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DESIGN AND VALIDATION OF AN INSTRUMENT TO EVALUATE A GAMIFIED STRATEGY IN E-LEARNING ENVIRONMENTS IN HIGHER EDUCATION

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ABSTRACT

Aim/Purpose	This study aims to design and validate an evaluation instrument for a didactic strategy based on gamification, specifically adapted to e-learning contexts in higher education. It addresses the ongoing challenge of enhancing student motivation, engagement, and retention in virtual learning environments.
Background	With the sustained growth of online education, higher education institutions need to develop and evaluate coherent pedagogical strategies that promote active learning. Although gamification has shown the potential to increase student participation, there is a lack of validated instruments to measure its effectiveness. This study responds to that need by proposing a validated framework for evaluating a gamified instructional model.
Methodology	A non-experimental, descriptive, cross-sectional design with a mixed-methods approach was used. The Delphi method was applied, involving 33 experts who evaluated the validity and reliability of the proposed strategy. Content validity was assessed using the Content Validity Coefficient (CVC), and reliability was confirmed through Cronbach's alpha.
Contribution	This study provides an empirically validated instrument for implementing and evaluating gamification-based strategies in e-learning environments. It offers a

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	structured and reliable tool for enhancing instructional planning and student engagement in virtual settings.
Findings	Experts showed high levels of agreement regarding the structure, clarity, and pedagogical coherence of the strategy's components. The instrument demonstrated strong reliability and validity, confirming its suitability for evaluating gamified instructional models. The proposed framework is expected to inform future research and serve as a practical guide for educators integrating gamification into online learning.
Recommendations for Practitioners	Educators and instructional designers should consider integrating gamification elements such as narratives, levels, and rewards to enhance student motivation and participation in e-learning environments.
Recommendations for Researchers	Future research should explore the long-term effects of gamification on academic performance and assess its adaptability across different disciplines and educational levels.
Impact on Society	The validated gamification strategy can improve online education accessibility and effectiveness, reduce dropout rates, and foster more engaging and interactive learning experiences.
Future Research	Further studies should investigate how different game mechanics influence student engagement and learning outcomes in diverse cultural and academic settings.

Keywords	gamification, e-learning, higher education, instructional strategy, student motivation

INTRODUCTION

In higher education, substantial changes have been seen recently, forcing teachers to take on challenges and change their work methodologies, increasing the use of technologies in training processes (Mollo-Torrico et al., 2023). The integration of digital tools in student training has been a challenge for educational institutions globally, increasing its accelerated use due to the pandemic and post-pandemic, showing weaknesses in the digital skills of some teachers to implement technologies in the educational process (Huamán Ramos et al., 2021). While it is true that there are many studies focused on the technological component, many times, they have left aside the pedagogical component (Padilla Escobedo & Ayala Jiménez, 2021). Therefore, focusing more on how the teacher teaches is necessary, looking for suitable strategies for students to understand the content and obtain meaningful learning.

García et al. (2022) mention that the work of teachers when implementing technologies should not be assumed only by a set of skills but also that knowledge and attitudes that allow addressing complex scenarios are essential in the planning of didactic strategies and that the teacher has a certain degree of technological knowledge. This has led to a rethink of the ways of teaching in the different study modalities, especially in the online modality since research reveals a higher dropout rate in online learning because it represents more autonomy and responsibility for the student (Gonzales Lopez & Evaristo Chiyong, 2021).

At the Latin American level, it has been proven that there are significant differences between face-to-face and online modalities concerning student dropout, with the highest being in virtual environments. However, addressing this issue is crucial, and we should not just accept it as a norm. There are different criteria regarding this problem, depending to a certain extent on how the classes are taught

for the process to be effective. This should encourage educators and policymakers to find solutions and improve the online learning experience.

Hachey et al. (2023) argue that several factors influence student performance: (1) their psychological attributes, skills, academic background, and experiences; (2) environmental factors ranging from conducive study environments to the student's work commitments; and finally, most importantly (3) those related to the course such as the interactions they have, the institutional support and the program design where the strategies for course development are included.

Due to the factors that have been influencing attrition in online courses in higher education, the use of gamification has increased as a strategy that has elements of a game in activities that are not games and that serves to stimulate student participation, allowing the recreation of more dynamic and motivating environments in the academic process. However, Khaldi et al. (2023) argue that the appropriate selection of game elements of such a strategy remains a challenge for designers and gamification practitioners, given that there are no proven design approaches and no single solution effective in all gamification contexts. Gamification remains a prominent trend in research but still lacks clear frameworks and guidelines for developing "gamified" learning tools that facilitate innovative and engaging forms of learning (Al-Smadi, 2015). Some studies corroborate that this strategy is used without a unique application scheme where it must connect, relate, and transform pedagogical objectives with game mechanics (Kabilan et al., 2023). In this context, the following research question has been formulated:

> What is the validity and reliability of an instrument designed to evaluate the effectiveness of a gamification strategy in e-learning environments in higher education?

A didactic proposal was designed based on gamification in e-learning contexts to answer the research question. Experts evaluated this proposal, which will be a reference for future studies. The validation and reliability of the instrument were crucial since they gave precision and consistency to the evaluations of the effectiveness of the gamified strategy. The relevance of this study lies in its potential to positively influence educational methodologies in higher education, particularly in online modalities. The integration of gamification elements, such as challenges, competitions, rewards, and levels, has the potential to make the training process more attractive and fun for students. These elements allow students to progress at their own pace and receive immediate feedback, which can significantly improve their motivation and academic performance. For the design of this didactic proposal, an exhaustive review of the existing literature was carried out, focusing on how gamification has been implemented in online scenarios. This review allowed the development of a scheme that meets the requirements of an effective gamified model.

In this context, the main objective was to design and validate an instrument to evaluate the effectiveness of a didactic strategy based on gamification in online education environments in higher education. This validation was done through expert judgment using the Delphi method to ensure the proposed items' relevance, clarity, and applicability. This instrument is expected to serve as a basis for future research or practical implementations to improve virtual teaching in university contexts.

LITERATURE REVIEW

E-LEARNING IN HIGHER EDUCATION

Online learning has been characterized in various ways: virtual, digital, and distance education. However, all of them refer to the fact that the teaching-learning process occurs online, mediated by digital tools that strengthen knowledge through interaction between teacher and student (Awan et al., 2021). There are no geographical barriers to this type of learning, so it is used worldwide within educational institutions so students can carry out their studies wherever they are.

