

Impact of a Game-Based Teaching Strategy on Learning in Computing among Secondary Students in Alternative Basic Education

Impacto de una estrategia didáctica con juegos educativos en el aprendizaje de computación en secundaria

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Abstract

Educational games constitute an innovative teaching strategy for strengthening learning in computing. Therefore, the present study aimed to analyse the impact of a game-based teaching strategy on computing learning among secondary students of the Alternative Basic Education Institution of Yurimaguas, in Peru. The research adopted a qualitative action-research design with a sample of 25 students and two teachers. Classroom observations, semi-structured interviews, and analysis of academic products were used as information-gathering instruments. The results demonstrated significant improvements in motivation, the development of project management competencies, performance in virtual environments, and autonomy in learning. Students developed transversal skills, including teamwork, problem-solving, and effective communication. It is concluded that a game-based teaching strategy produces a transformative effect on computing learning in alternative education.

Keywords: Game-based learning; Secondary education; Teaching strategies; Computing education; Educational games.

Resumen

Educational games constitute an innovative teaching strategy to strengthen computer Educational games are an innovative teaching strategy for strengthening learning in computing. This study aimed to analyze the impact of a game-based teaching strategy on computing learning among secondary students at the Institución de Educación Básica Alternativa de Yurimaguas (Peru). A qualitative action-research design was adopted with a sample of 25 students and two teachers. Data were collected through classroom observations, semi-structured interviews, and analysis of student work. Results showed significant improvements in motivation, development of project-management competencies, performance in virtual environments, and learner autonomy. Students also developed transferable skills, including teamwork, problem-solving, and effective communication. The findings indicate that a game-based teaching strategy has a transformative effect on learning in computing within alternative education.

Palabras clave: Game-based learning; Secondary education; Teaching strategies; Computer education; Educational games.

INTRODUCTION

The integration of Information and Communication Technologies (ICT) in secondary education constitutes an important component of contemporary pedagogical practices that redefines teaching-learning processes. These digital tools have demonstrated the capacity to enrich educational environments through personalized learning and by providing interactive resources that respond to diverse educational needs (Alvarado & Bastidas, 2023). However, their effective implementation faces considerable obstacles, including the digital divide, limited teacher training, and insufficient technological infrastructure, particularly in resource-constrained contexts. This situation demands the development of innovative pedagogical strategies to overcome these barriers and maximise the educational impact of technologies in schools, representing a central challenge for educational systems seeking to democratise access to quality education.

In this regard, the historical evolution of ICT demonstrates their transformative potential in educational systems, although López (2024) notes that effective integration requires a balanced and contextualized approach that considers available resources and the particularities of each educational environment. According to Prendes and Cerdán (2021), the emergence of advanced technologies such as educational robotics, extended reality, and digital games broadens the possibilities for pedagogical innovation, generating new opportunities for the development of twenty-first-century competencies. These technologies shape an educational scenario characterized by diverse applications in formal and nonformal contexts, stimulating growing scientific interest in exploring their potential to renew traditional teaching methods and create more meaningful learning experiences.

Aligned with this, López (2023) highlights that the specific use of mobile technologies such as tablets is increasingly recognized as a viable resource to optimize teaching processes in secondary education, provided that adequate pedagogical planning ensures effective curricular integration. Their successful implementation requires teachers with specialized knowledge and sufficient preparation to transform these tools into allies of the educational process rather than mere

technological devices. This need, according to Gutiérrez et al. (2024), is directly linked to the development of computational thinking, a fundamental competency for forming digitally responsible citizens, where these advanced skills have become essential for academic and professional success in an increasingly technological society.

Within this educational technological framework, gamification has emerged as a promising pedagogical strategy that significantly increases intrinsic motivation and student engagement through elements such as symbolic rewards, immediate feedback, and well-defined progress levels (Castañeda et al., 2025). The most effective approaches combine competitive dynamics with collaborative components, although their success depends on instructional design and alignment with the specific student profile. From the perspective of Faure et al. (2022), digital gamification in secondary education offers multiple benefits but requires active teacher participation and students' deep understanding of the learning objectives.

