying the specific needs and challenges of the educational system and ensuring that the results are relevant and applicable in various educational contexts.

Ruiz-Tapia, Juan Alberto: Specialist in research methodology, has been instrumental in the design and structure of the study, ensuring the use of rigorous and appropriate research methods; Their approach has allowed us to obtain robust and generalizable conclusions.

Cruz-Solis, Ivette del Rosario: Specialist in educational technology, has contributed her deep knowledge of the most recent technological tools and their integration into the educational process; His experience has been very important, as well as in its implementation and evaluation, since it has provided a theoretical and practical framework that has allowed us to evaluate the impact of these technologies on learning and teaching as been key in identifying the appropriate technological tool.

Availability of data and materials

The availability of the data in its entirety is contemplated for those interested who wish to delve deeper into the complete study and contact us as authors. We will be happy to provide access to detailed data, provided that applicable privacy and confidentiality policies are respected, and established ethical and legal procedures are followed. To request access to full data, we invite you to get in touch and we will assess the request on an individual basis and take the necessary steps to ensure compliance with the relevant requirements. We are committed to fostering transparency and replicability in our research, and to collaborating with other researchers interested in using our data for related future studies and analyses.

Funding

It is important to note that this research was conducted without the support of any external funding. All costs associated with data collection, analysis, and presentation were borne by the authors themselves. This absence of external financing guarantees the independence and objectivity of the study, by avoiding any potential influence that could arise from financial interests or commitments with external entities.

This study was conducted with internal resources, ensuring that the results and conclusions presented are based solely on the evidence collected and unbiased analysis of the data.

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Furthermore, we recognize the collaboration of all participants who dedicated their time and shared their experiences, which was essential to enrich the findings of this work.

Abbreviations

It is important to note that no abbreviations were used in this work. It was chosen to use full terms instead of abbreviations to ensure clarity and understanding of the text, as well as to maintain a more formal and readable presentation. This decision helps ensure coherence and consistency in the presentation of information, making it easier for readers to read and interpret the content.

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Antecedents

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