The use of e-learning allows more personalized learning and quick access to information. It is considered a way to optimize resources since the learner can access classes and learning materials, interact with the teacher, and perform activities without the need to be physically on a university campus (Álava et al., 2022). In other words, this technology-mediated learning offers a flexible alternative for those who cannot access conventional education.

While the online learning modality has numerous advantages, its high dropout or abandonment rate in training has raised questions. This underscores the need for further research and study to ensure a practical and quality educational experience (Awan et al., 2021). Educators and policymakers play a crucial role in this ongoing exploration of e-learning. According to Ayala et al. (2021), some factors influence indirectly, such as the little interaction that exists through virtual environments, internet connectivity problems, and time management, and those that influence directly and that fall mainly on the educational institution's responsibility. These are aligned with the classroom design involving content, resources, and strategies to plan a class (Romero Alonso & Anzola Vera, 2022). Addressing these problems requires a comprehensive approach that includes all educational actors, teachers, students, and course designers in choosing appropriate teaching-learning strategies according to the needs of an educational program, as well as facilitating the necessary support to ensure students' success in virtual environments.

For this, it is necessary to design instruments that help to evaluate the interactivity and participation of the learner and that these, in turn, enable the appropriation of learning (García Villarroel, 2021). In a systematic review conducted by Prieto Andreu (2022), it was detected that the instruments most commonly used with the use of gamification are questionnaires, followed by the game log, which implies a need for further research and open horizons in terms of evaluating more procedures of the usability of the strategy.

Didactic Strategies in E-Learning

Didactic strategies are methods and techniques designed to facilitate the teaching-learning process. They enhance student learning and promote active and effective participation in a virtual environment (Vera et al., 2021). As in face-to-face education, it is necessary to develop planning and design activities for teaching-learning experiences (Rivera Tejada et al., 2023).

According to Mehrpouyan (2023), there are three types of interaction: the student with the teacher, the student with the content, and the student with his/her peers. These three types of interaction are not just options but essential components of the e-learning process. They are very relevant and complement the training process since they allow students to be fully involved by receiving instructions from the teacher, reviewing texts, audio, or videos, and sharing experiences with their peers. Likewise, W. O. Aguilar et al. (2020) mention that another important factor that strategies should have is personalization based on students' individual needs, considering interests, abilities, and learning styles.

Under this premise, several investigations have developed and validated specific instruments to evaluate the effectiveness of didactic strategies in e-learning environments. For example, Parra-González et al. (2022) designed and validated the EGAMEDU scale to measure the gamification experience in educational contexts where participation, motivation, interaction, learning, perceived evaluation, and narrative can be evaluated; however, it does not claim to apply to all educational levels or modalities.

According to Domínguez et al. (2023), most gamified experiences are evaluated afterward, do not have an instrument that evaluates the process, or do not focus on important aspects that should be considered when learning regarding content, methodology, evaluation systems, etc. Based on the previous text, it is important to develop instruments that allow for the development or progress of students in an individual way to encourage their active participation.

Andayani et al. (2020) claim that online learning is complex for teachers and students. Therefore, strategies must be flexible and adaptable to adjust to any eventuality and encourage participation. According to this criterion, didactic strategies in e-learning are fundamental tools that will help to promote meaningful learning, creating enriching and motivating experiences for the learner.

In order to create optimal learning in an online training process, instruments have been designed that include various didactic strategies, among them: (1) *active learning*, where practical activities, online discussions, and problem-solving are carried out (Rosales Márquez, 2022), (2) *problem-based learning*, focused on solving authentic problems where the student investigates, analyzes and proposes (Cabero-Almenara & Palacios-Rodríguez, 2021), (3) *collaborative learning*, which focuses on discussion forums, wikis, videoconferences, shared documents for students to work together and achieve common goals (Oradini et al., 2022), (4) *individualized learning*, which allows students to advance at their own pace according to individual abilities, and (5) *gamification*, which incorporates game elements such as rewards, competitions, levels, challenges that make the process more fun (Ghai & Tandon, 2023). While it is true that there are many strategies applied in the field of higher education that help strengthen the interaction between teacher and student, this study will only focus on the design of an instrument with a gamified structure.

Gamification in E-Learning

Gamification in e-learning uses game design elements in online learning contexts to motivate and engage the learner in a virtual classroom. Under this premise, several characteristics of games, such as rewards, competitions, challenges, and levels, are integrated to structure the activities and make them more interactive and attractive (Khaldi et al., 2023).

Gamification is generally a potent tool for enhancing students' intrinsic motivation, boosting participation and engagement, and creating stimulating experiences that keep the learner engrossed and completing the class. Saleem et al. (2022) support this, suggesting that this strategy allows the integration of points, medals, or badges as rewards within the training process. Moreover, incorporating narratives to tell a story can make the course more immersive and inspiring for the learner.

Gamification in e-learning contexts has gained popularity due to its effectiveness and the growing interest in involving elements of a game in an educational environment; however, as the practice of this strategy has different success rates (Alves, 2020), a formal standard design or guide is needed to streamline gamification in virtual learning platforms (Abdulaziz Alsubhi et al., 2020). Many studies have been conducted on gamification, but not on how to bring a schematic process of all the elements that compose it (Jayawardena, 2020); therefore, it is necessary to go further to seek clear guidelines that can serve to improve the teaching-learning process in an online environment.

Smirani and Yamani (2024), for example, developed a 19-question questionnaire to assess student perceptions of engagement, motivation, knowledge retention, perceived effectiveness of learning, enjoyment, and competitiveness. The questionnaire showed positive results in academic performance. In this same approach, Zainuddin et al. (2024) developed a questionnaire called GAQ (Gamification for Adult Questionnaires) based on Knowles' andragogical principles to evaluate the effectiveness of gamification in an e-learning context, considering factors such as intrinsic motivation and satisfaction. According to the above, it is evident that the use of the strategy has been primarily evaluated through questionnaires, reviewing results before and after; therefore, it is pertinent to go further to evaluate the process and give an optimal follow-up during the development and applicability of the strategy.

Research Objective

The primary aim of the research is to create and validate a didactic strategy for e-learning using Gamification in Higher Education. This overarching objective leads to the following specific objectives:

O1: To evaluate and compare the means of the Knowledge (Kc) and Argumentation (Ka) coefficients of the experts participating in validating a gamified didactic strategy in e-learning environments.

O2: To calculate the Content Validity Coefficient (CVC) of the instrument designed to evaluate the effectiveness of a gamified didactic strategy in higher education e-learning environments.