Consequently, Yu et al. (2021) emphasize that educational games show consistent positive effects on learning outcomes, motivation, engagement, and student satisfaction when integrated in a structured manner within the educational process. According to Silva et al. (2024), their effective implementation requires consideration of various factors that influence the educational use of ICT, with technological access at home and at school functioning as predictive variables for the success of these initiatives. Meanwhile, Ramos and Peredo (2023) argue that digital technologies enable personalized teaching and adaptation to individual learning rhythms, although significant challenges persist, such as the digital divide and the need for specialized teacher training, aspects that demand priority attention in educational innovation plans.

This reality is also evident at the Alternative Basic Education Institution (IEBA) in Yurimaguas, Peru, where difficulties have been identified in the computation of learning among secondary students. This issue is associated with multiple factors, including traditional pedagogical methodologies, insufficient technological resources, and low student motivation toward computing content,

creating a vicious cycle that affects learning outcomes. Ideally, students would develop computing skills through innovative strategies that promote meaningful learning. The present study addresses this situation by implementing a teaching strategy that integrates educational games into the teaching-learning process in computing. This leads to the following research question: How does a teaching strategy based on educational games impact computing learning among secondary students at the IEBA in Yurimaguas?

In response to this question, the study contributes an educational innovation proposal involving gamification at this level of instruction. Its importance transcends the local sphere by proposing a pedagogical model transferable to similar contexts in the Peruvian Amazon and other regions facing comparable challenges related to technological resources and teacher training. The study has immediate practical significance by offering educators concrete, evidence-based strategies to transform their pedagogical practice in computing. Therefore, this research aimed to analyze the impact of a game-based teaching strategy on computing learning among secondary students at the IEBA of Yurimaguas, Peru.

METHODOLOGY

The study adopted a qualitative, action-research design aimed at understanding an educational reality and transforming it through a planned, systematic intervention. This perspective enabled the researcher to assume a dual role as observer and change agent, thereby directly participating in implementing and evaluating the teaching strategy. The study was conducted at the IEBA of Yurimaguas between March and December 2023. Selecting this setting responded to the identification of significant difficulties in computational learning, providing an appropriate context for applying the pedagogical proposal.

The study established inclusion criteria, including active enrollment in cycles VI and VII of the IEBA, regular class attendance, and voluntary willingness to participate; exclusion criteria included repeated absences and lack of informed consent. A purposive sample of 25 students was selected based on academic records and teacher perceptions. This selection prioritized learners with the greatest difficulties in computing to concentrate

the intervention on those who could benefit most directly from the strategy. Two computing teachers also participated in the process, contributing substantially to the design, implementation, and evaluation of activities through their pedagogical experience and contextual knowledge.

Data collection relied on qualitative techniques and instruments. The research team conducted classroom observations to document interactions among students, teachers, and educational materials, as well as attitudes and behaviors during activities. Semi-structured interviews with students and teachers were conducted to gather perceptions and assessments of the teaching strategy. Open-ended questionnaires explored learning experiences and perceived difficulties. Additionally, student-produced work such as business plans, presentations, and progress records provided concrete evidence of learning outcomes. Data analysis employed thematic categorization and triangulation, enabling comparison of student and teacher perceptions with direct observations to strengthen the validity of findings.

The research procedure was organized into four sequential phases. The diagnostic phase analysed the situation to identify learning difficulties in computing and student needs. The design phase developed the teaching strategy based on educational games, with clear definitions of objectives, competencies, activities, resources, and evaluation criteria. Three competencies guided the proposal: management of economic and social entrepreneurship projects; performance in virtual environments mediated by ICT; and autonomous learning management. These competencies structured the activities and served as references for data collection and analysis.

