REVISTA CÁTEDRA

Integration of gamification into the andragogical process of the physics area for intensive evening high school students

Integración de la gamificación en el proceso andragógico del área de física para estudiantes nivel bachillerato nocturno intensivo

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Abstract

This research analyzes the low academic performance, lack of motivation, and limited participation of adult and senior citizens with incomplete schooling in the Physics course within the intensive evening high school program. This problem is crucial, as it affects a traditionally excluded group whose education is vital for their personal and social development. Classical teaching strategies have proven insufficient to achieve meaningful learning and active participation in this andragogical context. The central proposal consists of incorporating gamification into the teaching process, based on the characteristics of adult learning. To make the teaching of complex concepts, such as density, dynamic game

elements and specific digital platforms (Websim and Spatial) were used. The methodology employed is a mixed-methods approach, based on the Sequential Exploratory Design (DEXPLOS) model, integrating qualitative analysis (interviews and observation sheets) and quantitative analysis (satisfaction surveys). The study was conducted with students and educators in the intensive evening program in the city of Azogues, Ecuador. Among the main results, a significant improvement was observed in motivation, conceptual understanding, active participation in the classroom, collaborative work, and the development of critical thinking. Contextualized and accessible gamification proved capable of transforming the teaching and learning process, fostering meaningful and resilient knowledge. This proposal represents an inclusive and replicable alternative for optimizing the teaching of Physics in vulnerable contexts.

Keywords
Andragogy, academic performance, gamification, and motivation.

Resumen
La presente investigación analiza el bajo rendimiento escolar, la escasa motivación y la limitada participación de estudiantes adultos y adultos mayores con escolaridad inconclusa en la asignatura de Física, dentro del bachillerato intensivo nocturno. Esta problemática es crucial, pues afecta a un grupo tradicionalmente excluido, cuya formación educativa es vital para su desarrollo personal y social. Las estrategias didácticas clásicas han demostrado ser insuficientes para lograr un aprendizaje significativo y una participación activa en este contexto andragógico. La propuesta central consiste en incorporar la gamificación en el proceso de enseñanza, tomando como base las características del aprendizaje adulto. Para dinamizar la enseñanza de conceptos complejos, como la densidad, se utilizaron elementos de juego y plataformas digitales específicas (Websim y Spatial). La metodología empleada es de enfoque mixto, bajo el modelo Diseño Exploratorio Secuencial (DEXPLOS), integrando análisis cualitativo (entrevistas y fichas de observación) y cuantitativo (encuestas de satisfacción). La aplicación se realizó con estudiantes y educadores de la sección nocturna intensiva en la ciudad de Azogues-Ecuador. Entre los principales resultados, se evidenció una mejora significativa en la motivación, la comprensión conceptual, la participación activa en el aula, el trabajo colaborativo y el desarrollo del pensamiento crítico. La gamificación contextualizada y accesible demostró ser capaz de transformar el proceso de enseñanza-aprendizaje, fomentando un conocimiento significativo y resiliente. Esta propuesta representa una alternativa inclusiva y replicable para optimizar la enseñanza de la Física en contextos de vulnerabilidad.

Palabras clave
Andragogía, desempeño académico, gamificación y motivación.

1. Introduction
This research is the result of thesis work, focusing on relevant aspects of Gordon-Salcedo and Noguera-Vásconez (2018). The analysis of gamification integration stems from the deficit in academic performance, lack of motivation, and limited active participation of adult and senior citizens with incomplete schooling who, for various reasons, have been unable to finish their studies, constituting a vulnerable group in the andragogical educational process. Gamification has positioned itself as an innovative and revolutionary strategy in education, especially in the training of this population group. According to Franco-Segovia,

the integration of this methodology into the andragogical process seeks to enhance student motivation, performance, and participation, particularly in Physics, considered a complex subject. This strategy is based on the use of game elements in educational contexts to optimize learning (Franco-Segovia, 2023, p. 846). This application of gamification not only facilitates the understanding of abstract physics concepts but also fosters critical thinking, collaborative participation, and the comprehensive development of cognitive skills in adult learners.

Andragogy is not just an educational process; it encompasses lifelong learning. It is aimed at adult students who work and have various obligations, and who are parents with diverse needs, seeking active and participatory learning in the educational and social spheres. This is why there is a need to integrate new teaching and learning methodologies for both teachers and students (Caraballo-Colmenares, 2007). Knowles et al., for their part, state that andragogy offers fundamental principles that allow for the design and implementation of more effective educational processes (2001). This context refers to the particularities of the learning situation and, therefore, is applicable to different adult education contexts, promoting methodological change in educational institutions, especially those serving vulnerable groups. Zambrano et al. indicate that gamification is also known as ludification, playfulness, and gameification; all these terms refer to the use of game mechanics, strategies, and processes within an activity (2020). In this sense, the sole purpose of gamification is to generate student engagement and motivation that facilitates the improvement of educational environments. This integrated perspective not only analyzes educational contexts from a playful viewpoint but also provides opportunities to enhance andragogical learning. By including playful dynamics, the approach goes beyond simply relating content and promotes emotional and social growth by addressing the respective challenges of daily life.

On the other hand, Angell et al. state that conventional physics teaching is based on traditional techniques that, despite having been effective in the past, do not always manage to capture students' attention or promote the practical application of the knowledge learned (2004). Since Physics is a complex discipline, it is essential to capture students' attention during class. For this reason, gamification emerges as a key option that focuses on transforming complex academic topics into dynamic, engaging, and motivating experiences, facilitating not only the understanding of concepts but also the development of skills. This study also emphasizes exploring the contribution of gamification and the development of cognitive abilities to the academic performance of high school students.

