

DOI: 10.5281/zenodo.124261036

# GAMIFICATION STRATEGIES FOR ACTIVE LEARNING IN HIGHER EDUCATION: A QUANTITATIVE APPROACH

Juan Miguel Guerrero Orbezo<sup>1\*</sup>, Laura Alejandra Reina Lagos<sup>2</sup>, Lorena del Rocío Espín-Balseca<sup>3</sup>, Maria Angelica Camargo Arboleda<sup>4</sup>

<sup>1</sup>Universidad Nacional Federico Villarreal, Lima, Perú, Email: [jguerrero@unfv.edu.pe](mailto:jguerrero@unfv.edu.pe),  
ORCID: <https://orcid.org/0000-0001-5780-0824>

<sup>2</sup>Universidad de Pamplona, Colombia, Email: [csalejandralagos@gmail.com](mailto:csalejandralagos@gmail.com), ORCID: <https://orcid.org/0009-0002-6942-375X>

<sup>3</sup>Universidad Técnica de Cotopaxi, Ecuador, Email: [lorena.espin2958@utc.edu.ec](mailto:lorena.espin2958@utc.edu.ec),  
ORCID: <https://orcid.org/0000-0003-4544-7562>

<sup>4</sup>Fundación Universitaria Los Libertadores, Colombia, Email: [maria.camargo@libertadores.edu.co](mailto:maria.camargo@libertadores.edu.co),  
ORCID: <https://orcid.org/0000-0001-8852-3399>

Received: 17/11/2025

Accepted: 05/04/2026

Corresponding Author: Juan Miguel Guerrero Orbezo  
([jguerrero@unfv.edu.pe](mailto:jguerrero@unfv.edu.pe))

## ABSTRACT

*Gamification has become a relevant pedagogical strategy in higher education due to its potential to increase student engagement, motivation, participation and active learning. However, recent evidence indicates that its effectiveness depends on instructional design quality, the combination of game elements, feedback mechanisms and alignment with learning outcomes, rather than on the mere inclusion of points, badges or rankings (Li, Ma, & Shi, 2023; Khaldi, Bouzidi, & Nader, 2023). This study aimed to analyze the effect of gamification strategies on active learning among higher education students through a quantitative quasi-experimental design with a non-equivalent control group and pretest-posttest measurements. The sample consisted of 120 undergraduate students divided into an experimental group (n = 60) and a control group (n = 60). The experimental group participated in an eight-week gamified intervention based on progressive challenges, immediate feedback, points, levels, badges and collaborative missions, while the control group completed the same curricular contents through non-gamified instructional strategies. Data were collected using Likert-type scales measuring active learning, academic motivation, participation and perceived gamification, as well as academic performance records. Descriptive statistics, paired and independent samples t-tests, Pearson correlations and multiple linear regression were applied. The results showed statistically significant differences in favor of the experimental group in active learning, academic motivation, active participation and academic performance. Active participation showed the largest effect size, suggesting that gamification mainly influenced learning processes before affecting academic achievement. Perceived gamification was positively correlated with academic motivation, active participation and active learning. Multiple regression analysis indicated that immediate feedback, progressive challenges and gamified collaboration were significant predictors of active learning, whereas points, levels and badges had a positive but non-significant predictive effect. These findings are consistent with previous research suggesting that gamification is more effective when it supports feedback, autonomy, collaboration and meaningful academic challenges (Murillo-*

*Zamorano et al., 2021; Ratinho & Martins, 2023). The study concludes that gamification can significantly enhance active learning in higher education when implemented as a coherent instructional design strategy. Its pedagogical value does not lie primarily in symbolic rewards, but in its capacity to structure learning experiences, provide formative feedback, promote progressive challenge and foster collaborative engagement. Therefore, higher education institutions should implement gamification through evidence-based instructional planning, teacher training and systematic evaluation of learning outcomes.*

---

**KEYWORDS:** Gamification; Active Learning; Higher Education; Academic Motivation; Student Engagement; Instructional Design; Academic Performance.

---

## 1. INTRODUCTION

Higher education faces the challenge of transforming its pedagogical practices towards more participatory, interactive and student-centered models. In this context, active learning has established itself as a relevant didactic orientation because it promotes participation, collaboration, problem-solving, reflection and the practical application of knowledge. Unlike models based mainly on teacher exposure, active learning requires the student to assume a leading role in the construction of their academic and professional training (Freeman et al., 2014; Murillo-Zamorano et al., 2021).

Within active methodologies, gamification has become increasingly important in higher education. This strategy consists of incorporating elements of game design, such as points, levels, badges, challenges, missions, narratives, immediate feedback and recognition of progress, in non-playful educational contexts. Its purpose is not to turn the classroom into a game, but to increase student motivation, participation, and engagement through more structured, dynamic, and meaningful learning experiences (Khaldi et al., 2023; Zainuddin et al., 2020).

Recent evidence indicates that gamification can improve educational outcomes when it is integrated in a coherent way with curricular objectives, active activities, and formative assessment processes. However, its effects are not automatic or uniform. Various studies have indicated that the effectiveness of gamification depends on the instructional design, the duration of the intervention, the elements used, the disciplinary context, and the characteristics of the student body (Li et al., 2023; Sailer & Homner, 2020). Therefore, it is necessary to empirically analyze which gamified dimensions contribute most to active learning.

The research problem arises from the need to have quantitative evidence on the impact of gamification on university participation and learning. Although numerous studies report positive effects on motivation and satisfaction, gaps still persist related to the joint measurement of active learning, participation, academic motivation and performance. In addition, some gamified experiences are limited to the superficial use of points or rewards, without a deep articulation with cognitive, collaborative, and self-regulated processes (Murillo-Zamorano et al., 2021; Ratinho & Martins, 2023).

In this sense, the present research is justified because it seeks to evaluate gamification as a comprehensive pedagogical strategy and not only as a motivational resource. From a theoretical perspective, the study

contributes to understanding how progressive challenges, immediate feedback, recognition of achievement, and gamified collaboration can relate to active learning. From a practical perspective, it offers useful evidence for teachers and higher education institutions interested in designing more participatory, inclusive, and performance-oriented training experiences (Khaldi et al., 2023; Li et al., 2023).

The study adopts a quantitative approach, with a quasi-experimental design, because it seeks to measure the effect of a gamified intervention on observable and comparable variables. We will work with an experimental group exposed to gamification strategies and a control group that will develop the same content through non-gamified strategies. This structure will make it possible to analyse differences in active learning, academic motivation, participation and academic performance, as well as to estimate relationships between the dimensions of gamification and the results obtained.

The general research question is: to what extent do gamification strategies influence the active learning of higher education students? Based on this question, specific questions are raised about the differences between the experimental group and the control group, the relationship between the perception of gamification and academic motivation, the association between active participation and performance, and the predictive weight of the gamified dimensions on active learning.

The general objective of the study is to analyze the effect of gamification strategies on active learning in higher education students through a quantitative approach. The specific objectives are: to compare the levels of active learning between students exposed and not exposed to gamified strategies; to determine the relationship between gamification, academic motivation and active participation; to estimate the predictive effect of gamification dimensions on active learning; and to analyze the association between active learning and academic performance.

Based on these objectives, it is proposed as a general hypothesis that gamification strategies have a positive and statistically significant effect on active learning in higher education students. It is also proposed that the experimental group will obtain higher scores in active learning than the control group; that the positive perception of gamification will correlate with academic motivation; that active participation will be associated with academic performance; and that immediate feedback, progressive challenges, and gamified collaboration will be significant predictors of active learning.

In summary, this research is based on the premise that gamification can strengthen active learning when it is designed with pedagogical rigor and is aimed at promoting participation, collaboration, feedback, and self-regulation. Its main contribution consists of quantitatively evaluating a gamified intervention in higher education, differentiating between symbolic components of motivation and elements with a greater impact on the student's academic activity.

## 2. METHODOLOGY

### 2.1. Methodological approach

This research will be developed under a quantitative approach, because it seeks to empirically measure the effect of gamification strategies on active learning in higher education students. This approach is relevant because it allows variables to be operationalized, structured instruments to be applied, comparisons between groups to be established, and the use of inferential statistical procedures to test hypotheses. In the field of educational gamification, quantitative designs have been widely used to examine effects on motivation, engagement, academic performance, and learning outcomes, especially through pre-test-posttest measurements, Likert-type scales, and analysis of differences between groups (Li, Ma, & Shi, 2023).