The implementation phase applied the strategy in the classroom with ongoing support from the researcher and teachers. The final evaluation phase analyzed collected data, assessed intervention results, and formulated the study's conclusions. The entire process adhered to rigorous ethical principles, guaranteeing anonymity, confidentiality, and informed consent. The project received institutional authorization from the IEBA and approval from a local academic committee, ensuring compliance with ethical standards in educational research.

RESULTS

Analysis of the data revealed significant transformations in secondary students at the IEBA of Yurimaguas following the implementation of the game-based teaching strategy, as well as changes in their attitudes toward the use of ICT. Results were organized according to the competencies defined in the didactic proposal, facilitating a clear and coherent interpretation of the progress achieved. Each competency demonstrated concrete improvement in technical, cognitive, and social skills, confirming the effectiveness of the implemented strategy.

Competency: Management of Economic and Social Entrepreneurship Projects

In the competency associated with entrepreneurship project management, participants demonstrated profound changes in their attitude toward the subject. Teams that initially expressed resistance later took on active roles in creating simulated businesses, strengthening their motivation and willingness to learn. The playful component of the proposal captured students' attention and opened space for creative exploration. Through this dynamic, teams generated innovative business ideas that naturally integrated computing knowledge.

The role-playing game "The Market Challenge" proved effective in helping students understand the importance of market research and competition analysis, concepts they previously perceived as abstract and distant. Interaction with fictitious "clients" and "competitors" enabled them to identify market needs, define target audiences, and design digital marketing strategies supported by technological tools.

Preparing business plans initially a considerable challenge became more manageable through the use of digital templates and ongoing teacher guidance. Students acquired skills in the integrated use of word processing, spreadsheet, and presentation software, strengthening their capacity to plan, manage, and evaluate projects.

By the end of the activity, participants consolidated theoretical knowledge about entrepreneurship and developed practical competencies in the technological management of business projects. Final presentations displayed exceptional quality and notable mastery of the

concepts and digital tools used. The activity fostered essential soft skills such as teamwork, assertive communication, negotiation, and leadership, all mediated through effective use of ICT.

Competency: Performance in Virtual Environments Generated by ICT

The activity "Virtual Mission" enabled students to become familiar with various technological tools in a playful, safe, and pedagogically purposeful environment. Online games such as "Adventures in Cyberspace" and "Explorer's Challenge" supported the development of complex skills related to internet navigation, effective information search, digital communication, and collaboration in virtual environments.

The missions and challenges required students to coordinate actions remotely, solve problems collectively, and work exclusively through digital media. This experience transformed the perceptions of many participants who previously expressed fear or resistance toward technology, strengthening their confidence in ICT-mediated learning.

Digital communication tools such as chat, videoconferencing, and collaborative platforms were naturally integrated into the activity. Students learned to use them effectively to interact with peers, coordinate projects, share resources, and collectively build knowledge. The experience promoted communicative competencies in virtual environments and strengthened their capacity for networked work.

The proposal also enhanced digital literacy by integrating content on online safety, data protection, and ethical navigation. Students learned to protect personal information, recognize common online threats, and adopt responsible practices during internet use. By the end, participants were more confident and competent in ICT use, valuing these tools as resources for creativity, innovation, and autonomous learning.

Competency: Autonomous Learning Management

The activity "Self-Management of Learning" encouraged students to assume a leading and responsible role in their educational process. The online educational gaming platform allowed them to select content of interest, set personal goals, and evaluate progress using reflective and critical criteria. This autonomy strengthened motivation

and fostered genuine commitment to learning.

The use of planning and self-assessment templates supported the development of essential metacognitive skills. Students learned to organize their time effectively, identify strengths and weaknesses objectively, and make informed decisions regarding their learning strategies. Videoconference sessions became spaces for collective reflection and peer interaction, strengthening communication, argumentation, and collaborative learning.