It is worth noting that integrating gamification can present several challenges, such as resistance to change and the digital divide among both teachers and students, a lack of resources, and the need for ongoing, progressive training to ensure the proper integration of new methodologies, among others. Alongside the integration of these methodologies, according to Ayala, the scarcity of technological resources should be taken into account, as this can be a limiting factor for access to interactive platforms and gamification systems suitable for teaching. Therefore, technological availability can be a key facilitator for accessing innovative methodologies such as gamification, which can also be used in different areas of the teaching process (Ayala-Escudero, et al., 2024).

In this regard, it is worth emphasizing that the use of gamification in the educational process can enhance student interest when properly designed from an educational approach that aligns with the student's pedagogical needs. However, despite the strategies implemented and resources allocated, many students continue to face significant learning gaps in the

subject. These difficulties contribute to low academic performance and a lack of motivation for active participation in the educational environment. Thus, the use of well-structured game-based activities could be an effective change in their academic process, especially in Physics, which is considered a complex subject.

Furthermore, the application of active methodologies such as gamification can develop soft skills that are considered important for collaborative problem-solving, problem-solving, and critical thinking in our students. This research aims to answer the following question: How could the integration of an andragogical model based on gamification contribute to the learning, motivation, and development of critical thinking skills in high school students in the evening program in the area of Physics? This approach invites reflection on the positive contributions that the integration of this methodology could generate in the classroom. Its constructivist principle implies not only technical mastery of the digital tools used, but also the need for a teaching model that facilitates the active construction of knowledge. Furthermore, it raises the need to analyze ways to reduce the existing challenges that hinder its effective application.

According to Alonso-García et al., there are several factors that can delay the implementation of the proposal, such as a lack of teacher training, resistance to change in the use of gamified platforms, and resistance to methodological change. These represent significant barriers to teaching and applying new methodologies in andragogical environments. Therefore, it is necessary to develop pedagogical models that incorporate gamification in a structured way and ensure its alignment with the foundations of adult learning and the curricular objectives of Physics. At the same time, teachers' competence in facilitating and monitoring this learning will also support its effective development (Alonso-García et al., 2021) to face the challenges of the contemporary world with a critical and creative attitude. The objective is to analyze the motivational contribution to the andragogical process of third-year high school students in the area of Physics when gamification is integrated, thus opening the possibility of implementing and designing a didactic proposal in the future that incorporates game elements to improve this emotional factor and, consequently, conceptual learning and active student participation.

Certain public educational institutions are interacting within a new ecosystem whose axes are technology, digitalization, and innovation. However, those institutions offering educational programs for young people, adults, and older adults with incomplete schooling face challenging situations such as limited interest in and collaboration with digital practices, a lack of resources, and insufficient support for innovative educational methodologies (Rodríguez-Laz & Rodríguez-Álava, 2024). Therefore, the effective integration of gamification with constructivist principles in educational programs for adults and older adults with incomplete schooling presents a multifaceted challenge. This type of teaching not only requires technical mastery of the digital tools used but also a model that facilitates the active construction of knowledge (Alonso-García et al., 2021). Within the constructivist framework, learning is enhanced as students autonomously engage in meaningful, contextualized, and emotionally stimulating environments.

Similarly, the lack of teacher training, resistance to change in the use of gamified platforms, and resistance to methodological change pose significant barriers to teaching and applying new methodologies for implementation in andragogical environments (Navarro et al., 2021). Therefore, it is necessary to develop pedagogical models that incorporate gamification in a structured way and ensure its alignment with the foundations of adult learning and the curricular objectives of Physics. At the same time, teachers' competence in

facilitating and monitoring learning will also support its effective development (Alonso-García et al., 2021) to face the challenges of the contemporary world with a critical and creative attitude.

According to Martínez-Cortes and Parrales-Loor, economic and social factors, health conditions, family problems, geographic displacement, and a lack of educational resources present obstacles for individuals with incomplete schooling in resuming their education (2024). This situation significantly limits their employment opportunities, perpetuating poverty and inequality within society. Muñoz-Ortiz et al. warn that educational exclusion not only affects students' personal and professional development but also has negative repercussions for the national economy (Muñoz-Ortiz et al., 2023). It is essential to implement public policies that address these barriers and promote safe and accessible educational inclusion.

To analyze the results obtained, a pedagogical proposal based on the Analysis, Design, Development, Implementation, and Evaluation (ADDIE) model is suggested for integrating gamification into the andragogical process of Physics. This proposal is aimed at high school students in the intensive evening program with incomplete schooling in the city of Azogues. The ADDIE model was chosen for its emphasis on instructional design in flexible learning contexts, centered on student needs. Various studies have verified that this model improves motivation and performance in Physics, and also aids in the understanding of abstract concepts through virtual tools and simulators. Zainuddin et al. state that andragogical-based gamification enhances autonomous learning, intrinsic motivation, and the connection of knowledge to real-world contexts. This proposal evaluates autonomy, collaboration, and the critical appropriation of knowledge, making it an inclusive and transformative approach (Zainuddin et al., 2020).

Regarding the article's structure, Section 2 addresses the main theoretical concepts that underpin the research and presents an analysis of various bibliographic sources. Section 3 describes in detail the methodology used to develop the study. Section 4 presents the results and analysis of the instruments used. Finally, Section 5 presents the conclusions derived from the results obtained.

