



Journal of Hunan University (Natural Sciences)

Vol. 51 No. 10
October 2024


Available online at

<http://jonuns.com/index.php/journal/index>



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Open Access Article

 <https://doi.org/10.55463/issn.1674-2974.51.10.3>

Comparison of the Main Evidence-Based Learning Strategies in Basic Education in Mexico

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Article History:

Received: August 8, 2024

Revised: September 5, 2024

Accepted: September 14, 2024

Published: October 31, 2024

Abstract: In the context of primary education in Mexico, it is essential to consider evidence-based learning strategies to improve student outcomes. Evidence-based learning techniques have focused on the application of rigorous scientific methods to determine the effectiveness and efficiency of various educational strategies. These techniques allow educators and teaching professionals to determine which methods and approaches are most effective in improving student learning. This study tests the methods of Adaptive Learning, Game-Based Learning, Collaborative Learning, and Online Learning. Qualitative research was carried out, and grounded theory was applied as a method with the purpose of analyzing the impact of these methods on the teaching-learning process in



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the four case studies that belong to primary basic education institutions in Mexico. Pedagogical activities based on digital games were created, and effective teaching practices, evidence-based teaching, and classroom management strategies were implemented. Finally, they built strong relationships with students, which contributed to positive learning outcomes. This research is novel due to the degree of participation of students, teachers, and administrators that resulted in verifying the importance of the implementation of new teaching methods that arouse the interest of students, thus generating significant learning.

Keywords: learning techniques, evidence-based learning, adaptive learning, game-based learning, collaborative

墨西哥基础教育主要循证学习策略比较

摘要: 在墨西哥的小学教育中, 考虑基于证据的学习策略对于提高学生成绩至关重要。基于证据的学习技术侧重于应用严格的科学方法来确定各种教育策略的有效性和效率。这些技术使教育工作者和教学专业人员能够确定哪些方法和方法最有效地提高学生的学习能力。本研究测试了自适应学习、基于游戏的学习、协作学习和在线学习的方法。进行了定性研究, 并应用扎根理论作为一种方法, 目的是分析这些方法对墨西哥小学基础教育机构的四个案例研究中的教学过程的影响。创建了基于数字游戏的教学活动, 并实施了有效的教学实践、基于证据的教学和课堂管理策略。最后, 他们与学生建立了牢固的关系, 这有助于取得积极的学习成果。这项研究的新颖之处在于学生、教师和管理人员的参与程度, 从而证实了实施新的教学方法的重要性, 这些方法可以激发学生的兴趣, 从而产生重要的学习效果。

关键词: 学习技巧、基于证据的学习、自适应学习、基于游戏的学习、协作

1. Introduction

Evidence-based learning techniques, although they are very diverse and currently new lines continue to emerge, all focus on applying rigorous scientific, statistical, or systemic methods to determine the effectiveness and efficiency of various educational strategies [1].

These tools are essential because they provide teachers with a better perspective on the teaching-learning process and thus help them make informed decisions about which methods and approaches are most effective [2].

In this research, we use the following techniques: adaptive learning, which uses artificial intelligence and machine learning to adapt the content and pace of learning to the individual needs of each student [3]; game-based learning (gamification), which uses recreational elements and games in the teaching process to improve students' motivation, commitment, and learning. Playful games are carefully designed to align learning objectives with game activities [4]. Collaborative and online learning: This type of learning platforms online encourage collaboration between students and facilitate the exchange of knowledge and experiences is a modern postmodernist trend which includes discussion forums, problem-solving activities using online communication [5].

Literature shows that these techniques can be effective in different controlled environments to improve teaching and learning; however, no link provides a better comparison. Therefore, we developed a new theory of knowledge in this qualitative research.

We intend to demonstrate a better alternative for its application in basic primary education.

2. Methods and Materials

Evidence-based learning, also known as research-based learning, represents an educational approach that focuses on investigating empirical and scientific evidence to improve the practices of the teaching-learning process [1]. The main objective is to help make educational decisions more informed and effective by using data and results from formal and rigorous research. It is based primarily on the premise that education and pedagogy should be supported using the best possible evidence, rather than relying solely on the educator's intuition, tradition, or personal experience. Therefore, teachers and decision-makers in educational institutions seek to use scientific research of any type (quantitative, qualitative, or mixed) to design effective teaching practices and strategies seeking their effectiveness [6]. Evidence-based learning covers several aspects that highlight educational research, evaluation, and analysis of results, evidence-based teaching practices where teachers implement methods and strategies in the classroom supported by scientific research that demonstrates their effectiveness in terms of facilitating student learning, and finally, informed decision-making. Educational institution decision-makers use data and evidence to make decisions about educational policies, programs, and curricula [7].

In this research, we seek to make a comparison of all these efforts, aiming to improve the quality of

education, increase student success, and promote a more reflective and informed approach to teaching. Given that this area of knowledge is on the frontier, it is constantly evolving. It is fed back by research carried out by the educational community, which is discovering new ways to improve the learning process. The three most important aspects of this study are as follows.