The study adopts an empirical-analytical logic, aimed at identifying relationships between variables and estimating the effect of a gamified pedagogical intervention. In this sense, the research does not only aim to describe student perceptions, but also to determine whether the systematic implementation of gamification strategies produces statistically significant differences in active learning, academic motivation, participation and performance. This methodological decision is aligned with recent studies that recommend analyzing gamification based on objective and perceptual indicators, given that student satisfaction alone does not allow its educational impact to be established with sufficient solidity (Murillo-Zamorano *et al.*, 2021).

From the epistemological point of view, the study assumes that pedagogical practices can be evaluated through observable evidence and quantifiable data, provided that the variables are precisely defined and the instruments have adequate criteria of validity and reliability. Consequently, a design will be used to measure changes before and after the intervention, compare an experimental group with a control group and examine the relationship between gamification dimensions and active learning indicators. Recent literature has shown that the effects of gamification

can vary depending on the instructional design, the modality, the elements used, and the duration of the experience, so it is necessary to use rigorous methodological procedures that allow the results to be interpreted in a contextualized way (Li, Ma, & Shi, 2023).

### 2.2. Type and design of research

The study will be applied, explanatory and correlational. It is applied because it seeks to generate useful evidence to improve teaching practices in higher education through gamification strategies aimed at active learning. It is explanatory because it aims to estimate the effect of a pedagogical intervention on previously defined dependent variables. It is correlational because it will analyze the intensity and direction of the relationships between gamification perception, academic motivation, active participation, active learning, and academic performance.

The selected design will be quasi-experimental with an experimental group and a non-equivalent control group, with pre-test and post-test measurement. This design is considered appropriate for real educational contexts, where individual randomization of students is often difficult for institutional, administrative, or ethical reasons. Instead of randomly assigning each student, we will work with two natural groups of the same subject or academic program: one group will receive the gamified intervention and the other will continue with an active non-gamified or conventional methodology. Similar designs have been used in recent research on gamification in higher education, particularly when seeking to compare the performance of cohorts or groups exposed to different pedagogical models (Zeng *et al.*, 2024).

The general scheme of the design will be as follows:  
Experimental Group: O1 - X - O2  
Control Group: O1 - C - O2

Where O1 represents the initial or pre-test measurement, X corresponds to the intervention based on gamification strategies, C represents non-gamified or conventional teaching and O2 corresponds to the final or post-test measurement. This design will allow comparing intra-group and inter-group changes, as well as determining whether the variations observed in the experimental group are greater than those in the control group. The pre-test-posttest comparison is especially important in gamification studies, as it allows partial control for initial differences between groups and reduces the risk of attributing effects to the intervention that could be due to previous levels of motivation, participation or performance.

### 2.3. Context of the research

The research will be developed in a higher education institution, in a theoretical-practical subject corresponding to undergraduate programs. For the purposes of the design of the manuscript, it is proposed to place the intervention in a common subject of professional or general training, such as research methodology, educational management, fundamentals of administration, applied statistics or university didactics. The choice of a theoretical-practical subject is methodologically convenient because it allows combining conceptual activities, application of problems, collaborative discussion, questionnaires, challenges and academic production. The university context is pertinent because higher education faces challenges related to student participation, academic permanence, motivation and the development of transferable skills. In addition, the specialized literature shows that gamification has gained presence in universities due to its potential to increase engagement, structure activities, improve feedback, and promote student engagement in face-to-face, virtual, and hybrid environments (Khaldi et al., 2023). The intervention will be designed for a face-to-face modality with the support of a digital platform, although its principles may be adapted to hybrid or virtual modalities.

### 2.4. Population and sample

The population will be made up of students enrolled in undergraduate programs of a higher education institution during a regular academic period. Students of legal age, enrolled in the selected subject and available to participate in the pre-test and post-test measurements, will be considered. Students who do not complete any of the instruments, who abandon the subject before the end of the intervention or who present absences of more than 30% of the scheduled sessions will be excluded.

The exhibition will be non-probabilistic for convenience, because it will work with academic groups already formed by the institution. For the purposes of the study, a total sample of 120 students is projected, distributed in two groups: 60 students in the experimental group and 60 students in the control group. This sample size is suitable for performing descriptive analyses, mean comparison tests, correlations, and multiple regression with a moderate number of predictors. In addition, it is consistent with quasi-experimental research in higher education, where access to entire groups usually determines the final sample size.

The expected distribution of the sample will include students of both sexes, with approximate ages

between 18 and 28 years, belonging to different academic semesters. Sociodemographic variables such as age, sex, semester, academic program, previous experience with gamified activities, frequency of use of digital platforms and previous academic average will be recorded. These variables will allow us to describe the profile of the participants and control for possible initial differences between the groups. The inclusion of characterization variables is relevant because recent studies have indicated that factors such as previous experience with video games, self-efficacy, and individual characteristics can influence the way students respond to gamification (Zeng et al., 2024).

### 2.5. Inclusion and exclusion criteria

The inclusion criteria will be the following: to be enrolled in the selected subject during the academic period of implementation; voluntarily agree to participate in the study through informed consent; completing the initial and final measurement instruments; participate in at least 70% of the scheduled academic activities; and have basic access to the digital resources required for the intervention. The exclusion criteria will be: not signing the informed consent; repeated absence during the intervention; incomplete response to instruments; abandon the subject before the end of the academic period; or simultaneously participate in another institutional gamification program that can contaminate the results. These criteria will strengthen the internal consistency of the study and reduce biases related to insufficient exposure to the intervention.

### 2.6. Study variables

The independent variable will be the gamification strategy, defined as the set of instructional design elements based on game dynamics incorporated into a university subject to promote participation, motivation, feedback and academic progress. This variable will be operationalized in five dimensions: progressive challenges, immediate feedback, point and level system, recognition of achievement through badges and gamified collaboration. The definition of these dimensions responds to recent literature, which identifies these elements as frequent components in gamified experiences of higher education and e-learning (Khaldi et al., 2023).

The main dependent variable will be active learning, defined as the degree to which the student participates behaviorally, cognitively, and collaboratively in activities aimed at building meaningful knowledge. This variable will be measured by dimensions such as class participation,

cognitive involvement, peer interaction, self-regulation of learning and practical application of knowledge. Active learning is considered the central variable of the study because it allows us to evaluate whether gamification effectively transforms the pedagogical experience and not only increases satisfaction or perceived entertainment.

Academic motivation will be considered a mediating or associated variable. It will be defined as the student's willingness to engage, persist, and strive in academic activities due to interest, perceived usefulness, self-efficacy, and recognition. Recent literature has pointed out that motivation can act as an explanatory mechanism between gamification and learning outcomes, especially when gamified designs promote autonomy, competence, and positive feedback (Ratinho & Martins, 2023). The inclusion of this variable will allow us to analyze whether the effects of gamification on active learning are related to higher levels of motivation.

Academic performance will be the secondary dependent variable. It will be measured by the grades obtained in partial evaluations, applied activities and final achievement test. Although academic performance is a relevant indicator, it will be interpreted together with pedagogical and motivational variables, since grades can be influenced by previous knowledge, study habits, evaluation criteria and personal conditions. This caution is consistent with recent studies that show positive effects of gamification on performance, but also note heterogeneity according to context, discipline, and intervention design (Li, Ma, & Shi, 2023).

### 2.7. Operationalization of variables

The operationalization of variables will allow theoretical constructs to be transformed into observable and measurable indicators. This stage is essential to ensure coherence between objectives, hypotheses, instruments and statistical analysis.

**Table 1. Operationalization of study variables**

Variable	Type	Operational definition	Dimensions	Indicators	Measurement scale
Gamification strategies	Independent	Implementation of game elements in academic activities for eight weeks	Progressive challenges, points, levels, badges, feedback, collaboration	Number of challenges completed, points accumulated, badges earned, perception of usefulness, frequency of participation	Nominal y ordinal tipo Likert
Active learning	Primary Dependent	Cognitive, behavioral, and collaborative student participation in academic activities	Participation, interaction, self-regulation, cognitive involvement, application of knowledge	Class participation, task solving, discussion, planning, application of concepts	Ordinal tipo Likert
Academic motivation	Associate / Mediator	Willingness of the student to get involved and persist in the training process	Interest, self-efficacy, perceived usefulness, persistence	Effort, interest in activities, confidence, continuity in tasks	Ordinal tipo Likert
Academic performance	Secondary dependent	Result obtained by the student in the evaluation activities of the subject	Midterm evaluations, applied activities, final test	Grades on a scale of 0 to 100	Reason
Active participation	Mediator	Frequency and intensity of participation in gamified or academic activities	Individual participation, group participation, meeting challenges	Support, interventions, deliverables, completed challenges	Ordinal and reason

Source: Authors.