O3: To calculate Cronbach's alpha coefficient to estimate the instrument's reliability and evaluate the effectiveness of a gamified didactic strategy in e-learning environments in higher education.

METHODOLOGICAL DESIGN

The design used was non-experimental, descriptive transactional (Arias & Covinos, 2021), based on a mixed research methodology. The goal was to validate the methodological model through the Delphi method and to learn the different criteria of the group of experts. This method made it possible to obtain reliable information from a panel of experts through a series of cyclical rounds characterized by anonymity, controlled feedback, and statistical responses from the group. The depth and richness of the expert opinions were valued more than statistical quantification (Cañizares Cedeño & Suárez Mena, 2022).

The expert's self-perception was analyzed using the knowledge coefficient "Kc." It was implemented to establish the information known by the expert on the topic in question, placing the assessment based on his experience and the argumentation coefficient 'Ka' used for the basis of the experts' criteria. "This coefficient is obtained from the assignment of a series of scores to the different sources of argumentation that the expert has been able to wield" (Almenara & Osuna, 2013). The content validity coefficient was used to assess the degree of agreement among the experts on the proposal's validity. Finally, to corroborate the instrument's reliability, the internal consistency was carried out using Cronbach's alpha (Hernández-Nieto, 2002, as cited in Sánchez, 2021). In addition, descriptive analyses were performed on the open-ended questions incorporated in the validation.

SAMPLE

The type of sampling of the study was non-probabilistic by convenience, and to achieve the objectives proposed in the research, the recommendations of the Delphi method were followed according to its theoretical postulates (Lugo-López et al., 2024); that is, two rounds of consultation, the selection of experts, the evaluation of the items and the analysis of reliability were carried out, which are detailed below. Two groups were used to validate the instrument: an organizing group and a set of 33 experts. Both groups, composed of university professors with extensive knowledge of the evaluated subject matter and the various learning methodologies used in the training process, were specifically selected for their experience and competence in the field.

The coordinating group comprised three teachers with broad expertise in university education. Two of them are education doctors and belong to research groups. One is a specialist in Educational Technology and Innovation, in charge of developing the research, complying with what Nápoles and Barrueta (2023) adduce, where they establish the basic and defining characteristics when choosing the expert group in a study.

The coordinating team carried out the selection process of the group of experts. Although diversity was sought regarding educational experience, priority was given to including university teachers with specific experience in virtual learning classrooms. To collect the experts' criteria, a mass mailing was sent to 230 teachers working at the Technical University of Manabí who met the abovementioned criteria, of which only 33 responses were received from 33 experts. It is important to note that the sample was significant for the validation of the proposal, which was carried out in two stages, and to

justify that a third round was not necessary. The Cabero-Almenara et al. (2020) strategy was used to refine the expert selection process, including in the form of questions about the self-perception that the participants had about their level of knowledge according to the topic, as well as the sources that allowed them to argue the decision adopted (López Gómez, 2018), as justified by Powell (2003) and Landeta Rodríguez et al. (2002) mentioning that both the number of experts and the rounds that need to validate an instrument can vary according to the research problem, information obtained and the objectives that are intended to be achieved.

INSTRUMENT

The instrument submitted for validation is a didactic proposal based on the use of gamification in e-learning contexts, which follows a constructivist and behaviorist model entitled "Discovering Academic Paths with Gamification" inspired by the story of the pirate Morgan and designed within a virtual classroom on a Moodle platform with eight work sessions and 15 levels of complexity and which is specifically detailed in the proposal design section of Figure 1.

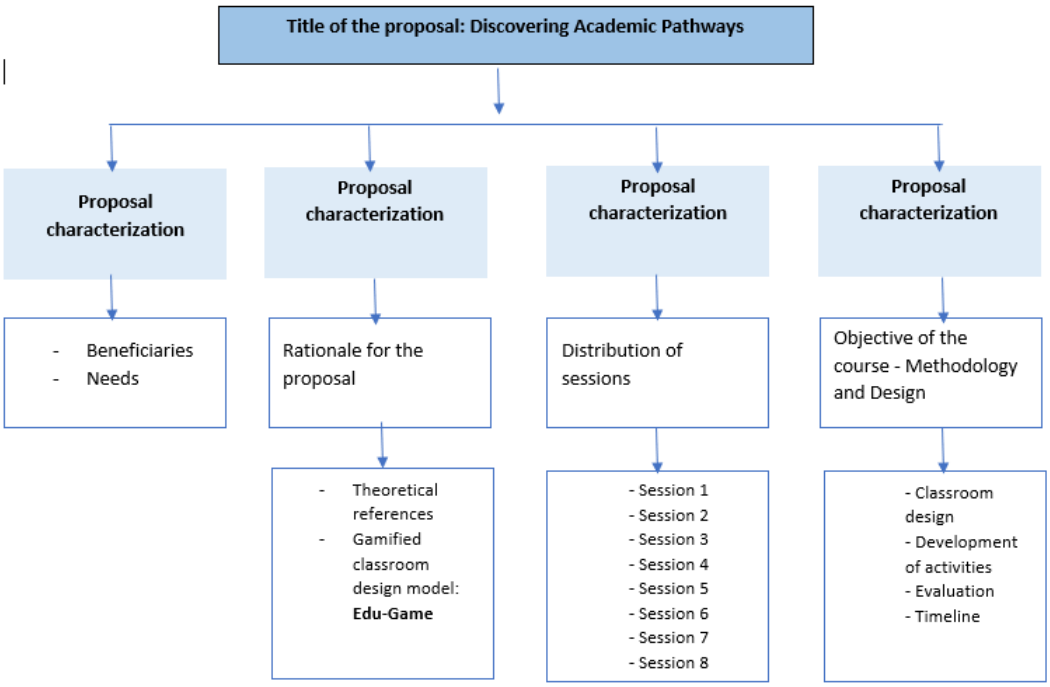

Figure 1. Structure of the didactic proposal design

To validate the proposal, the Delphi method was applied to establish the instrument's relevance, clarity, and pertinence (Sánchez-Tarazaga & Ferrández-Berrueco, 2022). Likewise, to know the criteria of the experts, it was necessary to develop an online form, which was divided into three sections. The first was demographic data (gender, academic level, nationality, function performed, research group). The second was the expert competence to know the level of competence based on the topic according to the degree of knowledge on a scale of 0 to 10, with 0 having absolutely no knowledge and 10 having complete knowledge of the state in question. In this same dimension, another self-assessment question was added according to the knowledge of the use of gamification in the e-learning context. The third section was for the specific validation of the proposal and evaluation of the quality of digital educational resources implemented by the evaluation instrument LORI (Learning Object Review Instrument) (Leacock & Nesbit, 2007, as cited in S. J. Aguilar, 2020), which has been manipulated on several occasions to validate gamified instruments, analyzing the coherence of the didactic proposal based on the quality, objectives and design of the feedback (Ayuso-del-Puerto et al., 2025).