2. Literature review

2.1 Gamification

Gamification focuses on teaching through playful games to motivate students in their educational process, helping to improve their academic performance. Considered a tool capable of radically modifying self-directed learning, gamification also aims to differentiate how students' learning progress is assessed and is designed to be centered on real-time learning. Furthermore, the term "gamification," derived from the English word "game," refers to the way game techniques are used to maintain motivation, in this case, among vulnerable students, including adults and older adults with diverse educational, social, and economic needs (Zambrano et al., 2020, p. 350). Therefore, gamification is a strategy that has modified conventional learning, since the implementation of new pedagogical approaches through games radically alters academic performance through a fun and engaging experience. Thus, the student shows evident alterations in terms of their interest in active and collaborative learning, facing challenges and receiving feedbac.

2.2 Gamification as an educational innovation

Instruction and learning are constantly evolving processes, where both teachers and students must adapt throughout their own educational journey. Mercado-Borja et al. (2024) consider resistance to change to be a significant challenge, so much so that pedagogical innovation provides effective strategies that contribute to improved outcomes and induce genuine change in the teaching and learning processes (2024). This academic progress not only requires the incorporation of new technologies but also a positive attitude towards approaches that foster critical thinking and active student engagement. In the words of Carbonell et al. (2015), educational innovation is directed towards the search for appropriate and efficient methods to improve the teaching-learning process. These same authors state in their work that this innovation is linked to the development of personal skills and the modification of traditional education, creating a space where current strategies can be implemented to improve critical and creative reasoning in both students and teachers.

Instruction and learning are constantly evolving processes; teachers and students must adapt throughout their own educational journeys. Therefore, pedagogical innovation provides effective strategies that contribute to improved outcomes and foster genuine change in the teaching-learning process, creating educational environments where creativity and critical thinking are considered key components. However, according to Rodríguez-Laz and Rodríguez-Álava, adults and older adults with incomplete schooling face challenging situations such as limited interest in and participation in digital practices, and a lack of resources and support for technologically innovative educational processes (Rodríguez-Laz & Rodríguez-Álava, 2024). These challenges demonstrate the importance of developing new, inclusive, and easily accessible strategies so that all students experience educational equity. The effective integration of gamification into education requires not only mastery of digital tools but also the commitment of students and teachers to overcome technological barriers and resistance to change. In this way, we can move towards an innovative and motivating education.

2.3 Theoretical foundations of gamification in education

Gamification, understood as the application of game design elements and principles in non-game contexts, such as education, constitutes a pedagogical strategy aimed at enriching teaching and learning processes (Deterding et al., 2011). In this sense, it is not limited to the simple incorporation of game components, but rather is based on study methods that integrate reward and challenge systems with the purpose of improving learning. Thus, according to Zambrano-Álava, it fosters the development of cognitive and social skills in students, in a context that stimulates creativity and the ability to solve real-life problems (Zambrano-Álava, 2020). If pedagogical methods and models are implemented with a more dynamic, meaningful, and active teaching and learning design, students could be provided with learning experiences in which they are able to construct their knowledge through interaction, experimentation, and reflection (Kapp, 2012). This reading supports a constructivist culture, where teaching is more exploratory and less traditional, positively influencing academic performance, group participation in class, and the development of soft skills such as autonomous or group collaboration or problem-solving ability (Deterding, et al., 2020, p. 6).

2.4 Principles of andragogy

As Córdova-Córdova et al. indicate, andragogy is defined by the characteristic of autonomous adult learning, considering prior experience, intrinsic motivation, and the

capacity for self-reflection as its fundamental pillars in the educational process (2025). For this approach, enabling adult learners to be active participants in a continuous learning process translates into a facilitating element for problem-solving within the educational context and fostering skills useful in their professional and social lives. In the Ecuadorian context, Vásquez-Aguilar et al. point out that the country has made progress in inclusive policies aimed at guaranteeing equitable access to education, especially for adults with educational disadvantages (2024). However, structural challenges still exist that restrict the completion of their studies, especially for a vulnerable group, as demonstrated by the Ministry of Education in its reports on the educational situation. Thus, regulatory progress and social realities highlight the need to implement more comprehensive strategies that address access to, retention in, and completion of their studies.

According to the Ministry of Human Development, in 2023, Ecuador had approximately 1,049,824 people over 65 years of age, representing 6.5% of the total population. It is projected that by 2054, this group will reach 18%, which poses significant challenges in terms of public policies and assistance programs aimed at this sector (Ministry of Economic and Social Inclusion, 2023). Furthermore, an analysis by DVV International indicates that, in 2020, approximately 5.7 million young people and adults in Ecuador were illiterate or had incomplete schooling. This fact underscores the importance of strengthening educational programs aimed at this population group (Crespo-Burgos and Larrea-Robalino, 2023).

The Organic Law of Intercultural Education (LOE), in Article 6, section (i), regarding the state's obligations concerning the right to education, emphasizes "promoting lifelong learning processes for adults and the eradication of pure, functional, and digital illiteracy, and overcoming educational backwardness." Established within the legal framework and by ministerial agreement, this law promotes the education of young people and adults with incomplete schooling. The Ministry of Education of Ecuador is implementing the "Todos ABC" Campaign, a program focused on literacy, basic education, and intensive high school studies named after Monsignor Leónidas Proaño. This campaign aims to provide lifelong learning opportunities for Ecuadorians, fostering their skills and abilities.