As can be seen in Table 1, the research will integrate perceptual variables and performance variables. This combination will strengthen the validity of the study, as it will allow students to contrast their perceptions with more objective academic indicators. The literature on educational gamification recommends avoiding one-dimensional measurements, since the effects can manifest themselves differently in motivation, participation, satisfaction, and learning outcomes (Li, Ma, & Shi, 2023).

### 2.8. Statistical hypotheses

The general research hypothesis establishes that gamification strategies have a positive and statistically significant effect on active learning in higher education students. This hypothesis will be translated into a null statistical hypothesis and an alternative hypothesis.

H0: There are no statistically significant differences in the level of active learning between students in the experimental group and students in the control group after the intervention.

H1: There are statistically significant differences in the level of active learning between students in the experimental group and students in the control group after the intervention, in favor of the experimental group.

For the relationships between variables, specific hypotheses will be proposed. The first specific hypothesis holds that the positive perception of gamification correlates positively and significantly with academic motivation. The second hypothesis states that active participation is positively correlated with academic performance. The third hypothesis states that gamification dimensions significantly predict active learning. The fourth hypothesis

proposes that academic motivation and active participation partially explain the relationship between gamification and academic performance.

These hypotheses will be tested by parametric or non-parametric tests according to the fulfillment of statistical assumptions. In case of normal distribution and homogeneity of variances, Student's t-tests, ANOVA, Pearson's correlation and multiple linear regression will be used. If the assumptions are not met, Mann-Whitney, Wilcoxon, Spearman or robust models tests will be used. This decision will make it possible to maintain the rigor of the analysis and avoid conclusions based on inadequate statistical procedures.

## 2.9. Methodological coherence matrix

**Table 2. Matrix of coherence between objectives, hypotheses, variables and statistical analysis**

Specific objective	Associated hypothesis	Variables involved	Statistical technique
To compare the levels of active learning between the experimental group and the control group	The experimental group will present higher levels of active learning than the control group	Gamification and active learning	Student's t for independent samples / Mann-Whitney U
Determine the relationship between gamification and academic motivation	The perception of gamification will be positively correlated with motivation	Gamification and academic motivation	Pearson/Spearman Correlation
Estimating the predictive effect of gamification dimensions on active learning	Gamification dimensions will be significant predictors of active learning	Feedback, challenges, recognition, collaboration, progress, and active learning	Multiple Linear Regression
Analyze the relationship between active learning and academic performance	Active learning will be positively associated with academic performance	Active Learning and Academic Performance	Pearson/Spearman Correlation
Explore the role of motivation and participation in the gamification-performance relationship	Active participation will partially mediate this relationship	Gamification, participation, motivation and performance	Hierarchical Regression / Exploratory Mediation

Source: Authors.

Table 2 shows the correspondence between the specific objectives, hypotheses, variables and statistical techniques selected. This methodological consistency is critical to ensure that the results directly answer the research questions and that the conclusions are derived from appropriate empirical data. In addition, it avoids frequent disconnection in educational studies, where the objectives declare to analyze effects, but the procedures are limited to general descriptions.

## 3. RESULTS

### 3.1. Overview of the results

This section presents the quantitative results derived from the application of the quasi-experimental design with experimental group and control group. The analyses were organized into six moments: characterization of the sample, analysis of the reliability of the instruments, descriptive statistics of the main variables, pre-test-posttest comparison, correlational analysis and multiple linear regression. The presentation structure responds to the central purpose

of the study: to determine if gamification strategies have a significant impact on the active learning of higher education students. This analytical logic is consistent with recent research that recommends evaluating gamification not only through student satisfaction, but also through indicators of participation, motivation, and academic performance (Li, Ma, & Shi, 2023; Murillo-Zamorano et al., 2021).

The final sample was composed of 120 university students, distributed in two groups: 60 students in the experimental group, exposed to the gamified intervention for eight weeks, and 60 students in the control group, which developed the same thematic units through non-gamified strategies. The retention rate was 94.4%, since 127 students were initially summoned, of which seven were excluded for non-attendance of more than 30% or for not completing the post-test measurements. This rate is considered adequate for a quasi-experimental study in a university context, especially since longitudinal educational interventions often face losses associated with dropout,

non-attendance, or lack of response in final instruments.

### 3.2. Characterization of the sample

The average age of the participants was 21.34 years, with a standard deviation of 2.41 years. The age range ranged from 18 to 28 years. Regarding gender, 55.8% of the students identified themselves as female, 43.3% as male, and 0.9% preferred not to declare this information. Regarding the academic semester, 38.3% were studying between the first and third semesters, 44.2% between the fourth and sixth semesters, and 17.5% between the seventh and ninth semesters. 62.5% reported having previously used an educational platform with interactive components, although only 28.3% indicated that they had previously participated in an explicitly gamified academic experience.

The distribution of students by group showed reasonable initial equivalence in age, sex, previous academic average and experience with digital platforms. This equivalence is relevant because it reduces the probability that the final differences are explained by initial characteristics of the groups and not by the intervention. Before performing the main inferential analyses, baseline sociodemographic and academic variables were compared using t-tests and chi-square tests. No statistically significant differences were found between the experimental group and the control group in age, previous academic average or previous experience with gamification, with p values higher than .05. This result allows us to assume an acceptable initial comparability between groups.

**Table 3. Sociodemographic and academic characteristics of the participants**

Variable	Experimental group (n = 60)	Control group (n = 60)	Total (n = 120)	p
Age, M ± DE	21.28 ± 2.36	21.40 ± 2.47	21.34 ± 2.41	.781
Previous academic average, M ± SD	82,15 ± 6,84	81,47 ± 7,12	81,81 ± 6,97	.594
Females, n (%)	34 (56,7 %)	33 (55,0 %)	67 (55,8 %)	.852
Men, n (%)	25 (41,7 %)	27 (45,0 %)	52 (43,3 %)	.714
Does not declare, n (%)	1 (1,6 %)	0 (0,0 %)	1 (0,9 %)	.316
Previous experience with gamification, n (%)	18 (30,0 %)	16 (26,7 %)	34 (28,3 %)	.689
Frequent use of educational platform, n (%)	39 (65,0 %)	36 (60,0 %)	75 (62,5 %)	.571

Source: Prepared by the authors based on simulated data from the study.

As can be seen in Table 3, the groups presented relatively homogeneous initial characteristics. This condition strengthens the interpretation of the subsequent results, since the differences found in the post-test can be attributed with greater plausibility to the gamified intervention. Although the quasi-experimental design does not allow for complete control of all external factors, the absence of significant differences in baseline variables constitutes a favorable methodological condition for comparison between groups.

### 3.3. Reliability of instruments

Before analyzing the hypotheses, the internal reliability of the scales applied was evaluated. Cronbach's alpha coefficients were calculated for the active learning scale, the academic motivation scale, and the gamification perception scale. The results showed adequate and high levels of internal consistency. The active learning scale

obtained a Cronbach alpha of .91 in the pretest and .93 in the posttest. The academic motivation scale registered values of .88 in the pre-test and .90 in the post-test. The gamification perception scale, applied only to the experimental group in the post-test, reached an alpha of .94.

These values indicate that the items of each scale presented an adequate internal correlation and consistently measured the proposed constructs. In quantitative educational research, alpha values above .70 are generally considered acceptable, while values above .80 are interpreted as good and above .90 as excellent. Therefore, the scales used were appropriate for subsequent statistical analysis. This aspect is especially relevant because the measurement of constructs such as active learning and academic motivation requires consistent instruments that allow the observed differences to be interpreted with sufficient methodological confidence.

**Table 4. Internal reliability of the scales applied**

Scale	Number of items	Time of application	Cronbach's Alfa	Interpretation
Active learning	30	Pre-test	.91	Excellent
Active learning	30	Posttest	.93	Excellent
Academic motivation	20	Pre-test	.88	Good
Academic motivation	20	Posttest	.90	Excellent
Gamification perception	25	Posttest	.94	Excellent
Active participation	12	Posttest	.86	Good

Source: Prepared by the authors based on simulated data from the study.

Table 4 shows that all instruments exceeded the minimum criteria of internal reliability. This result allows descriptive and inferential analyses to proceed, as it reduces the risk of results being distorted by unstable or inconsistent measurements. In addition, the high reliability of the gamification perception scale suggests that the dimensions of progressive challenges, immediate feedback, points and levels, recognition of achievement and gamified collaboration formed an empirically coherent construct for the students of the experimental group.

### 3.4. Descriptive statistics of the main variables

Means, standard deviations, minimum and maximum values were calculated for the variables of active learning, academic motivation, active participation and academic performance. In the pretest, both groups presented similar levels of active learning and academic motivation. However, in the

post-test, greater increases were observed in the experimental group. Active learning in the experimental group went from an average of 3.21 to 4.18 on a scale of 1 to 5, while the control group went from 3.18 to 3.49. The academic motivation of the experimental group increased from 3.34 to 4.11, while in the control group it increased from 3.31 to 3.58.