Some recommendations by Hérnandez Nieto were followed, applying a Likert-type scale with five alternatives: Unacceptable, Deficient, Acceptable, Good, and Excellent (Sánchez, 2021). This last section comprised nine criteria based on the LORI rubric: (1) quality of content, (2) adequacy of the learning objectives, and (3) compliance with standards (according to the institution). It is pertinent to point out that, for each criterion, an observation panel was added at the end in case they wished to make any additional suggestions.

PROCEDURE

As expressed in previous sections, the coordinating group oversees the research. Therefore, the criteria were explicitly qualitative for creating the proposal; as a small group, applying a survey was unnecessary. As for the group of 33 experts, it can be observed in Table 1 that 12 participants are female while 21 are male; likewise, since it is a university in Ecuador, there are 28 experts, with a predominance of Ecuadorian nationality, 3 of Cuban nationality, and 2 of Venezuelan nationality. As for the function they perform, 17 participants have a master's degree, 11 have a doctorate, 4 have a post-doctorate, and 1 has only a bachelor's degree, which shows a relatively high level of preparation of the participants for being in an institution of higher education. One of the criteria to be met by the group of experts was their experience as university teachers. This can be identified in Table 1 with the totality of their primary function, teaching, which denotes relevance in the criteria collected. Likewise, it is possible to observe their years of experience in university teaching; 23 participants have more than ten years of experience, 6 have between 4 and 6 years of experience, and 4 have 1 to 3 years of experience.

Of the 33 experts, 20 are part of a research group. Their diverse responses, ranging across the thematic areas of educational technology and active methodologies, where they predominantly have experience, underscore the relevance of the criteria used in validating the didactic proposal for e-learning with gamification. This emphasis on relevance ensures that the audience is well-informed about the research process.

Table 1. Sociological data of the experts

Nº	Sex	Nationality	Academic background	Role	Teaching experience	Research group	Subject area in which he/she works
EXP. 1	Male	Ecuadorian	Post Doctorate	Teacher, researcher, middle management	>10 years	Yes	Educational technology, artificial intelligence
EXP. 2	Male	Ecuadorian	Master	Professor, researcher	>10 years	Yes	Educational technology
EXP. 3	Male	Ecuadorian	Post Doctorate	Professor, Vice-Dean for Research, graduate studies and outreach	More than 10 years	Yes	Curricular planning, active methodologies, innovation
EXP. 4	Male	Ecuadorian	Master	Teacher	4 to 6 years	No	Educational technology, active methodologies
EXP. 5	Male	Ecuadorian	Post Doctorate	Teacher, researcher	More than 10 years	Yes	Educational technology, postgraduate training
EXP. 6	Female	Cuban	Master	Teacher	More than 10 years	Yes	Curriculum planning
EXP. 7	Female	Venezuelan	PhD	Teacher	More than 10 years	Yes	Educational technology

Nº	Sex	Nationality	Academic background	Role	Teaching experience	Research group	Subject area in which he/she works
EXP. 8	Male	Ecuadorian	Master	Teacher	More than 10 years	Yes	Educational technology
EXP. 9	Male	Ecuadorian	Master	Teacher	4 to 6 years	Yes	Active methodologies
EXP. 10	Female	Ecuadorian	Master	Teacher	More than 10 years	No	Human communication
EXP. 11	Female	Ecuadorian	Master	Teacher	More than 10 years	No	Educational technology, active methodologies
EXP. 12	Male	Cuban	PhD	Teacher	More than 10 years	Yes	Quality of graduate studies, human communication
EXP. 13	Male	Cuban	PhD	Teacher, researcher	More than 10 years	Yes	Educational technology, educational psychology, natural sciences didactics
EXP. 14	Male	Ecuadorian	PhD	Teacher, researcher	More than 10 years	Yes	Active methodologies
EXP. 15	Male	Ecuadorian	PhD	Teacher	More than 10 years	Yes	Environmental sociology, educational technology
EXP. 16	Female	Ecuadorian	Master	Teacher	1 to 3 years	No	Curriculum planning
EXP. 17	Male	Ecuadorian	PhD	Teacher	More than 10 years	Yes	Cultural heritage
EXP. 18	Male	Venezuelan	Post Doctorate	Teacher	More than 10 years	Yes	Economy
EXP. 19	Female	Ecuadorian	PhD	Teacher	1 to 3 years	No	Active methodologies
EXP. 20	Female	Ecuadorian	Master	Teacher	More than 10 years	No	Public health teaching, educational technology
EXP. 21	Male	Ecuadorian	Master	Teacher, researcher	1 to 3 years	No	Active methodologies
EXP. 22	Male	Ecuadorian	Master	Teacher	4 to 6 years	Yes	Information systems, educational technology
EXP. 23	Female	Ecuadorian	Master	Teacher	More than 10 years	No	Curriculum planning
EXP. 24	Male	Ecuadorian	Master	Teacher, researcher	4 to 6 years	Yes	Educational evaluation
EXP. 25	Female	Ecuadorian	Master	Teacher	More than 10 years	Yes	Educational technology
EXP. 26	Female	Ecuadorian	Master	Teacher, administrative	4 to 6 years	No	Curriculum planning, educational evaluation
EXP. 27	Male	Ecuadorian	Bachelor's Degree	Teacher	1 to 3 years	No	Educational technology
EXP. 28	Male	Ecuadorian	PhD	Teacher	More than 10 years	Yes	Economic development research
EXP. 29	Female	Ecuadorian	PhD	Teacher, researcher	More than 10 years	Yes	Educational technology
EXP. 30	Male	Ecuadorian	Master	Teacher	More than 10 years	No	Educational technology

Nº	Sex	Nationality	Academic background	Role	Teaching experience	Research group	Subject area in which he/she works
EXP. 31	Female	Ecuadorian	PhD	Teacher	More than 10 years	Yes	Active methodologies
EXP. 32	Male	Ecuadorian	PhD	Teacher	More than 10 years	No	Educational technology
EXP. 33	Male	Ecuadorian	Master	Teacher	4 to 6 years	No	Educational technology, active methodologies

For the development of the study, the criteria of some authors who have applied the Delphi method were followed (Andrés García et al., 2020; Fernández de Castro Fabre & López Padrón, 2013; García Valdés & Suárez Marín, 2013) and distributed in three phases: (I) preliminary phase, (II) exploratory phase, (III) final phase.