Andragogy, conceived as the art and science of helping adults learn, is based on the premise that adult learners have different characteristics and needs than children (Knowles et al., 2001). The authors identified several key principles of andragogy, including the need to understand the reasons for learning, the importance of prior experience, a problem-solving orientation, intrinsic motivation, and the individual needs of each learner. Andragogy rejects a learner-centered approach, promotes self-direction, and recognizes the value of experiential learning as an integral part of the learning process (Knowles, 2001). According to Caraballo-Colmenares, adult education should focus on the learner's prior experience, since this directly influences how new knowledge is absorbed. In contrast to children, adults achieve more solid learning when they relate information to their own experience (Caraballo-Colmenares, 2007).

The use of diverse andragogical strategies in higher education increases the motivation and academic performance of adult learners. It is important to highlight that autonomy and self-regulation are key factors in this process, promoting more effective and confident learning and facilitating time management for students (Córdova-Córdova et al., 2024). These factors reflect the adult learner's experience, helping them construct knowledge in a more relevant way and connect with their own reality. Thus, it can be seen how andragogy not only

contributes to academic performance but also facilitates more autonomous and meaningful learning for personal and professional growth.

Andragogy has two principles: horizontality and participation. The first occurs when the adult learner becomes aware that they can manage their own learning and feels motivated to continue the process; the second, the principle of participation, is defined as the adult learner's decision to become involved and take a more active role (Torres, 2000). For this approach, making the adult learner an active participant in a continuous learning process translates into a facilitating element for problem-solving within the very reality of an educational context that also fosters skills useful for their work and social life. Therefore, andragogical principles and postulates contribute to the transfer of knowledge in adult learning (Gutiérrez et al., 2021). In the Ecuadorian context, Vásquez-Agilar et al. point out that "the country has made progress in inclusive policies aimed at guaranteeing equitable access to education, especially for adults with educational disadvantages" (2024).

2.5 Challenges in the teaching and learning of Physics in high school

Regarding the educational changes proposed in the 2008 Ecuadorian Constitution, the curriculum was updated and strengthened in 2010. This update is based on the principles of critical pedagogy and the development of macro-skills and performance-based skills, strengthening the process of interpreting and solving problems. It emphasizes that students can achieve meaningful learning when they solve real-life problems by applying different concepts and tools from the subject area (Gallegos et al., 2018).

Physics, as one of the fundamental pillars of science, is seen as a very important subject, although students often perceive it as an abstract, complex, and disconnected area of study (Angell et al., 2004). A lack of understanding of abstract concepts, weak mathematical skills, and the absence of pedagogical strategies that foster curiosity and exploration could contribute to demotivation and low performance in this subject. While misconceptions about physics have been documented, and these beliefs and values persist throughout secondary education, efforts are underway to eradicate them by moving away from the traditional approach of solving mechanical problems, which is insufficient for adequate conceptualization. To this end, Halloun and Hestenes propose innovative pedagogical alternatives that encourage student participation in class, using their own context as a methodology (Halloun & Hestenes, 1985).

From a pedagogical perspective, platforms such as Spatial and WebSim can be used, which make it possible to reconstruct physical concepts through playful and accessible experiences. For example, the combined use of gamified simulators to explore concepts like nature, density, and mechanical energy fosters a more dynamic understanding, aligned with the development of scientific thinking in students. This, in turn, promotes a culture of active, meaningful learning that connects emotionally with students. Gowin's V strategy in experimental Physics teaching allows for the structuring of cognitive processes, as well as fostering cooperative interaction in the classroom, in addition to encouraging the development of analytical and critical skills in students (Andrade-Vélez and Álvarez-Alvarado, 2024, p. 85).

2.6 Integration of gamification in the teaching of Physics

The pedagogical value of playful elements in physics teaching fosters a highly meaningful relationship between students and the academic content being taught. By reducing the perceived complexity, learning becomes more accessible, emotionally motivating, and conducive to the construction and retention of physical knowledge. Gamification has

revolutionized education as a technique with great potential for addressing the challenges of instruction and learning. With playful components in educational tasks, it is expected to foster intrinsic motivation, encourage participation, and offer a meaningful context for introducing physical concepts (Espinoza-Gaona et al., 2025). This approach allows for a more constructive relationship with the content, overcoming any apprehension about this method and creating a pleasant environment for study. Landers points out that poor gamification can generate distractions and decrease the effectiveness of learning. Thus, teachers must design activities focused on cognitive skills and not on superficial designs that only address rewards. Continuous feedback should also be integrated as a central pedagogical element, as it offers the possibility of guiding the learning process and, at the same time, fostering a better understanding of the physics concepts being studied. Gamification, by incorporating game elements, generates meaningful learning and allows students to integrate theoretical concepts into practical contexts (2014).

2.7 Andragogy as a framework for gamification in high school

Ojeda and Zaldívar state that gamification is a methodology that can integrate students' socio-emotional factors into the teaching and learning process. It is not only the playful component, but can also generate learning alternatives that foster creativity, promote self-directed learning, and encourage a greater understanding of extrinsic and intrinsic motivation (2023).

In this way, gamified dynamics place students at the center of the educational process, generating meaningful learning experiences that link the teaching and learning processes. Córdova-Córdova et al. explain that the inclusion of andragogical principles in secondary education can result in improved student autonomy and engagement (2024). This idea is reinforced by linking gamification with cognitive processes that promote decision-making and the resolution of real-world problems, fostering more meaningful learning. At the same time, without diminishing the teacher's role as a facilitator of active and reflective experiences, this strategy helps students become more motivated and take a more active role in the classroom.