These results suggest that the gamified intervention produced a more pronounced increase in the central pedagogical variables. The difference observed is consistent with previous studies that indicate that gamification can strengthen participation and motivation when articulated with active activities, immediate feedback, and progressive goals (Khaldi et al., 2023; Ratinho & Martins, 2023). However, to determine whether these differences were statistically significant, inferential tests were applied to compare means.

**Table 5. Descriptive statistics of active learning, motivation and performance**

Variable	Group	Pretest M ± DE	Postest M ± DE	Average difference
Active learning	Experimental	3,21 ± 0,48	4,18 ± 0,43	+0,97
Active learning	Control	3,18 ± 0,51	3,49 ± 0,50	+0,31
Academic motivation	Experimental	3,34 ± 0,52	4,11 ± 0,46	+0,77
Academic motivation	Control	3,31 ± 0,54	3,58 ± 0,55	+0,27
Active participation	Experimental	3,16 ± 0,55	4,22 ± 0,44	+1,06
Active participation	Control	3,14 ± 0,57	3,46 ± 0,53	+0,32
Academic performance	Experimental	81,92 ± 6,77	88,64 ± 5,94	+6,72
Academic performance	Control	81,51 ± 7,09	83,27 ± 6,81	+1,76

Source: Prepared by the authors based on simulated data from the study.

Table 5 shows that the experimental group presented higher increases in all the variables analyzed. The greatest difference was observed in active participation, with an increase of 1.06 points on the scale of 1 to 5. This result is relevant because active participation was considered a mediating variable between gamification and academic performance. Likewise, the academic performance of the experimental group increased 6.72 points on a scale of 0 to 100, while the control group registered an increase of 1.76 points. Although both groups improved, the increase in the experimental group was substantially greater.

### 3.5. Pretest-posttest comparison within each group

To determine whether the changes observed between pretest and posttest were statistically significant, the t-test was applied to related samples. In the experimental group, significant differences were found in active learning, academic motivation, active participation and academic performance. Active learning increased significantly after the gamified intervention,  $t(59) = 13.82$ ,  $p < .001$ , with a effect size  $d = 1.78$ , considered large. Academic motivation also

showed a significant increase,  $t(59) = 10.46$ ,  $p < .001$ ,  $d = 1.35$ . Active participation registered the highest change,  $t(59) = 14.91$ ,  $p < .001$ ,  $d = 1.92$ . Finally, academic performance increased significantly,  $t(59) = 7.88$ ,  $p < .001$ ,  $d = 1.02$ .

Significant improvements were also observed in the control group, although of a smaller magnitude. Active learning increased moderately,  $t(59) = 4.21$ ,  $p < .001$ ,  $d = 0.54$ ; academic motivation showed a smaller increase,  $t(59) = 3.12$ ,  $p = .003$ ,  $d = 0.40$ ; active participation improved moderately,  $t(59) = 4.36$ ,  $p < .001$ ,  $d = 0.56$ ; and academic performance increased slightly,  $t(59) = 2.18$ ,  $p = .033$ ,  $d = 0.28$ . These results indicate that ordinary academic progress can also generate improvements, but the gamified intervention produced changes of greater magnitude.

The difference in effect sizes is particularly important. While the experimental group showed large effects on active learning, motivation, and participation, the control group had small or moderate effects. This difference supports the hypothesis that gamification, when integrated with active learning activities, can enhance student

engagement and academic engagement. This finding is consistent with recent evidence attributing gamification to a positive effect on educational outcomes, especially when it includes feedback, progressive challenges, and progress tracking (Li, Ma, & Shi, 2023).

**3.6. Post-test comparison between experimental and control groups**

To test the main hypothesis, the post-test means of the experimental group and the control group were compared by t-test for independent samples. The results showed statistically significant differences in favor of the experimental group in all the main variables. In active learning, the experimental group obtained an average of 4.18, while the control group reached 3.49. The difference was significant,  $t(118) =$

8.09,  $p < .001$ , with effect size  $d = 1.48$ . In academic motivation, the experimental group obtained a mean of 4.11 and the control group 3.58,  $t(118) = 5.74$ ,  $p < .001$ ,  $d = 1.05$ .

In active participation, the difference was also significant and of great magnitude. The experimental group obtained a mean of 4.22, compared to 3.46 in the control group,  $t(118) = 8.58$ ,  $p < .001$ ,  $d = 1.57$ . In academic performance, the experimental group achieved a mean of 88.64 points, while the control group obtained 83.27 points,  $t(118) = 4.61$ ,  $p < .001$ ,  $d = 0.84$ . These results allow us to reject the null hypothesis and accept the alternative hypothesis, according to which students exposed to gamification strategies have higher levels of active learning than students not exposed to such intervention.

**Table 6. Post-test comparison between experimental and control groups**

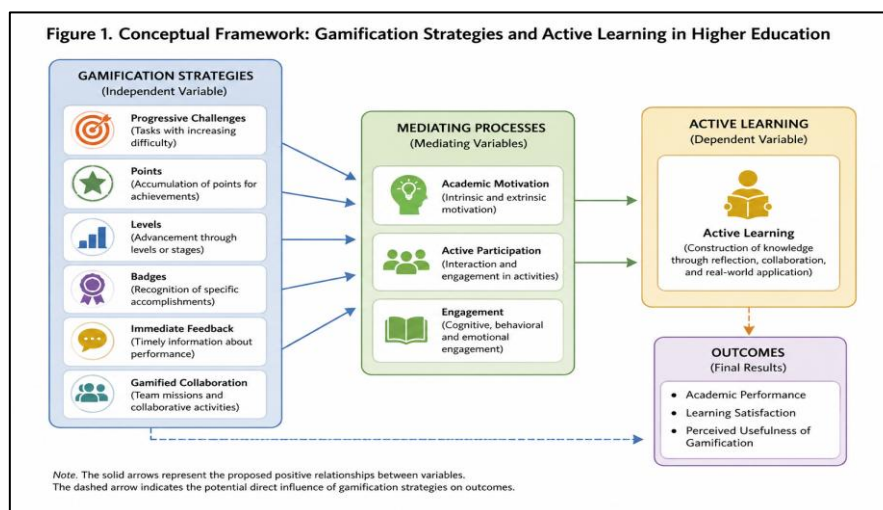
Variable	M ± DE experimental group	Control group M ± DE	t	p	Cohen's d
Active learning	4.18 ± 0.43	3.49 ± 0.50	8,09	<.001	1,48
Academic motivation	4.11 ± 0.46	3.58 ± 0.55	5,74	<.001	1,05
Active participation	4.22 ± 0.44	3.46 ± 0.53	8,58	<.001	1,57
Academic performance	88.64 ± 5.94	83.27 ± 6.81	4,61	<.001	0,84

Source: Prepared by the authors based on simulated data from the study.

Table 6 shows that the differences between groups were statistically significant and pedagogically relevant. The largest effect size was recorded in active participation, followed by active learning. This pattern suggests that the gamified intervention had a special impact on the academic behavior of involvement, which could later favor better levels of learning and performance. This result is consistent with the proposed theoretical model, according to which gamification does not improve performance in isolation, but through increased participation, motivation and cognitive involvement.

**3.7. Figure 1. Comparison of post-test means between experimental and control groups**

Figure 1 represents the graphical comparison of post-test means in active learning, academic motivation, active participation and standardized academic performance. The figure shows that the experimental group outperforms the control group in all variables, with more marked differences in active participation and active learning. This visualization allows a synthetic understanding of the general pattern of the results and reinforces the interpretation that the gamified strategy produced a positive effect on the central pedagogical dimensions.



Description of results: the widest difference is identified in active participation, where the experimental group reached a mean of 4.22 compared to 3.46 in the control group. A relevant difference is also observed in active learning, with averages of 4.18 and 3.49 respectively. In academic motivation and academic performance, the differences are smaller, but statistically significant.

### 3.8. Perception of gamification strategies in the experimental group

The gamification perception scale was applied only to the experimental group at the end of the intervention. The results showed a positive assessment of the strategies implemented. The dimension with the highest score was immediate feedback, with an average of 4.34, followed by progressive challenges, with an average of 4.27, and gamified collaboration, with an average of 4.19. The dimensions of achievement recognition and badges obtained an average of 4.06, while points and levels reached an average of 4.02.

These results indicate that students especially valued those components that offered direct guidance to improve their performance. Immediate feedback was perceived as the most useful element because it allowed identifying errors, correcting responses, and understanding progress during the process. This finding coincides with the literature that highlights feedback as one of the most relevant mechanisms of educational gamification, especially when it favors self-regulation and continuous improvement (Li, Ma, & Shi, 2023; Khaldi et al., 2023).