I) Preliminary phase

In the first phase, the coordinating team conducted an exhaustive literature review to explore the application of gamification in higher education, specifically in e-learning environments. Web of Science and Scopus databases were used for this review, covering the academic production of the last ten years. This bibliographic analysis identified critical elements for formulating a didactic proposal based on gamification in e-learning environments.

Among the priority criteria for designing the strategy are promoting collaborative work, implementing activities adapted to different levels of competence, and incorporating a feedback system that facilitates participants' identification of their strengths and areas for improvement in the training process.

At the same stage, potential participants were identified to validate the proposal. It was established that these participants should have experience as teachers in higher education and have previously worked in virtual classrooms. In addition, it was defined that the entire consultation process with the group of experts would be carried out via e-mail, ensuring a thorough approach to obtaining objective and well-founded responses.

II) Exploratory phase

In this stage, the first version of the proposal was elaborated, integrating the necessary elements reviewed in the literature to achieve the research objective. Subsequently, the coordinating group submitted this first version to an initial round of analysis and discussion. During this process, corrections and adjustments were made based on qualitative judgments that received greater consensus from the team.

Once the pertinent corrections had been made, the proposal was submitted to a second round to be evaluated by previously selected experts to obtain broader quantitative and qualitative criteria. This process was carried out using an online form sent by e-mail, which attached the proposal file and gave access to the virtual classroom to verify and evaluate the document's contents. The form was divided into four different sections, starting with a presentation on the objective and purpose of the instrument, including a question on whether or not they agreed to participate in the process. The next section was established to learn their gender, academic level, experience, whether they belonged to a research group and their area. The third section focused on expert competence to identify the degree of knowledge on the subject and the relationship with the sources on applying gamification in an e-learning context. Finally, to evaluate the quality and validity of the proposal, the criteria indicated in the LORI evaluation instrument were used with a Likert scale: unacceptable (1), deficient (2), acceptable (3), good (4), excellent (5).

The results of the second consultation round to validate the group of experts were meticulously analyzed from a quantitative and qualitative approach. We examined the expert's self-perception through the 'knowledge coefficient' and the 'argumentation coefficient.' The content validity coefficient was employed to assess the degree of agreement among the experts and ensure the proposal's validity. Finally, internal consistency was assessed using Cronbach's alpha to confirm the instrument's reliability. A qualitative analysis was made of the opinions expressed in the open-ended question included in the proposal, further enhancing the thoroughness of our process.

III) Final phase

In this last phase, the experts' criteria on the proposed items were analyzed to determine if they were (1) unacceptable, (2) deficient, (3) acceptable, (4) good, or (5) excellent, to anticipate, design and measure the impact and conception they have based on their experience with the use of gamification in virtual classrooms. The results of the entire validation process are consolidated through an interactive consultation with experts, culminating in the final proposal for designing a gamified classroom for subsequent application in the research process.

RESULTS

EXPERT COMPETENCE

To fulfill the first research objective aimed at evaluating and comparing the means of the knowledge (Kc) and argumentation (Ka) coefficients of the experts participating in the validation of a gamified didactic strategy in e-learning environments, it was necessary to carry out the following procedure according to the postulates of Almenara and Osuna (2013).

Calculating the expert competence of the 33 participants was a precise process. We used the formula K =½ (Kc + Ka), where Kc is the 'knowledge coefficient,' and each expert obtained the perception directly. Ka is the 'argumentation coefficient,' which is generated by adding the options specified by the expert.

The values used to determine the expert's position were:

- 0.8 < K < 1.0 high competence coefficient.
- 0.5 < K < 0.8 medium competence coefficient
- K < 0.5, low coefficient of competence

According to the averages achieved, as shown in Table 2, the experts' perceptions of the degree of knowledge of the topic to be validated were considered high and significant, providing a clear vision of how the participants value their knowledge and the various sources that contribute to it, highlighting a high self-perception of general knowledge and a moderate and consistent valuation of the specific sources of knowledge, which gives value and relevance to the criteria given by the participants, with only two rounds of validation being necessary.

Table 2. Means of the knowledge (Kc) and argumentation (Ka) coefficients.

Variable	Media	D. Tip.
Degree of knowledge	8.12	1.27
Theoretical analysis performed by you	2.42	0.5
Experience gained from your teaching activity	2.61	0.5
Study of works related to the subject by national authors	2.24	0.56
Study of works related to the subject by foreign authors	2.39	0.56
Your knowledge of the state of the problem abroad	2.3	0.47
Your intuition about the subject matter	2.45	0.62

*D. Tip. = standard deviation

Didactic Proposal - Content Validity

In order to answer the second specific objective of the study focused on calculating the Content Validity Coefficient (CVC) of the instrument designed to evaluate the effectiveness of a gamified didactic strategy in e-learning environments in higher education, it is essential to know the general structure of the proposal:

In the design of the didactic proposal, we have chosen to use the Edu-Game model as a reference for the implementation of gamification. This model, developed by Vázquez Ramos (2021), is a comprehensive framework that addresses all the substantial elements of curricular planning, integrating a game's dynamics, mechanics, and components. This comprehensive nature of the model is crucial when introducing gamification in the classroom, as it ensures that we not only consider the didactics but also some essential aspects of the strategy, as highlighted by Sadovets et al. (2022). A scheme summarizing the model is presented in Figure 2.