1. Adaptive Learning, also known as Personalized Learning or Intelligent Adaptive Learning, is an educational methodology that is based on the idea that each student is unique; and therefore, the teaching and learning process must be adjusted to meet the individual needs of each student. Information technologies and intelligent systems are used to collect data, which are then used to adapt and personalize the delivery of educational content.

2. Game-based learning (gamification): An educational strategy that uses game elements and mechanics in educational contexts to promote motivation, commitment, and effective learning. The concepts of play and fun are applied to learning situations to improve the experience and results of the participants. Some of the common characteristics of gamification are as follows:

a) Points and Rewards: Participants accumulate points or receive rewards as they progress through the learning process or complete specific tasks.

b) Levels and progress: Levels or stages represent the participant's progress, allowing them to feel a sense of achievement and constant improvement.

c) Challenges and missions are set for students to overcome, which increases their involvement and concentration in the activity.

d) Rankings and leaders: Leaderboards are used to demonstrate the relative performance of participants, which can encourage competitiveness and teamwork.

e) Narrative and context: Incorporate a narrative or context that links learning activities to a broader story or mission, making the process more meaningful and engaging. According to [4], demonstrated that gamification is not only an effective tool to improve learning in various contexts, but it also improves concentration and encourages a positive attitude towards learning. The framework is complete, and indicates how it is implemented in a balanced and appropriate manner.

3. Collaborative and online learning: This is an educational strategy based on the interaction and collaboration between students and teachers through digital platforms and online communication tools. This learning modality allows participants to work together on projects, activities, and discussions regardless of their geographic location. The following elements stand out.

a. Interaction between students: Students can communicate and collaborate with other classmates.

b. Access to digital resources: Participants have Access to various online educational resources that facilitate the learning process, such as readings, videos, presentations, and simulations.

c. Flexibility in time and place: By being online, students can access materials and participate in activities at times and in convenient locations.

d. Teacher Facilitation: The teacher plays a vital role in the learning process by guiding and moderating discussions, providing feedback, and ensuring that course objectives are met.

4. Promoting social and digital skills: By working collaboratively online, students develop social, communication, and digital skills that are valuable in today's world.

Our research work will focus on these three strategies to compare their effectiveness.

3. Methodology

Grounded Theory is a methodology developed by sociologists Barney Glaser and Anselm Strauss in the 1960s [8-9] for conducting qualitative scientific research. Its objective is to generate new theories from data collected directly from the field of study without starting from a pre-existing theory [10]. Grounded Theory adopts an inductive approach, as illustrated in Figure 1. Theories were developed from the data collected and not before the investigation, which involves the following steps:

1. Data collection: Data were obtained from various sources, such as interviews, participant observations, or relevant documents.

2. Open coding: Data are analyzed using open coding, where researchers identify emerging concepts and categories in the raw data without imposing any predefined theoretical structure.

3. Axial coding: In this step, relationships are sought between the categories identified during open coding, exploring how they relate to and organize each other.

4. Selective coding: In this stage, researchers select the most relevant and significant categories and concepts to develop a theory.

5. Theory construction: Based on the selected categories and concepts, researchers develop a theory based on the collected data, seeking to explain and understand the phenomenon under study.

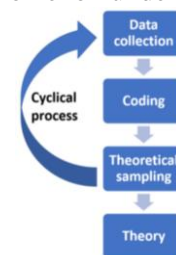


Figure 1. Important aspects of the application of Grounded Theory [4, 8]

the gamification activity was “very useful” to them above the other tools to learn better the topics presented. It was observed that students favored the implementation of different types of learning tools, and it is worth mentioning that online learning provided 50% effectiveness according to what the participants commented, so it was observed in the student segment that students prefer constant interaction to the generation of learning.

According to the results obtained, both gamification and adaptive learning contribute to a greater extent to the generation of significant learning in children between 9 and 10 years of age (see Table 1).

Table 1. Quantitative interview instrument. Source: Own elaboration of research results

Learning method	Question	Totals Obtained (a lot)			
		A lot 3	Something 2	Little 1	nothing 0
Gamification	Did the activity you did help you learn the subject better?	560			
Adaptive learning	Did the fourth topic help you learn? Why?	520			
Collaborative	Did the first topic help you learn? Why?	500			
Gamification	Did the third topic help you learn? Why?	350			
Online	Did the second topic help you learn? Why?	300			

The results obtained through the application of the main strategies and comparing their effectiveness according to the experience of the participating students allowed us to observe four critical aspects, which were generated by the data analyzed for this purpose:

1. Cooperative learning improved students’ motivation, self-esteem, and academic performance, favoring the development of social skills and a sense of belonging to the group, as argued [14].
2. The use of educational technology improved the accessibility of information, interaction, and personalization of learning [15].
3. Educational platforms such as digital educational resources, simulations, and online learning tools can enrich educational experience and promote digital skills in students [16].
4. The inclusive approach emerged as an approach that involved the diversity of students in the classroom and provided an inclusive environment, adapting resources and methodologies for each student, significantly improving students’ perceptions of academic performance and emotional well-being [17].