According to Hamari et al., incorporating playful elements into the learning process is one way to promote the retention of difficult-to-grasp concepts (2014). This argument proposes gamification as a well-founded didactic intervention approach that would transform physics content into motivating experiences where critical thinking skills, such as analytical thinking, are developed. Hamadah, for his part, states that features like immediate feedback and peer assessment empower students in their learning process. These characteristics allow students not only to develop autonomy but also to become active participants in their learning, where knowledge is constructed collaboratively and academic performance is enhanced within a gamified environment mediated by methodologies that respect the individual needs of each student (Hamadah, 2023).

Kapp states that by including clear goals, constant feedback, and meaningful rewards, it is possible to improve engagement with the content, especially in areas related to physics, where abstract concepts often generate resistance or little interest (Kapp, 2012). The gamified structure offers the opportunity to adjust the difficulty according to each student's pace and promotes educational incusion in an attractive and motivating way.

2.8 Gaps in the research and justification of the study

Berrones-Yaulema et al. point out that gamification has been extensively analyzed within the framework of basic education; however, its contribution to teaching complex physics

concepts to secondary school students is still a new line of research (2023). This statement indicates clear evidence of the absence of playful teaching methods in adult education, as well as in physics teaching. Therefore, didactic proposals must be developed that incorporate andragogical principles, including gamified resources tailored to the cognitive and emotional context of the adult group.

Quiroz-Peña et al. indicate that most studies focus on short-term conclusions without considering that gamification centers on knowledge retention and the development of analytical skills over time (Quiroz-Peña et al., 2022). This statement highlights the need for research that allows us to evaluate not only the immediate impact but also the sustained progress of critical thinking skills in physics learning. According to Navarro, gamification can be used not only for entertainment but also as a long-term training strategy in the teaching-learning process, enabling students to achieve autonomy and develop critical thinking skills (Navarro et al., 2021). Therefore, this study seeks a theoretical and practical framework for introducing gamification into physics teaching, ensuring that the resources used are, above all, effective, accessible, and relevant to different educational settings, thus achieving the student's ongoing and meaningful participation in their learning process.

3. Methods and materials

The study was conducted at a public school in the city of Azogues, located in the province of Cañar, Ecuador. A non-probabilistic, purposive sampling method was used, consisting of 10 adult and senior citizen students enrolled in the unified high school program (intensive evening section) and 23 teachers from the same institution. Participant selection was based on accessibility, time availability, and educational relevance, with the aim of obtaining valuable information from this focused group.

This type of sampling is widely used in educational studies where random procedures are not feasible, especially when working with specific or vulnerable populations. The inclusion criteria for this student population were: being over 18 years of age, enrolled in the evening program, at the high school level, and having incomplete schooling. According to Asiamah et al., non-probability sampling allows for obtaining valuable information from focused groups when population parameters are unknown or difficult to identify individually (2017), making it a valid strategy for exploratory and applied research in education.

Regarding the teachers, their selection was based on their availability, the andragogical characteristics they exhibit in their pedagogical practice, and their direct connection to the level where the gamified approach was implemented. This population was not selected randomly but was intentionally defined by belonging to a vulnerable social, work, and family context, whose conditions directly influence the learning process. The research is structured under a pragmatic paradigm that combines mixed methods; therefore, in the qualitative phase, interviews were conducted with two experts in gamification and physics, as well as observation sheets to record experiences with the activities designed using play-based strategies. In addition, during the quantitative phase, Likert-scale satisfaction surveys were administered to 23 teachers and 19 students to assess their perceptions of the methodology used in these activities. It is worth noting that the instruments used were validated by experts, thus ensuring their reliability through Cronbach's alpha coefficient (Hernández et al., 2014), with the closer to one indicating better reliability.

The research also employed the DEXPLOS exploratory design, based on Diversity, Experience, Practice, Play, Information, and Meaningfulness, which aims to create a dynamic learning environment to integrate gamification into physics teaching. The data

obtained were analyzed using SPSS software, and it is important to emphasize that the participants' authorization and consent were obtained to share the information. While this study is contextualized within a specific setting, it is hoped that the results will provide valuable insights for implementing gamification as a motivational and inclusive strategy applicable in diverse educational environments with similar characteristics.

4. Results y discussion

Pegelajar-Palomino argues that gamification is a methodological strategy that incorporates game elements into the teaching and learning process, thus establishing a link between the student and the content from a different perspective (Pegelajar-Palomino, 2021). However, constant monitoring of these methodological approaches in the classroom is necessary, as, despite their benefits, they do not guarantee teaching success if they are not aligned with the class objectives (Gonzalez-Moya et al., 2021).

In relation to the above, Alonso-García et al. point out that one of the reasons gamification has become a more frequently used resource by teachers is its close relationship with both extrinsic motivation (rewards and satisfying challenges) and intrinsic motivation, which arises from the individual (Alonso-García et al., 2021). In other words, gamification as a teaching strategy becomes an ideal resource for use in teaching practice, allowing for meaningful learning by mobilizing diverse skills that, in turn, lead to the development of competence (Ramos-Vera & Ramos-Vera, 2021).

The researchers agree with the authors that the aforementioned strategies are fundamental for more holistic learning, and that the implementation of playful activities inherent in pedagogical methods such as gamification not only strengthens and improves motivational aspects but also contributes to improved academic performance. At the same time, it is considered necessary to strengthen these practices through teacher training to ensure that these strategies are effectively applied in the classroom.

4.1. Main findings in the qualitative analysis

The research analysis began with interviews with informants, which allowed for the identification of learning needs in Physics and the incorporation of gamification into the subject. Identifying problems (such as lack of motivation or low academic performance) was the necessary first step to solicit the opinions of teachers experienced in addressing these issues through gamification. The questions posed to the informants focused on students' needs and the different teaching strategies that foster autonomy and problem-solving. Therefore, these interviews constitute a good starting point for consolidating more effective teaching approaches that are better suited to the educational context.