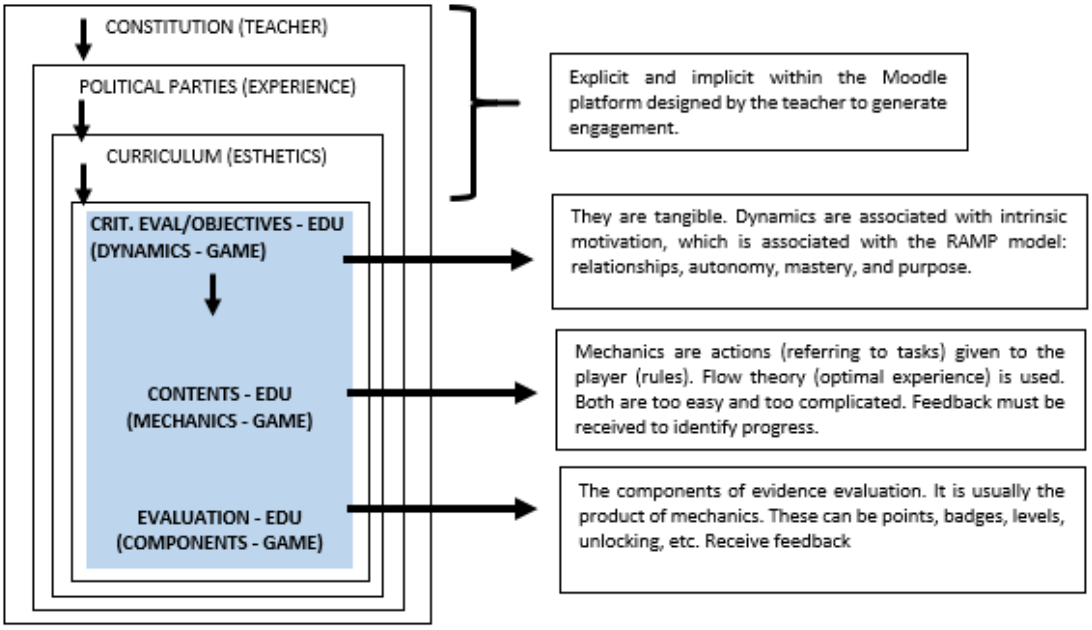

Figure 2. Own elaboration based on the Edu-Game model

This model will be implicitly integrated into the activities planned in the subject. On the one hand, it must have the presence of a teacher with experience in gamification to implement the proposal and develop the planning in the virtual learning platform (curriculum) with the objectives and evaluation criteria that are related to the content and dynamics or ways of how activities will be executed, For this reason, the class has a design of Captain Morgan's map and levels to open sessions or paths, in each of these the students will find the story with its level of difficulty. To open the sessions and review the contents, participants must comply with the established rules (mechanics) and go up levels each time in order to reach the final goal (evaluation), where they will receive their respective badges and feedback for their achievement (components). Figure 3 is an image of the gamified classroom design with Captain Morgan's map model.

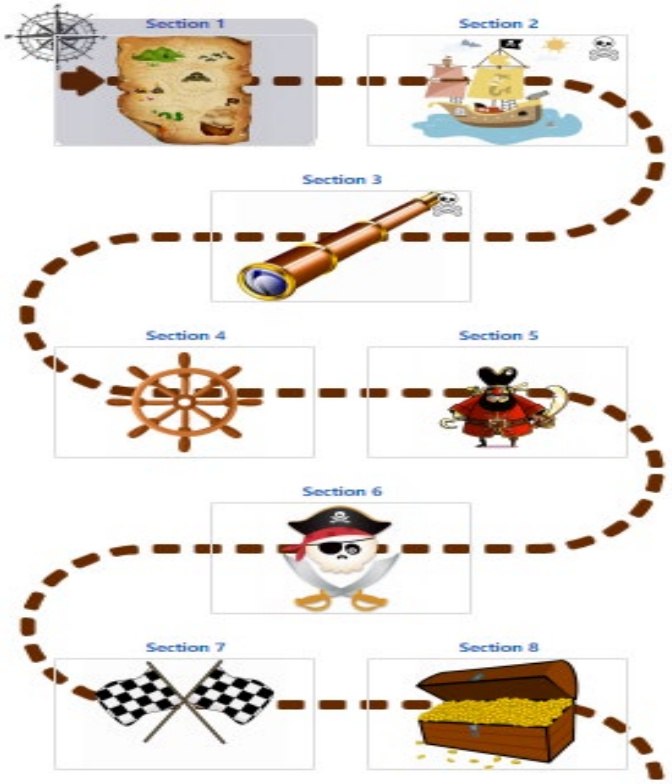

Figure 3. Gamified classroom design

In this context, to verify the content validity of the proposal according to the criteria given by each expert, the suggestions of Hernandez-Nieto (2002, as cited in Sánchez, 2021) on the content validity coefficient were followed, allowing to assess the degree of agreement of the experts of the nine items or questions applied in this study. For this process, the following formula was applied:

$$CVC_i = \frac{\text{Mx}}{\text{Vmax}}$$

The same author also stresses the importance of reducing the error rate and the bias some experts could introduce. To ensure the highest level of accuracy and objectivity in our research, we applied the following formula:

$$Pe\text{i} = \left(\frac{1}{J}\right)^J$$

The interpretation of the CVC can be done with the following scale of values: (a) less than 0.6, unacceptable validity and concordance; (b) equal or greater than 0.6 and less than 0.7, poor validity and concordance; (c) greater than 0.71 and less than or equal to 0.8, acceptable validity and concordance; (d) greater than 0.8 and less than or equal to 0.9, good validity and concordance; and (e) greater than 0.9, excellent validity and concordance.

Table 3 presents the results of the nine items proposed for the validation of the instrument. Notably, items 1, 2, 6, 7, 8, and 9 scored higher than 0.8, indicating good validity and concordance. However, items 3, 4, and 5 fell below the 0.8 threshold. According to the principles of Hernández-Nieto (2002, as cited in Sánchez, 2021), these items should be either eliminated or modified as per the requirement. This is the rationale behind these potential actions. While these items have acceptable validity and concordance, their current form may not be optimal for the instrument's validation.

Table 3. Calculation of the content validity coefficient

Items	Sx1	Mx	CVCi	Pei	CVCtc
1 Contents	140	28.00	0.85	0.00	0.85
2. Learning objectives	136	27.20	0.82	0.00	0.82
3. Feedback	131	26.20	0.79	0.00	0.79
4. Motivation	122	24.40	0.74	0.00	0.74
5. Design and presentation	127	25.40	0.77	0.00	0.77
6. Usability	133	26.60	0.81	0.00	0.81
7. Accessibility	135	27.00	0.82	0.00	0.82
8. Reusability	141	28.20	0.85	0.00	0.85
9. Compliance with standards	139	27.80	0.84	0.00	0.84

*Mx mean of the score the experts gave, CVCi = mean obtained for each item, Pei error assigned to each item, CVCtc corrected total content validity coefficient.

As part of the validation process for the didactic proposal, 'observation' panels were integrated. These panels served a crucial role, providing a reference for items that received unfavorable scores. They allowed experts to provide justifications or suggestions for the scores assigned to each item. The changes made as a result of this process are detailed in Table 4.