Notably, the evaluation and effectiveness of these strategies require constant monitoring and collection of evidence-based data, such as standardized tests, formative assessments, and classroom observations. Likewise, continuous training and support for teachers are essential to successfully implementing these strategies in Mexico’s primary education field.

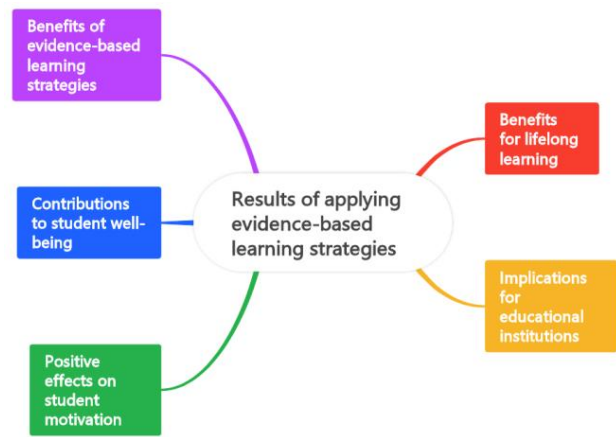


Figure 3. Main results found in the research. Source: result of coding and analysis and authors’ elaboration of research results.

Based on the results presented, the diagram that appears in Figure 3 is constructed, where the triggering aspects of benefits for lifelong learning are visualized, highlighting the combination of evidence-based strategies such as the methods analyzed in this study that allow to promote the well-being of students, due to the fact that challenges or challenges are included within the teaching-learning process that result in a positive effect on the motivation of students. Primary school students

5. Conclusion

Undoubtedly, the generation of significant learning is an arduous task for education in Mexico; however, this study shows the effectiveness of the implementation of learning methods in developing significant learning that impacts the academic performance of each student. Based on the results achieved in the evidence of standardized tests, formative evaluations, and observations that were carried out in the classrooms to study adaptive learning that allows recognizing that each student has unique characteristics to learn, game-based learning, also known as gamification, was also implemented, which allowed us to identify the relationship that was established with playful activities for the generation of students’ learning. dynamically and at their own pace because they are levels of knowledge that are unlocked according to the student’s progress.

It is concluded that learning methods allow primary school students to manage their time and use technology to their advantage to generate meaningful learning, with the combination of free applications at the reach of a click implementing them according to the characteristics of each group turns out to be effective, favoring the ability to understand and include all learning styles that are presented.

With this study and based on the findings, the importance of teaching work can be recommended, which should consider the definition of learning

objectives together with the learning styles of each group of students and choose a learning method that adapts to the needs of each student to improve academic achievement. Finally, it is essential to regularly monitor and continue to optimize tactics to stay in line with initial goals.

Declarations

Author Contributions

Conceptualization, M.T.S.-A.; methodology, J.A.A.-C.; software, T.A.-S.; validation, J.A.A.-C.; formal analysis, R.J.S.G.; investigation, M.A.-F.; resources, M.T.S.-A.; data curation, R.J.S.G.; writing—original draft preparation, all authors contributed equally; writing—review and editing, M.A.-F.; visualization, T.A.-S.; supervision, M.T.S.-A.; project administration, J.A.A.-C. All authors have read and agreed to the published version of the manuscript.

Data Availability Statement

The data presented in this study are available in this article.

Funding

Funding information is not available.

Acknowledgements

We are grateful for the facilities granted to carry out this work to the National Council of Science and Technology (CONACYT), Instituto Politécnico Nacional through the Research and Postgraduate Secretariat with the SIP 20180023, SIP 20220730, 20221302 projects. Furthermore, to the Interdisciplinary Unit of Engineering and Social and Administrative Sciences and Center for Research and Development of Digital Technology. Likewise, the “Programa de estímulos al desempeño de la investigación” (EDI), “Programa de estímulos al desempeño docente” (EDD), and “Comisión de Operación y promoción de actividades académicas” (COFAA), and the Tecnológico Nacional de México and Instituto Tecnológico Superior del Oriente del Estado de Hidalgo (ITESA).

Institutional Review Board Statement

The study was conducted in accordance with the Declaration of Helsinki and approved by the Institutional Review Board of the Instituto Tecnológico Superior del Oriente del Estado de Hidalgo and Instituto Politécnico Nacional, Mexico.

Informed Consent Statement

Informed consent was obtained from all subjects involved in the study.

Conflicts of Interest

The authors declare that there is no conflict of interests regarding the publication of this manuscript. In addition, the ethical issues, including plagiarism, informed consent, misconduct, data fabrication and/or falsification, double publication and/or submission, and redundancies have been completely observed by the authors.

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