4.1.1 Analysis of expert interviews

The qualitative analysis used the MAXQDA program to code the expert interviews according to the variables of Physics and gamification. See Table 1.

Question or objective it answers	Expert's answer	Code	Analisis

Identify student academic performance and motivation in an andragogical context in the area of physics.	Motivation is affected by the relevance of the content and its connection to students' daily lives.	Motivation	The connection between the content and daily life is analyzed, as it is essential for increasing motivation and academic performance, especially for adult learners and older adults with incomplete schooling, who require practical activities within the classroom.
Design gamified strategies that promote autonomy and problem-solving in physics, considering the principles of andragogy.	Strategies should include the possibility of choosing and personalizing tasks, allowing students to make decisions about their learning.	Autonomy and Personalization	Fostering autonomy through task personalization is key to motivating students and facilitating problem-solving, aligning with andragogical principles.
Select gamified activities that foster teamwork and collaboration among students, strengthening their skills and abilities.	Activities that require group work and have common goals are effective in fostering collaboration and teamwork.	Teamwork and Collaboration	Gamified activities that promote collaboration help strengthen essential personal and communication skills in the learning environment.
Evaluate the change in student academic performance through the integration of gamification in the area of physics.	Clear rules should be established to evaluate the contribution of gamification, including exams, projects, and self-assessments.	Assessment and Rules	The implementation of well-defined rules is fundamental to assessing the contribution of gamification to academic performance, allowing for a comprehensive analysis of learning.

How can gamification improve students' academic performance and the development of critical thinking in the andragogical process?	Gamification can increase motivation by making learning more interactive, comprehensive, and relevant, thus stimulating the development of students' critical thinking skills.	Interactivity, Relevance, and Critical Thinking	Interactivity and relevance are key elements in gamification, as they contribute to students improving their academic performance and developing their critical thinking skills in problem-solving and decision-making.

Cuadro 1. Entrevista a experto 1 resultado de análisis cualitativo

The interview results highlighted that applying concepts through gamification facilitates the understanding of topics taught in the area of Physics and enhances student motivation by progressively addressing cognitive conflicts. According to García-Casaus et al., this methodology facilitates student participation and critical thinking by integrating playful dynamics that stimulate intrinsic motivation and promote problem-solving (2020).

Question or objective it answers	Expert Answer 2	Code	Analisis
Identify student academic performance and motivation in an andragogical context in the area of physics	Intrinsic student motivation is essential. Strategies must consider the diversity of the players and their needs	Intrinsic Motivation, Diversity	To ensure the success of gamification in the classroom, it is essential to personalize the strategy according to the characteristics of the students. Therefore, autonomy and understanding of the objectives must be fostered to increase academic performance.
Design gamified strategies that promote autonomy and problem-solving in physics, considering the principles of andragogy	Motivation is key for psychological students, keeping in mind the needs of each individual student.	Autonomy and Problem Solving	Gamification strategies should be organized according to the students' interests and encourage their freedom to facilitate the assimilation of the physics content.

Enable students to make decisions through gamified activities that enhance cooperation and group participation to increase their capacities and skills.	A number of student skills must be integrated to achieve common goals, with the consequent improvement in coexistence and recognition of those skills.	Collaborative Work and Skills	Gamification can facilitate collaboration by focusing on shared goals, promoting an inclusive and diverse learning environment, and strengthening communication skills.
Evaluate the change in student academic performance through the integration of gamification in the area of physics	Indicators of motivation, independent work, and achievement of established goals must be clearly defined	Performance and Compliance Indicators	Evaluation should include both qualitative and quantitative aspects, ensuring that progress in motivation and engagement is measured progressively.
How does the integration of an andragogical model based on gamification influence learning, motivation, and the development of critical thinking skills in third-year high school students in the area of physics??	It is important to thoroughly understand the concepts and design original gamified strategies, without simply replicating others..	Individual Design and Critical Thinking	Clearly understanding the difference between gamification and ludification is crucial for integrating effective strategies that foster students' critical thinking and are adapted to the specific needs of the educational context.

Table 2. Interview with expert 2, result of qualitative analysis

The effects derived from this framework highlight elements such as reward, motivation, and a clearly defined game strategy, which are essential for engaging students in the work. Therefore, well-structured gamification, through the presentation of accessible challenges with symbolic rewards, improves intrinsic motivation and allows for rapid feedback.

4.1.2 Gamified class application process

In the implementation phase, which consisted of a demonstration class, the virtual platforms for use in the classroom were introduced for the first time by the group of students. These platforms allowed for real-time interaction, demonstrating the students' interest and commitment. During the evaluation phase, a satisfaction survey about the

demonstration class was administered to both teachers and students. A qualitative analysis was also conducted through interviews and observations, and the results confirmed the positive impact of gamification on academic performance and student participation. In this regard, the development of this proposal clearly demonstrates the possibility of transforming physics learning for adult university students into an enriching, inclusive, and motivating process through contextualized and accessible instructional design. The proposal was implemented as a demonstration class, in which students interacted with simulators and gamified challenges, leading to changes in motivation and improved comprehension of physics concepts.

The experts defined the pedagogical intervention process for the class, clarifying how to apply gamification to physics content. The intervention took place in a practical class on the concept of density, introduced with an initial explanation of the topic. WebSim and Spatial tools were used, facilitating a dynamic and motivating approach to physical concepts for the students through virtual environments. During the session, students interacted with real-time visual simulations on their own devices, both independently and collaboratively, and completed activities throughout the class. This approach fostered the understanding of complex concepts related to density. Following this, a challenge was presented in which students could apply the concepts they had learned by working collaboratively with their classmates to solve practical work-related problems. This approach not only encouraged hands-on learning but also helped students put theoretical concepts into practice.