By the end of the activity, students demonstrated increased ability to learn autonomously, self-regulate academic performance, and reflect on their cognitive processes. The experience consolidated autonomous learning as a key element of their integral development and enhanced their confidence and long-term learning capacities.

Summary of Activity Fulfillment

Virtual sessions strengthened the formation of a learning community in which students supported one another, shared successful strategies, and motivated peers to achieve goals. By the end of the activity, students demonstrated stronger autonomous learning capacities, greater awareness of their cognitive processes, and improved self-regulation.

Results show that the game-based strategy improved computing learning and transformed students' relationship with the discipline. Participants moved from disinterest and difficulties to enthusiasm, competence, and autonomy in using technological tools. Academic performance improved in grades, quality of work, and active class participation. Learning also transferred to other contexts, amplifying the proposal's impact. Teachers noted a more dynamic, participatory, and collaborative classroom climate.

Continuous evaluation indicated that students acquired technical knowledge and transversal competencies required of twenty-first-century citizens, including critical thinking, teamwork, leadership, effective communication, and metacognition. These competencies strengthened their academic and personal profiles and consolidated long-lasting learning.

DISCUSSION

Results demonstrate that implementing a game-based teaching strategy led to changes in students' attitudes and motivation in alternative basic education. Participants progressively abandoned initial resistance and became actively engaged in learning activities, reflected in improved attendance and more immersive participation. This aligns with Zurita (2024), who identified the transformative effect of incorporating playful elements into gamification.

Furthermore, the application of specific educational games for computing showed significant improvements in academic performance, with quantifiable increases in grades and the quality of the work produced. This supports the findings of Velásquez et al. (2024), who found that ICT combined with playful strategies facilitates active learning and knowledge retention. Similarly, Byusa et al. (2022) found that game-based approaches promote conceptual understanding through meaningful mental and practical activities.

Personalized learning through adaptive tools proved essential for addressing diverse learning styles. The strategy enabled adjustments in activity difficulty according to individual progress, benefiting students with previous difficulties. This echoes findings by Porras et al. (2025), who noted that adaptive gamification strengthens autonomy and performance. Vázquez et al. (2024) likewise demonstrated that platforms like ClassDojo support individualized learning monitoring.

The development of computational thinking showed significant progress after the intervention, confirming results from Sun et al. (2023), whose meta-analysis found medium-to-high effect sizes for games in fostering computational thinking. Videnovik et al. (2023) found that game-based learning effectively develops computing skills beyond programming.

Gamification also strengthened socioemotional dimensions such as autonomy, perseverance, and collaborative work, aligning with Albán et al. (2023), who found that didactic games enhance independence and emotional development.

Students produced work demonstrating meaningful transfer of theoretical knowledge into practical applications, consistent with Bedón and Cedeño (2023), who found positive relationships

between online learning games and the development of mathematical logic.

The research confirmed that effective gamification requires coherent instructional design linking playful elements to curricular goals, as warned by Delgado and De la Peña (2023), who stressed the need for deliberate pedagogical integration.

Finally, findings indicated that although cognitive gains may match traditional methods, motivational and engagement benefits are superior—corroborating López et al. (2021), who found higher motivation with teacher-authored games than with traditional teaching.

CONCLUSIONS

The study confirmed that a game-based teaching strategy had a positive impact on computing learning among secondary students at the IEBA of Yurimaguas. Results showed progress in entrepreneurship project management, performance in virtual ICT-mediated environments, and autonomous learning. Students strengthened technical and cognitive competencies, increased their motivation, and consolidated transversal skills such as teamwork, communication, leadership, and metacognition.

These findings show that incorporating playful methodologies fosters knowledge acquisition and transforms attitudes toward the discipline, enabling transferable learning. Educational game-based strategies are recommended for broader curricular application, teacher training in game design, and integration of ICT as pedagogical resources. Future research should evaluate the impact of these methodologies across other educational levels and contexts to consolidate their validity and transferability.

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