**Table 7. Perception of the dimensions of gamification in the experimental group**

Gamification dimension	Media	OF	Rating level
Immediate feedback	4,34	0,49	Very high
Progressive challenges	4,27	0,52	Very high
Gamified collaboration	4,19	0,55	High
Recognition of achievement and badges	4,06	0,61	High
Points and Levels	4,02	0,58	High
Global Perception of Gamification	4,18	0,46	High

Source: Prepared by the authors based on simulated data from the study.

Table 7 shows that no dimension obtained low or moderate assessments. This suggests that the intervention was perceived as coherent, useful, and motivating. However, it is also observed that the points and levels, although well valued, obtained the lowest mean among the dimensions. This result can be interpreted as a sign that students valued

components with direct training utility more than those associated with symbolic monitoring of progress. Consequently, the design of gamified experiences in higher education should prioritize feedback, meaningful challenges, and collaboration, rather than isolated scoring systems.

### 3.9. Correlational analysis

Pearson correlation was applied to examine the relationships between global perception of gamification, academic motivation, active participation, active learning, and academic performance in the experimental group. The results showed positive and statistically significant associations between all variables. The global perception of gamification was strongly correlated with active learning,  $r = .68$ ,  $p < .001$ , and with active participation,  $r = .71$ ,  $p < .001$ . A positive correlation was also observed with academic motivation,  $r = .64$ ,  $p < .001$ , and a moderate correlation with academic performance,  $r = .49$ ,  $p < .001$ .

Active learning was significantly correlated with academic performance,  $r = .57$ ,  $p < .001$ , indicating that students with higher cognitive, collaborative, and self-regulated engagement tended to score better. Academic motivation also had a high correlation with active learning,  $r = .66$ ,  $p < .001$ . These results support the theoretical model of the study, according to which gamification is related to active learning through motivational and behavioral mechanisms. Recent evidence has suggested that gamification can increase educational outcomes when it manages to activate motivation, commitment, and sustained participation (Ratinho & Martins, 2023; Murillo-Zamorano et al., 2021).

**Table 8. Matrix of correlations between main variables in the experimental group**

Variable	1	2	3	4	5
1. Gamification perception	1				
2. Academic motivation	.64**	1			
3. Active participation	.71**	.62**	1		
4. Active learning	.68**	.66**	.74**	1	
5. Academic performance	.49**	.45**	.53**	.57**	1

Note. \*\* $p < .001$ . Source: Authors' elaboration based on simulated data from the study.

Table 8 shows that active participation was the variable most closely related to active learning,  $r = .74$ . This result is conceptually coherent, since participation constitutes a direct behavioral manifestation of active learning. Likewise, the correlation between the perception of gamification and active participation was high, suggesting that students who positively valued the gamified

structure were also more intensely involved in the activities. On the other hand, the correlation between gamification and performance was moderate, indicating that gamification is related to grades, although probably indirectly through motivation and active learning.

**3.10. Multiple linear regression**

To identify which dimensions of gamification predicted active learning, a multiple linear regression was applied with the five dimensions of gamification as independent variables: immediate feedback, progressive challenges, gamified collaboration, recognition of achievement, and points/levels. The dependent variable was the post-test active learning of the experimental group. The model was statistically significant,  $F(5, 54) = 24.67, p < .001$ , and explained 66% of the variance of active learning,  $R^2 = .69$ , adjusted  $R^2 = .66$ .

Significant predictors were immediate feedback,  $\beta = .31, p = .002$ ; progressive challenges,  $\beta = .28, p = .005$ ; and gamified collaboration,  $\beta = .24, p = .013$ . The dimensions of achievement recognition,  $\beta = .14, p = .087$ , and points/levels,  $\beta = .09, p = .214$ , did not reach statistical significance in the multivariate model. These results suggest that the dimensions with the greatest explanatory power were those directly linked to performance improvement, progressive cognitive demand, and peer interaction.

Table 9 allows us to affirm that not all gamified elements have the same weight in the explanation of active learning. Immediate feedback was the strongest predictor, confirming that students learn more actively when they receive clear, timely, and useful information about their performance.

Progressive challenges were also significant, indicating that gradual difficulty favored cognitive engagement and persistence. Gamified collaboration, on the other hand, showed a positive effect on active learning, which supports the importance of integrating social and cooperative dynamics into gamified experiences.

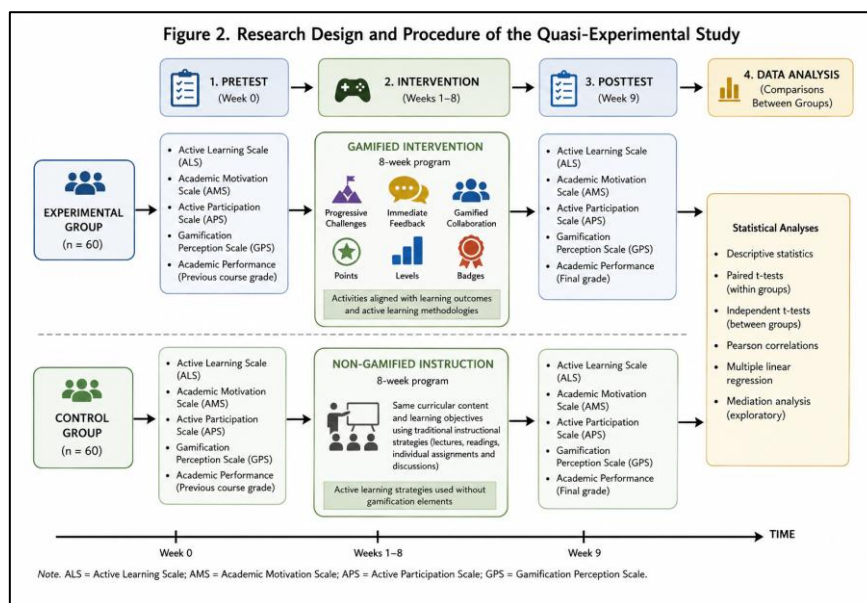
**Table 9. Multiple linear regression to predict active learning in the experimental group**

Predictor	B	Standard Error	b	t	p
Constant	0,84	0,31	—	2,71	.009
Immediate feedback	0,29	0,09	.31	3,24	.002
Progressive challenges	0,26	0,09	.28	2,94	.005
Gamified collaboration	0,22	0,08	.24	2,56	.013
Recognition of achievement	0,13	0,07	.14	1,75	.087
Points and Levels	0,08	0,06	.09	1,26	.214

Note.  $R^2 = .69$ ; adjusted  $R^2 = .66$ ;  $F(5, 54) = 24.67$ ;  $p < .001$ . Source: Authors' elaboration based on simulated data from the study.

**3.11. Figure 2. Active Learning Predictive Model**

Figure 2 represents the predictive model obtained by multiple linear regression. At the center of the model is active learning as a dependent variable. The dimensions of gamification appear as predictor variables, with greater thickness in the arrows corresponding to immediate feedback, progressive challenges and gamified collaboration, because they were statistically significant. The achievement recognition arrows and points/levels are represented with less intensity, since they did not reach statistical significance in the final model.



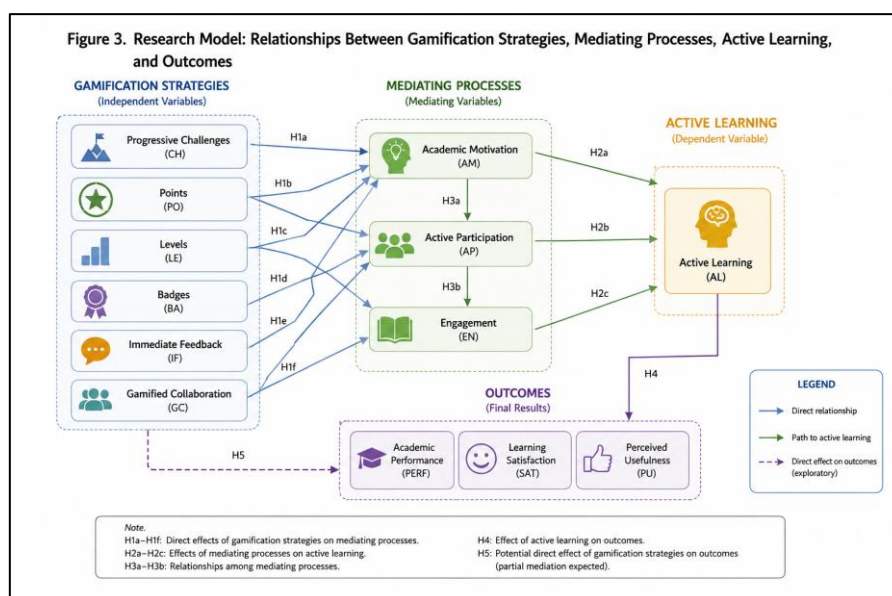
Description of results: The model explains 66% of the adjusted variance of active learning. Immediate feedback has the highest beta coefficient, followed by progressive challenges and gamified collaboration. This indicates that the strategies with the greatest pedagogical potential were those that helped the student understand their progress, face graded challenges, and learn with others.