Through its progressive assessment, the Websim platform was used, which allows for online quizzes and enabled students to answer in a fun and dynamic way. The gamification of the subject was complemented by the implementation of reward elements using the Websim platform and Deck Toys, where students received points and recognition based on their participation and performance. This strategy, on the one hand, allowed students to easily assimilate knowledge and, on the other hand, created a collaborative and enthusiastic learning environment. Students felt motivated to participate fully in their learning process.

At the end of the demonstration class, the results were positive, as evidenced by the surveys administered to students and teachers. The use of interactive tools facilitated the assimilation of complex concepts related to density, allowing students to approach the content in an accessible and motivating manner. Likewise, working with real-time visual simulators promoted both independent learning and collaborative work. Furthermore, the challenges presented encouraged collaborative work, allowing the application of theoretical concepts in practical situations. The progressive evaluation through online questionnaires via the Websim platform made the process more dynamic and fun, and the student demonstrated their interest in learning. Thus, these results reflect how gamification transformed the dynamics in the classroom with a different and more interactive educational experience.

Figure 1. Demonstration class application of Spatial

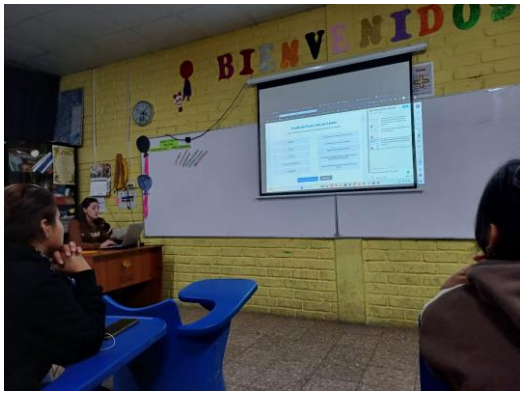

Figure 2. Demonstration class application of Websim

4.1.3 Analysis of observation sheets

During the gamified practical class, observation sheets were integrated for qualitative analysis, showing how each student responds to the change in teaching strategy, resulting in the following frequency table according to the observation category.

OBSERVATION CATEGORY	ALWAYS	ALMOST ALWAYS	NEVER
Interaction with peers	9	8	2
Demonstration of skills	12	5	2
Understanding of tools	10	7	2
Interest in learning	10	8	1
Enthusiasm for new challenges	11	6	2
Involvement in the platform	13	4	2
Relationship of concepts	14	4	1
Participation in collaborative work	11	7	1
Expression of ideas	13	4	2
Application of concepts	10	5	2

Table 3. Frequency of observation sheets.

Following the analysis using observation sheets, the findings regarding students in the area of Physics, particularly in the playful activities related to the topic of density, revealed a high degree of interaction and participation. The majority of students, close to 70%, showed a desire to continue learning during the sessions, while also demonstrating clear motivation

to face various challenges once their training had concluded. This behavior indicates that gamification is on the right track in motivating students, given its tendency to create a learning environment focused on cooperative work and classroom activities.

Furthermore, it was observed that by participating interactively and contextualizing the topic in Physics, the material is understood more fully through the gamified approach. Once again, student participation and engagement were significant. In this regard, several authors emphasize that the use of game elements in educational contexts increases both motivation and engagement, fostering a collaborative and dynamic environment that facilitates the understanding of complex ideas and helps students adapt to new learning techniques (Deterding et al., 2011; Kapp, 2012).

However, areas for improvement were also observed: very few students (approximately 10%) experienced difficulties integrating and fully participating in the activities. There is a clear need to implement additional strategies to support more introverted participants. Nevertheless, the data reflect a positive effect on learning physics concepts through gamification, as demonstrated by students' ability to apply learned concepts in practical scenarios, such as their own definition of the density of different materials (Deterding et al., 2011; Kapp, 2012). As Deterding et al. indicate, gamification can transform the learning experience (2011). Likewise, the results also guide teachers to transform their pedagogical practice by introducing gamification into their classes in an attractive and appropriate way..

4.2 Relevant findings in the quantitative part

The results of the satisfaction survey administered to the 23 high school teachers showed a positive opinion regarding the integration of gamification in Physics classes. Furthermore, 78.3% of the teachers believe that gamification fosters autonomy in learning, indicating that students become more proactive in their educational process. The surveys demonstrate the effectiveness of game-based activities not only in optimizing academic performance but also in advancing interpersonal and communication skills among students. According to Sarabia-Guevara and Bowen-Mendoza, the success of gamification lies in a suitable design that integrates appropriate understanding among participants, as well as the mission and incentive that motivates them to continue with their academic process (Sarabia-Guevara and Bowen-Mendoza, 2023). Thus, the incorporation of gamification into teaching is essential as an attractive, dynamic, and effective study method during the teaching-learning process.

When asked, "Do you think that gamification has increased the motivation and commitment of adult high school students in the subject of Physics?", 65.2% of the teachers who participated in the development of the class emphasized that gamification is a key aspect in generating motivation among students at all educational levels; highlighting it as an alternative to increase students' academic performance (Ojeda and Zaldívar, 2023).