Table 4. Corrections were made to the didactic proposal based on the items

Items	Modified	Observation
Quality of content: truthfulness, accuracy, balanced presentation of ideas, and adequate level of detail.	No	No changes were made because a specialist designed the contents from an Analytical Program (PA), and the class's development is aligned with the PA. In the same way, there was no direct observation.
Adequacy of learning objectives: coherence between objectives, activities, evaluations, and student profile.	No	The activities were changed according to the story told about the pirate Morgan, which is related to item 3.
Feedback and adaptability: adaptive content or targeted feedback based on the response of each student and their learning style.	Yes	Activities that elicited feedback were not only adapted but also tailored to the story of the pirate Morgan and the appropriate level of complexity. This responsiveness to feedback ensures the continuous improvement of our educational program.
Motivation: the ability to motivate and generate interest in a specific group of students.	Yes	A story about the pirate Morgan was designed to motivate the students to read and continue doing the activities.
Design and presentation: the design of audiovisual information favors the proper processing of information.	Yes	
Usability: ease of navigation, predictive interface, and quality of interface help resources.	No	It was added to the constructivist and behaviorist models according to the proposed model.

Items	Modified	Observation
Accessibility: the design of the controls and presentation of the information is adapted for entry from different electronic devices.	No	No observation
Reusability: the ability to be used in different learning scenarios.	No	No observation
Compliance with standards: adaptation of the institution's standards.	No	No observation

Item 1: Quality of the contents. Changing the wording and structure took time and effort. However, observations were made, such as "integrate a story into the virtual classroom to make it more attractive, as well as work on presentations that reinforce the points," "crucial and significant ideas of the content of the subject," and "observe spelling mistakes." However, the first comment is related to the specific content of the subject that is shown to the student. This change was considered for item 5, "Motivation," since telling and integrating a story about the pirate Morgan while the class takes place is more aligned with this section. As for spelling mistakes, they were reviewed and corrected.

I**tem 2: Adequacy of the learning objectives.** No direct changes were made. Still, the experts commented, "It is recommended that the instruments related to the images of the playing process be related to the age group." "At the beginning of the course, you must place the learning object, if you wish, in a narrative form, for example: Let's help the Pirate Morgan find his treasure and in this way become experts in educational technology." These changes were welcomed and considered Item 5, "Design and Presentation," aligning more with this area.

Item 3: Feedback and adaptability. Suggestions were received, such as "It has activities that cannot be given personalized feedback, such as the video lesson." "Detail the method and frequency with which feedback will be provided to the students." Students are guided in their progress and understanding." "I did not develop the activities, so I could not observe the feedback, but as it states, there will always be feedback; I rate it as good." "The activities must have an order, according to the complexity." Based on the judgments given by the experts, the pertinent adjustments were considered and made, as identified in Table 5. The video lesson was eliminated and changed to a questionnaire that generates automatic feedback. Likewise, the activities went from a basic to an advanced level; therefore, some had to be moved. Others altered to adapt to the story of the pirate Morgan, such as the crossword puzzle and the use of the pallet.

Table 5. Change of activities

Grading parameters	Old activities	Actual activities
Teaching	Act. 1: Didactic methodology (III) Act. 3: Collaborative forum (III) Act. 5: Double entry table (IV)	Act. 1: Didactic methodology (Padlet) (III) Act. 3: Collaborative forum (III) Act. 5: Double entry table (IV)
Practice and experimentation in learning	Act. 4: Video lesson – test (III) Act. 7: Standard UNE 71362 - test (IV)	Act. 4: Concepts questionnaire 1 (III) Act. 7: Concepts questionnaire 2 (IV)
Autonomous work	Act. 2: Creation of website (III)	Act. 2: Crossword (III) Act. 6: Creation of website
Exam	Act. 6: Criteria for evaluating environments	End-of-cycle evaluation (III y IV)

*Activity = active, Unit III = (III) and Unit IV = (IV)

Item 4: Motivation. There were significant changes, according to comments such as the following. "Take into account that the contents treated have an interdisciplinary perspective if possible and that they are related to their daily reality; this guarantees levels of motivation when working on known situations." "I think it adapts correctly to some important characteristics of gamification, such as escalation of levels, obtaining prizes or gifts, qualifications, suddenly polishing the issue of challenges a little with some activity that can be carried out as a competition." "Including a narrative of the story that the student will follow throughout their learning path is essential." One of the same sources he uses in his foundation, Cornellà et al. (2020) establishes the importance of the narrative that relates to gamification's mechanics, dynamics, and components. An outline called *The Hero's Journey* by Christopher Vogler sets out how to develop a narrative and what it can follow (Vogler, 2007, p.114). With these enriching arguments, a narrative was integrated into each work session and was coupled according to each level and the participant's progress (Table 6).

Table 6. Modified sessions with the narrative of the story of the Pirate Morgan

Session 1: Island of Beginning. In this first stage, we find ourselves on the mysterious Island of Beginning, where we are presented with the initial challenge. Students must demonstrate their skills in an introductory game that will test their basic knowledge.
Session 2: The Cave of Enigmas. Deep in the Jungle is the mysterious Cave of Enigmas. Teams must solve riddles and puzzles related to the course content to unlock the path to the next level.
Session 3: The Boarding Attention, buccaneers! An enemy ship is approaching. At this level, teams face a real-time problem-solving challenge, working together to overcome an obstacle and continue the treasure hunt.
Session 4: Crossing the Seas 1. It is time to set sail and face the turbulent waters of the sea! At this level, students will face a quiz on key course concepts to advance to the next stage.
Session 5: The Test of Courage. On a remote island, students face physical and mental challenges that test their bravery and determination. Only those who demonstrate true courage can advance to the next level.
Session 6: The Labyrinth of Knowledge. At this level, students must navigate an intricate maze of information, where each wrong path will take them further from their goal. Only those who demonstrate a solid mastery of the course content can find their way out.
Session 7: Crossing the Seas 2. Oh no! Once again, we face the turbulent waters of the sea! But with more force! At this level, students will face a quiz on key concepts of the course to advance to the last and long-awaited stage.
Session 8: The Discovery of the Treasure. We have done it, sailors! After overcoming all the challenges and obstacles, we have finally reached the island's heart, where the legendary treasure of the Pirate Morgan is located. However, be careful; the treasure is protected by a final test that only true adventurers can overcome. Are you ready to claim your reward and become a legend of the sea?