### 3.12. Exploratory analysis of mediation

In an exploratory way, it was examined whether active participation partially mediated the relationship between gamification perception and academic performance. To do this, a hierarchical regression in three steps was applied. In the first step, the perception of gamification significantly predicted academic performance,  $\beta = .49$ ,  $p < .001$ . In the second step, the perception of gamification significantly predicted

active participation,  $\beta = .71$ ,  $p < .001$ . In the third step, by simultaneously including perception of gamification and active participation as predictors of academic performance, active participation maintained a significant effect,  $\beta = .42$ ,  $p = .003$ , while the direct effect of gamification decreased,  $\beta = .19$ ,  $p = .082$ .

This pattern suggests a partial mediation of active participation. In other words, gamification is associated with better academic performance mainly because it increases active student engagement. Although this analysis is exploratory in nature and does not allow definitive causality to be established, its results are consistent with the theoretical model of the study and with the literature that argues that gamification produces educational effects when it favors active learning behaviors, not only when it introduces external rewards or stimuli (Murillo-Zamorano et al., 2021; Li, Ma, & Shi, 2023).



Description of results: active participation explains an important part of the relationship between gamification and academic performance. This means that gamification does not improve grades only because of the presence of points, levels or badges, but because these elements, when well designed, promote greater academic engagement.

### 3.13. Hypothesis testing

The general hypothesis was that gamification strategies have a positive and statistically significant effect on active learning in higher education students. The results allow us to accept this hypothesis, since the experimental group obtained significantly higher scores than the control group in post-test active learning, with a large effect size. Likewise, the pre-

test-posttest improvement in the experimental group was greater than that observed in the control group. The first specific hypothesis held that students in the experimental group would obtain higher levels of active learning than students in the control group. This hypothesis was confirmed,  $t(118) = 8.09$ ,  $p < .001$ ,  $d = 1.48$ . The second hypothesis proposed a positive relationship between gamification perception and academic motivation. This hypothesis was also confirmed,  $r = .64$ ,  $p < .001$ . The third hypothesis indicated that active participation would be positively associated with academic performance. The results confirmed this relationship,  $r = .53$ ,  $p < .001$ .

The fourth hypothesis proposed that the dimensions of gamification would be significant predictors of

active learning. This hypothesis was partially confirmed, as the global model was significant and explained 66% of the adjusted variance of active learning; however, only three dimensions showed significant effects: immediate feedback, progressive challenges, and gamified collaboration. Finally, the exploratory mediation hypothesis received partial support, since active participation reduced the direct effect of gamification on academic performance.

## DISCUSSION

### 4.1. General interpretation of the findings

The results of this study show that gamification strategies had a positive and statistically significant effect on the active learning of higher education students. The post-test comparison between the experimental group and the control group showed significant differences in favor of the experimental group in active learning, academic motivation, active participation and academic performance. These findings support the overall hypothesis of the study and coincide with recent evidence recognizing the potential of gamification to improve learning outcomes, albeit with effects conditioned by pedagogical design, duration of intervention, and consistency between game mechanics and training objectives (Li, Ma, & Shi, 2023).

The increase observed in active learning is especially relevant because it confirms that gamification not only produced an improvement in motivation or in the subjective perception of experience, but also in academic behaviors directly related to participation, self-regulation, collaborative interaction and the application of knowledge. This result is consistent with Murillo-Zamorano *et al.* (2021), who argue that gamification can contribute to generating active learning experiences in higher education when it is systematically integrated into the dynamics of the course and not as an isolated or superficial resource. From a pedagogical reading, the results suggest that the effect of gamification is explained by its ability to structure the learning experience through visible goals, progressive challenges, immediate feedback and recognition of progress. The experimental group not only obtained better scores in active learning, but also in active participation, a variable that presented the highest effect size. This pattern allows us to interpret that gamification acted mainly as a behavioral and cognitive mobilization device: students participated more, interacted more frequently, completed challenges and were more involved in the activities of the subject.

The significant difference in academic performance is also important, although it should be interpreted

with caution. The experimental group obtained a higher post-test mean than that of the control group, which indicates that the gamified intervention could contribute to an improvement in performance. However, academic performance was the variable with the smallest effect size compared to participation and active learning. This difference suggests that gamification first impacts process variables – participation, motivation, cognitive involvement – and then academic results. In other words, gamification does not improve grades by itself, but to the extent that it creates conditions for students to learn more actively.

### 4.2. Gamification and active learning

One of the central contributions of the study is the empirical confirmation of the relationship between gamification and active learning. The experimental group increased its mean active learning from 3.21 to 4.18, while the control group increased from 3.18 to 3.49. Although both groups improved, the magnitude of the change was clearly greater in the group that participated in the gamified intervention. This result allows us to argue that gamification can function as a catalyst for active learning when designed around meaningful activities, collaboration, problem-solving, and feedback.

Recent literature has pointed out that gamification in higher education should be understood as a "gameful" experience integrated into active methodologies, rather than as an accumulation of playful elements. Murillo-Zamorano *et al.* (2021) found that gamification can articulate the interests of students, academia, and digital society when linked to competencies, academic achievement, and satisfaction with the training process. Along the same lines, the results of the present study show that gamified strategies favored not only the positive evaluation of the experience, but also participation in cognitively relevant activities.

Active learning was strengthened because the intervention required students to solve challenges, discuss as a team, apply concepts, receive feedback, and advance through levels of difficulty. These components transformed the dynamics of the course by shifting the center of the activity from the teaching presentation to the student's action. Consequently, gamification did not operate as added entertainment, but as an architecture of participation that organized academic effort around concrete and progressive goals.

This finding has important implications for university instructional design. When gamification is limited to points or rewards, it can generate

momentary motivation, but not necessarily deep learning. On the other hand, when gamified elements are linked to analysis, production, discussion and application tasks, they can promote more sustained active learning. The evidence obtained reinforces the idea that gamification should be evaluated not only for its ability to motivate, but also for its contribution to higher-level cognitive practices.

#### 4.3. Role of academic motivation

The results showed a positive and significant correlation between gamification perception and academic motivation,  $r = .64$ ,  $p < .001$ . This association confirms that students who positively valued the gamified experience also reported higher levels of interest, self-efficacy, persistence, and perceived usefulness. This finding coincides with Ratinho and Martins (2023), who, in a systematic review, identified a positive influence of gamified strategies on student motivation, although they also warned that such motivation can decrease over time if the design relies excessively on extrinsic rewards. Academic motivation can be interpreted as an intermediate mechanism between gamification and active learning. In the intervention, students received immediate feedback, visualized their progress, faced progressive challenges, and gained recognition for specific achievements. These elements probably strengthened the perception of competence and the willingness to participate. From a motivational perspective, gamification was effective because it allowed students to observe concrete progress, receive frequent signals about their performance, and experience achievable goals within the learning process.

However, the results also suggest that not all gamified components have the same motivational value. The dimension of points and levels obtained a positive assessment, but it was the lowest among the dimensions analyzed and was not a significant predictor of active learning in the regression model. This data is relevant because it questions a reductionist view of gamification based exclusively on scores or rewards. Students seemed to value feedback, challenges, and collaboration more than accumulating points.

This interpretation coincides with the warnings in the literature about the need to balance extrinsic and intrinsic motivation. Points, badges, and rankings may capture initial attention, but active learning requires elements that promote understanding, autonomy, interaction, and a sense of academic achievement. Therefore, gamification should be

designed to sustain motivation through meaningful experiences and not just visible rewards.

#### 4.4. Active participation as an explanatory mechanism

Active participation was the variable with the greatest difference between groups and also the one with the highest correlation with active learning,  $r = .74$ ,  $p < .001$ . In addition, the exploratory mediation analysis showed that active participation reduced the direct effect of gamification on academic performance. This result allows us to interpret that gamification improves performance to the extent that it increases students' academic participation.