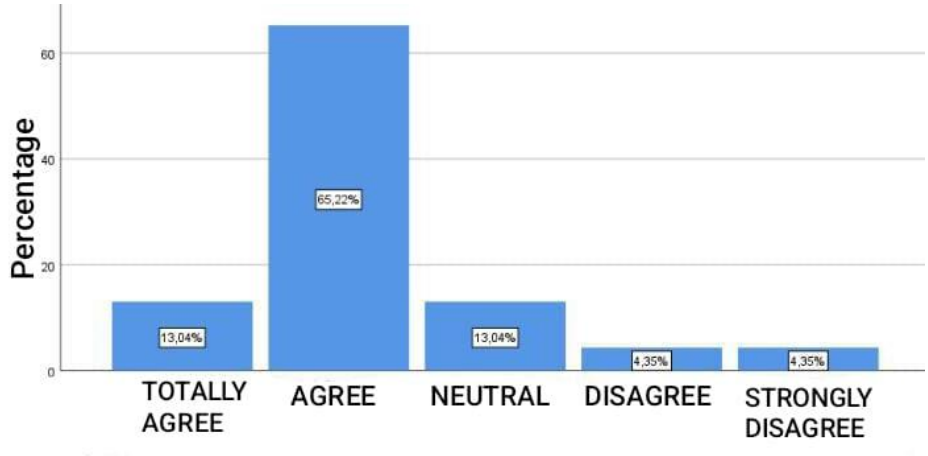

Figure 3. I believe that gamification has increased the motivation and engagement of adult high school students in the area of physics

Regarding the results of the student surveys, a positive assessment of gamification as a pedagogical tool is evident. In this respect, 79% of respondents stated that interactive activities encourage them to participate more actively in the school environment, while 74% emphasized that such activities allow them to better understand abstract physics concepts. Furthermore, 68.4% of students indicated that gamification facilitates connecting the knowledge acquired with their personal experiences, thus strengthening appropriate learning. These findings indicate that gamification not only enhances content comprehension but also fosters more contextual and relevant learning for students. Similarly, it is important to highlight that, according to the survey conducted, gamification is a good way to learn Physics, especially for people who are resuming their studies. This is relevant because it reflects students' opinions on the effectiveness of gamification in their learning process, particularly for those returning to formal education after several years of educational setbacks.

Based on the question, "Do you think gamification is a good way to learn Physics, especially for people like you who are resuming their studies?", it was found that 36.84% of students strongly agreed and 47.37% agreed. This result is significant, reflecting a widespread positive perception of the effectiveness of gamification in the learning process of adults with incomplete schooling. This trend coincides with the findings of Espinoza-Gaona et al., who state that gamification in experimental Physics not only increases motivation but also facilitates the understanding of complex Physics concepts and strengthens critical thinking in students facing educational challenges in their learning process (Espinoza-Gaona et al., 2025).

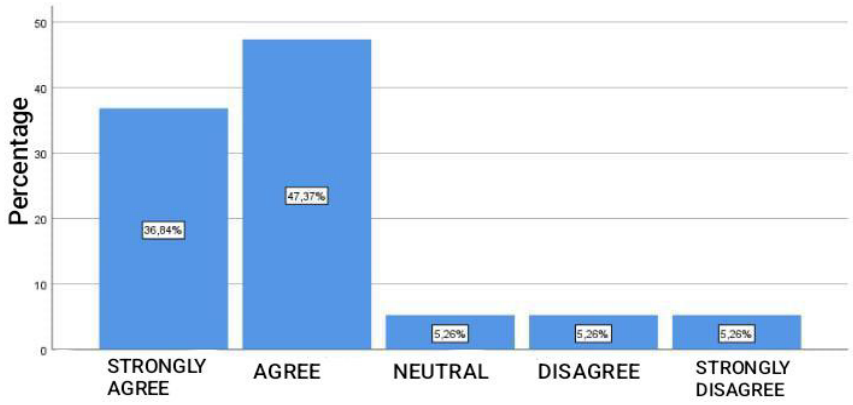

Figure 4. I believe that gamification is a good way to learn physics, especially for people who, like me, are resuming their studies.

The application of gamification in physics instruction for adult and senior citizens in evening high school demonstrated clear improvements in motivation, autonomy, and understanding of abstract concepts. More than 78% of teachers and 84% of students expressed positive perceptions, highlighting the effectiveness of the game-based activities integrated into physics, as well as the improvement in academic performance.

5.Conclusions

Regarding the content presented in the literature review, it can be emphasized that gamification is a pedagogical model that enhances learning; through playful interaction, it allows students to construct meaning from their own definitions and experiences. Furthermore, the research employed a pragmatic paradigm with theoretical methods such as historical-logical analysis and empirical methods such as observation and interviews. The designof the proposal was based on theoretical and methodological findings related to gamification, focusing on the area of Physics. Therefore, its development consisted of analyzing games aimed at encouraging problem-solving and critical thinking. The intervention was implemented with the objective of increasing motivation and optimizing students' understanding of abstract concepts. Finally, to understand the perception of the proposal in relation to the structure and mechanics of the games in the designed activities, interviews were conducted with students and teachers. This process facilitated understanding its feasibility of implementation and its potential to transform the teaching-learning experience.

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Declaration of authorship-CRediT

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

DIANA CEVALLOS-BENAVIDES: State of the art, related concepts, data analysis, validation, data analysis, conclusions, final review.

Declaration of the use of artificial intelligence

The authors declare that they used the ChatGPT tool – GPT-4 model (OpenAI), June 2025 version – solely to assist in the reformulation and linguistic improvement of some sections of the manuscript. No part of the scientific content, results, analyses, or interpretations was generated by artificial intelligence. All material was reviewed and validated by the authors, who are responsible for its accuracy and rigor.