Item 5: Design and presentation. Comments were received, such as "In the Methodology and design of gamification, a constructivist model is declared. However, it would be advisable to assess the possibility of integrating other models that are trends in the object of study of the proposal." "I would only change the image of Section 7 for one more adapted to the pirate theme. It can be improved by introducing a form of video narration, including a narrator explaining the mechanics of the activities. Always having to read the instructions can cause boredom and resistance to continue with the gamification sequence." In this item, the constructivist model was integrated because the student must have active participation, and the previously established guidelines of the Edu-Game

model were followed (Vázquez Ramos, 2021). According to the recommendations given by experts, this design emphasizes stimuli and responses, which is why the behavioral model was involved, since rewards, positive reinforcements, and immediate feedback will be used to encourage certain behaviors or specific skills (Descalzo & Rodríguez, 2023). Finally, the image was changed according to the Morgan pirate format, as shown in Figure 2.

Items 6: Usability, 7: Accessibility, 8: Reusability, 9: Compliance with standards. No changes were made, but they received comments like the following. "With a backup copy or HTML code, it can be shared, but I understand which would only be in MOODLE environments." "One of the positive aspects is that by including it in a Moodle classroom, it can be replicated to other subjects by making adjustments to the activities." "It complies with the standards established by the institution." "It has efficient usability, being easy to navigate and intuitive." These last items were focused on the functionality of the strategy within the virtual classroom on the Moodle platform, which was intended to make it as user-friendly and straightforward as possible for the student, as indicated by the experts.

Internal Consistency

To fulfill the third objective aimed at calculating Cronbach's alpha coefficient to estimate the reliability of the instrument designed to evaluate the effectiveness of a gamified teaching strategy in e-learning environments in higher education, the method of internal consistency based on Cronbach's alpha is detailed below.

Cronbach's alpha, a statistical test, simplifies the estimation of a measurement instrument's reliability. It uses items designed to measure a construct or theoretical dimension (Gonzáles & Durán, 2021). One of its key advantages is that it does not require separating items into two halves; one simply applies the items and calculates the coefficient (Palacios Molina et al., 2020). The coefficient value reflects the internal consistency or the correlation between each question in the instrument (Posso Pacheco & Bertheau, 2020). It is crucial to note that the minimum acceptable value for Cronbach's alpha coefficient is 0.7; any value below this threshold indicates low internal consistency (Landa Cavazos & Ramírez Sánchez, 2018).

Cronbach's alpha coefficient was calculated based on the responses of 33 experts. The resulting value of 0.91, which falls within the acceptable range of greater than 0.7, as referenced by Landa Cavazos and Ramírez Sánchez (2018), confirms the instrument's internal consistency, allowing for further application (Table 7).

Table 7. Cronbach's alpha coefficient

Instrument Reliability	
Cronbach's alpha	**No. of elements**
0.91	9

Discussion and Conclusion

With the results obtained and taking into account the proposed objectives of designing and validating a didactic strategy based on the use of gamification in e-learning contexts, it was evident that it is necessary to continue studying and improving gamified practice, corroborating this postulate with what Khaldi et al. (2023) claim, where they emphasize that there is no consolidation of what is the best way to apply the strategy. Therefore, it is unavoidable to continue investigating the effects of gamification in the university environment. According to this background, for the design of the strategy, it was necessary to involve the Edu-Game model and integrate the elements of the game in the learning process in a general way, avoiding its isolated use, incorporating formative assessment into teaching

approaches, avoiding oversimplification by limiting itself to the delivery of badges, points or levels only, and clarifying the terminology used in this context (Vázquez Ramos, 2021).

Katherin et al. (2020) express that incorporating gamification in educational environments presents a considerable challenge since it involves designing academic environments that integrate elements consistent with pedagogical projects and effectively stimulate positive results in the teaching and learning processes. In this context, the model had a constructivist and behaviorist approach because this will allow it to be adapted to different learning styles and previous experiences, creating dynamic and interactive environments focused on the student (Sánchez-Pacheco et al., 2020).

In the validation of the strategy, it was essential to have "experience in managing virtual classrooms" as one of the main expert selection criteria, even though they had not had experience using gamification. However, this contributed significantly to the results since the judgment issued by the experts was in accordance with their expertise in virtual environments. Cabero-Almenara et al. (2021) mention that, in applying expert judgment, various challenges arise, including the selection of participants and the possibility that a person may be an expert in certain aspects but not others.

To obtain a more objective approach to the perceptions of each of the experts, it was necessary to know the level of the knowledge coefficients (Kc) and argumentation coefficients (Ka), resulting in them being high and significant, which gives value and relevance to the criteria provided by the participants. Based on the postulates of Cisneros-Barahona et al. (2023), carrying out the knowledge level test of the knowledge coefficients (Kc) and argumentation coefficients (Ka) in validation by expert judgment is crucial to guarantee competence. Moreover, the quality of the selected experts will be improved, and the reliability and validity of the validation process results will be improved.

In the content validation of the nine items, six obtained a weight greater than 0.8, representing validity and agreement, and no changes were made within the proposal; however, in three items, a result below 0.8 was generated, and they were modified regarding the narrative of the story of Pirate Morgan and updating of activities with their level of complexity per level. According to Hernández-Nieto (2002, as cited in Sánchez, 2021), content validity is achieved when an evaluation or measurement instrument wholly and adequately covers all the relevant dimensions of the construct it intends to measure. This concept is guaranteed through a rigorous process that includes the precise definition of the construct, the generation of representative and exhaustive items, evaluation by experts, and continuous review of the instrument (Sánchez, 2021).

Furthermore, the high Cronbach's alpha coefficient underlines the solidity of the instrument used and strengthens the validity of the results derived from evaluating the teaching strategy with gamification. This finding is crucial to advancing the understanding and practical application of innovative methodologies in higher education.

Finally, it can be concluded that the study and improvement of gamified strategies in virtual educational environments is an ongoing and important challenge. It is evident that teachers must continue to train comprehensively in the use of technological tools to be able to implement strategies that adapt to the needs of the students.

This research has not only contributed to theoretical and methodological advancement in the fields of higher education and gamification but has also provided clear guidelines for future research and practical applications, significantly benefiting the scientific and educational community in general.

LIMITATIONS

Although the research was conducted with the utmost scientific rigor, some limitations have been detected that could be improved in future research. The validation process focused only on the Delphi method without incorporating an empirical application phase with students that would allow for demonstrating the real impact of the gamified strategy in e-learning contexts.

Another important limitation lies in the specificity of the context in which the research was developed, which may affect the generalizability of the findings to other institutions or educational modalities. Likewise, although a mixed approach was used, the predominance of qualitative techniques restricts the possibility of making broader statistical inferences.

In conclusion, the strategy designed is adjusted to a particular virtual environment, implying that its applicability to other platforms or educational levels requires additional adaptation and validation studies to corroborate whether significant results are obtained.

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