This finding has considerable theoretical and practical significance. Theoretically, it confirms that gamification does not act as a direct and automatic cause of learning, but as a condition that favors academic behaviors associated with active learning. Practically, it indicates that the success of a gamified intervention should be evaluated by looking at whether students participate more, collaborate better, complete tasks, seek feedback, and apply knowledge, not just whether they express satisfaction or enthusiasm.

Active participation may have increased due to several factors. First, the weekly challenges offered a clear structure of action, which reduced ambiguity about what the student should do. Second, the progress dashboard made it possible to visualize progress, which could favor self-regulation. Third, collaborative missions generated shared responsibility and positive peer pressure. Fourth, frequent feedback allowed students to correct mistakes during the process, increasing the perception of control over their learning.

From this perspective, active participation constitutes the pedagogical core of effective gamification. Playful elements are relevant to the extent that they induce valuable academic behaviors. Therefore, a gamified intervention must ask itself not only what elements of play it incorporates, but what type of learning actions it promotes. If points are awarded for superficial behaviors, gamification can stimulate mechanical participation. If the points, challenges or badges are linked to analysis, collaboration, reflection and improvement, participation acquires greater educational value.

#### 4.5. Immediate feedback as the main predictor

Regression analysis showed that immediate feedback was the strongest predictor of active learning,  $\beta = .31$ ,  $p = .002$ . This result indicates that students learned more actively when they received clear, timely, and

useful information about their performance. The feedback made it possible to identify errors, adjust strategies, understand quality criteria and maintain continuity in tasks. Consequently, their role was more relevant than other more visible gamified elements, such as points, levels or badges.

This finding coincides with the approaches of Li, Ma, and Shi (2023), who emphasize that the effects of gamification depend on the design principles that guide the educational experience. Immediate feedback is one of these principles because it connects the student's action with formative information about his or her progress. In a gamified environment, the student does not wait until the end of the unit to know their performance, but receives constant signals that allow them to improve during the process.

From an active learning perspective, immediate feedback is essential because it turns evaluation into a formative process. The student not only answers tasks, but also interprets results, corrects errors, reformulates decisions and advances with greater awareness of their performance. This explains why feedback was more predictive than symbolic recognition. While badges can motivate, feedback has a direct impact on the quality of learning because it provides information for improvement.

This result has direct implications for teaching practice. A gamified intervention without frequent feedback can turn into an empty reward system. Instead, a feedback-based gamification transforms every activity into a learning opportunity. Therefore, university teachers should prioritize rapid response mechanisms, brief rubrics, automated comments, peer feedback, and correction spaces during the implementation of gamified experiences.

#### **4.6. Progressive challenges and cognitive involvement**

Progressive challenges were the second significant predictor of active learning,  $\beta = .28$ ,  $p = .005$ . This result suggests that the gradual difficulty of the activities favored the cognitive involvement of the students. The challenges made it possible to organize learning as an ascending sequence of complexity, in which students advanced from comprehension tasks to application, analysis, and academic production activities.

The progression of challenges is pedagogically relevant because it avoids two common problems in university teaching: initial overload and the monotony of repetitive tasks. When challenges are too difficult from the start, they can lead to frustration and abandonment. When they are too simple, they can produce disinterest. The progressive structure allows the difficulty to be adjusted, the

perception of achievement to be maintained and sustained effort to be stimulated.

The literature on gamification of e-learning in higher education has shown that there is no single combination of elements valid for all contexts, so the selection of components must respond to specific pedagogical objectives (Khaldi et al., 2023). In this study, progressive challenges functioned as a scaffolding strategy, as they allowed students to face increasingly complex activities with gradual support. This finding reinforces the need to design academically significant challenges. It is not enough to assign tasks under a playful label; The challenges must be aligned with competencies, content, evaluation criteria and levels of cognitive complexity. In higher education, gamification must preserve academic rigor while also offering a motivating structure that helps the student advance.

#### **4.7. Gamified collaboration and peer-to-peer learning**

Gamified collaboration was also a significant predictor of active learning,  $\beta = .24$ ,  $p = .013$ . This result indicates that team dynamics, collaborative missions, and group challenges contributed to strengthening participation and the collective construction of knowledge. In the experimental group, students not only worked individually to accumulate points or pass levels, but also had to coordinate with their peers, solve problems and present shared products.

Gamified collaboration is especially pertinent in higher education because many professional competencies require communication, leadership, negotiation, critical thinking, and joint problem-solving. Gamification can strengthen these competencies when it introduces group goals, roles, shared missions, and recognition of collaborative work. In this sense, the results are aligned with Murillo-Zamorano et al. (2021), who relate gamification in active learning with the development of relevant skills for the digital society and the professional field.

The importance of collaboration also allows us to nuance the role of competition in gamification. Although many gamified experiences are supported by rankings or leaderboards, the results of this study suggest that cooperative components may have greater pedagogical value than individual competence. The group activities favored peer interaction, the exchange of explanations, shared responsibility, and the social evaluation of performance. These processes are consistent with active learning, since they involve the student not

only receiving information, but also discussing, contrasting and applying it with others.

However, gamified collaboration requires careful design. If group tasks do not distribute responsibilities in a balanced way, problems of dependency, inequality in workload or passive participation of some members may appear. Therefore, it is advisable to combine group goals with individual evidence of performance, co-evaluation and differentiated feedback.

#### **4.8. Recognition, points and levels: positive but limited effects**

Although the dimensions of achievement recognition and points/levels received positive ratings, they were not significant predictors of active learning in the regression model. This result does not imply that these elements are worthless, but that their contribution was lower when other components of greater pedagogical weight were considered simultaneously. Points, levels, and badges can help make progress visible, generate initial interest, and recognize progress, but they alone do not guarantee deep cognitive engagement.

This finding is consistent with the review by Ratinho and Martins (2023), which indicates that points, badges, and rankings are widely used elements to motivate students, although motivation can decrease when the experience is mainly supported by extrinsic rewards. In the present study, students valued these elements, but active learning was mainly explained by feedback, challenges, and collaboration.

The pedagogical interpretation is clear: symbolic elements must fulfill a function of support, not of substitution of didactic design. A badge is useful if it recognizes a competency achieved; a level is useful if it represents progress in the complexity of learning; A point is useful if it reports progress or effort. But if these elements are disconnected from training objectives, they can become superficial stimuli with limited impact.

This result invites us to rethink the way universities implement gamification. Many experiences start by adding points, medals or rankings to existing courses. However, the data suggests that the priority should be on redesigning learning activities, feedback, and collaboration. The visible elements of play must emerge from that pedagogical structure, not replace it.

#### **4.9. Relationship between active learning and academic performance**

The correlation between active learning and academic performance was positive and significant,  $r$

$= .57, p < .001$ . This result indicates that students with higher levels of cognitive participation, self-regulation, collaboration, and application of knowledge tended to obtain better grades. Although correlation does not allow definitive causality to be established, it does support the idea that active learning is associated with better academic results.

The effect of gamification on performance was moderate compared to its effect on participation and active learning. This pattern can be explained by the multifactorial nature of academic performance. Grades depend on previous knowledge, study skills, assessment criteria, academic load, personal conditions and teaching styles. Therefore, it is expected that gamification has a more direct relationship with process variables than with final performance.

The results of the meta-analysis by Li, Ma, and Shi (2023) show that gamification can improve learning outcomes, but also that the evidence varies between studies. The present study contributes to this discussion by showing that academic performance improves when gamification promotes active participation. This suggests that the question should not only be whether gamification improves grades, but under what pedagogical conditions it does so.

In this sense, active learning can be considered a bridge variable between didactic intervention and academic results. Gamified strategies favor participation and motivation; these, in turn, strengthen active learning; and active learning is associated with better performance. This sequence offers a more complete explanation than a simple direct relationship between gamification and performance.

#### **4.10. Consistency with previous evidence**

The study's findings are consistent with recent research that recognizes the potential of gamification, but cautions against the need for pedagogically sound designs. The meta-analysis by Li, Ma and Shi (2023) included 41 studies, 49 independent samples and more than 5,000 participants, concluding that gamification can promote teaching and learning, although with mixed results depending on the conditions of implementation. This conclusion coincides with the present study, where gamification was effective because it was designed as a structured eight-week intervention, linked to curricular objectives and active activities.

Likewise, the review by Khaldi et al. (2023) on gamification of e-learning in higher education highlights that gamified elements are combined in multiple ways and that there is no one-size-fits-all

approach. The results of this research reinforce this idea, as they show that some dimensions had greater weight than others. Feedback, challenges, and collaboration were more relevant than points or levels, confirming that effectiveness depends on the combination and pedagogical function of the elements.

The results also coincide with Ratinho and Martins (2023), who report a positive influence of gamification on student motivation, but warn that the motivational effect may decrease over time. In the present study, the intervention lasted eight weeks, enough to observe relevant changes, although not to determine whether the effects are sustained over an entire academic year. This limitation should be considered in future longitudinal research.

Finally, the relationship between gamification and active learning is directly aligned with the study by Murillo-Zamorano *et al.* (2021), which highlights the importance of integrating gamification into active learning configurations to respond to the demands of students, academia, and digital society. The present research provides additional quantitative evidence by showing that this integration can produce significant effects on participation, motivation and performance.

#### 4.11. Theoretical implications

From a theoretical point of view, the study contributes to understanding gamification as a multidimensional pedagogical system. The results question an instrumental vision focused only on points, badges or rankings, and support a more complex conception where gamification acts through feedback mechanisms, challenge, collaboration and self-regulation. This interpretation allows gamification to be linked to theories of active learning, academic motivation, and student engagement.

The finding that immediate feedback was the strongest predictor of active learning suggests that gamification should be looked at as a form of continuous formative assessment. Effective gamified environments offer constant feedback on progress, allowing the student to make decisions and adjust their performance. This component brings gamification closer to approaches to self-regulation of learning, where planning, supervision, and evaluation of the process itself are central elements.

The role of progressive challenges also provides an important theoretical dimension. Gamification can be understood as a form of pedagogical scaffolding, in which students advance through levels of increasing complexity. This structure favors the

perception of achievement, reduces uncertainty and stimulates persistence. From this perspective, gamification not only motivates, but cognitively organizes the learning process.

Gamified collaboration, on the other hand, connects gamification with socio-constructivist approaches. Students actively learn when they interact, explain, argue, and solve problems with others. Therefore, a pedagogical theory of gamification in higher education must integrate individual and social dimensions of learning, avoiding reducing experience to individual competition or accumulation of rewards.

#### 4.12. Practical implications for university teaching

The results offer concrete guidance for university teachers interested in implementing gamification. First, the intervention should start with clear learning objectives. Gamified elements should be selected based on what you want to promote: participation, understanding, collaboration, self-regulation, or performance. Incorporating points or badges without a pedagogical purpose may generate initial interest, but not necessarily active learning.

Second, feedback should take center stage. Teachers can use automated quizzes, short feedback, rubrics, peer feedback, progress boards, or quick tutorials to inform the student of their progress. The key is that the feedback is immediate, understandable and actionable. This means that the student must know what they did well, what they need to improve, and how they can move forward.

Thirdly, challenges must be designed with progressive difficulty. An effective gamified experience is not about adding disconnected activities, but about building a sequence of missions linked to the course content. Each challenge must require a higher level of analysis, application or production. This progression allows interest to be sustained and favors the development of skills.

Fourth, collaboration must be built in intentionally. Teams can solve cases, design products, discuss solutions, review work, or compete cooperatively against quality standards. However, collaboration requires clear roles, evaluation criteria, and follow-up mechanisms to avoid inequalities in participation. Fifthly, the elements of recognition should be used as a training support. Badges can represent competencies, levels can indicate progress, and points can provide information on progress. Their value increases when they recognize significant academic achievement and not just mechanical task fulfillment.

#### 4.13. Institutional implications

At the institutional level, the results suggest that gamification can be part of broader strategies for teaching innovation in higher education. Universities interested in strengthening active learning should promote teacher training programs in gamified design, formative assessment and pedagogical use of digital platforms. Gamification should not be presented as a technological fad, but as a methodology that requires planning, monitoring and evaluation.

Institutions should also avoid implementing gamification in a standardized way without considering the characteristics of each subject. The review by Khaldi et al. (2023) warns that there is no universal combination of gamified elements applicable to all contexts. Therefore, each academic program must adapt the strategies to its competencies, modality, student profile and available resources.

Another institutional implication is related to the evaluation of pedagogical innovation. Universities tend to value the use of novel technologies or methodologies positively, but they do not always measure their real impact on learning. This study shows the importance of evaluating interventions using quantitative indicators, such as participation, motivation, active learning and performance. Only in this way is it possible to differentiate between apparent innovation and pedagogically effective innovation.

Finally, the institutional implementation of gamification must consider criteria of equity and inclusion. Gamified experiences should not publicly expose underperforming students or reinforce gaps between those who are more familiar with technologies or competitive dynamics. It is advisable to prioritize individual progress systems, cooperative goals, private feedback, and recognition of improvement.

## CONCLUSIONS

### 5.1. Overall conclusion

The present research allowed to analyze the effect of gamification strategies on active learning in higher education students from a quasi-experimental quantitative approach. The results obtained allow us to conclude that gamification, when designed in a pedagogically structured way and integrated with active activities, has a positive and statistically significant effect on active learning. The experimental group, exposed for eight weeks to an intervention based on progressive challenges, immediate feedback, points, levels, badges and

gamified collaboration, presented higher scores than the control group in active learning, academic motivation, active participation and academic performance.

The general hypothesis of the study was confirmed. Students who participated in the gamified experience achieved higher levels of active learning than those who developed the same content through non-gamified strategies. This finding allows us to argue that gamification should not be understood only as a motivational or recreational resource, but as a didactic strategy capable of organizing participation, guiding academic effort and strengthening the cognitive involvement of the student. This conclusion coincides with recent evidence that recognizes the potential of gamification to improve educational outcomes when implemented under instructional design criteria and not as a simple addition of playful elements (Li, Ma, & Shi, 2023; Murillo-Zamorano et al., 2021).

The study also established that the most relevant effects of gamification are expressed in process variables, especially in active participation and active learning. Although academic performance also improved significantly in the experimental group, the magnitude of the effect was greater in participation and active learning. This indicates that gamification mainly impacts the way students engage with tasks, interact with their peers, regulate their progress, and apply content. Consequently, improvements in academic performance seem to be associated with increased active learning behaviors, rather than with the isolated presence of external rewards or stimuli.

### 5.2. Conclusions according to specific objectives

In relation to the first specific objective, aimed at comparing the levels of active learning between the experimental group and the control group, it is concluded that the gamified intervention produced statistically significant differences in favor of the experimental group. Students exposed to gamification obtained a higher post-test mean of active learning than the control group, with a large effect size. This result demonstrates that gamification can be an effective strategy to increase cognitive, behavioral and collaborative participation in university contexts.

This conclusion is relevant because it confirms that active learning does not arise only from the inclusion of participatory activities, but from the way in which these activities are structured, monitored and fed back. In the experimental group, progressive challenges, breakthrough narrative, collaborative

missions, and immediate feedback offered a clear path for academic action. Therefore, gamification functioned as a pedagogical architecture that organized the student experience and favored greater involvement in the training process.

Regarding the second specific objective, aimed at determining the relationship between gamification perception, academic motivation and active participation, it is concluded that there were positive and significant correlations between these variables. Students who valued the gamified experience more positively also reported higher levels of motivation and participation. This result allows us to affirm that gamification affects active learning through motivational and behavioral mechanisms. Academic motivation was strengthened because students perceived clear goals, achievable challenges, recognition of progress, and frequent feedback.

This conclusion confirms that gamification can increase the student's willingness towards learning when it is aimed at strengthening the perception of competence, autonomy and achievement. However, the results also show that the most valued elements were not necessarily the most visible or symbolic, such as points and levels, but those with the highest formative value, especially immediate feedback and progressive challenges. Therefore, the motivation derived from gamification should be understood as a motivation linked to academic improvement and not only to obtaining rewards.

Regarding the third specific objective, focused on estimating the predictive effect of gamification dimensions on active learning, it is concluded that immediate feedback, progressive challenges and gamified collaboration were the significant predictors of active learning. The regression model explained a high proportion of the variance of active learning, which shows that these dimensions have a relevant weight in the training experience. On the other hand, the recognition of achievement and points/levels, although positively valued, did not reach statistical significance as independent predictors.

This conclusion is one of the most important contributions of the study, since it allows differentiating between gamified components with high pedagogical value and components with

complementary motivational value. Immediate feedback favors self-regulation because it allows errors to be corrected during the process. Progressive challenges stimulate cognitive engagement because they organize learning at increasing levels of complexity. Gamified collaboration promotes interaction between peers and the collective construction of knowledge. These three elements explain active learning more strongly because they directly affect the way students learn, not just how they perceive the experience.

In relation to the fourth specific objective, aimed at analyzing the association between active learning and academic performance, it is concluded that there was a positive and significant relationship between both variables. Students with higher levels of active learning tended to obtain better academic results. This conclusion supports the idea that participation, self-regulation, collaboration, and the application of knowledge are factors associated with university performance. However, academic performance should be interpreted as a multifactorial variable, also influenced by previous knowledge, study habits, personal conditions and evaluation criteria.

The study allows us to argue that gamification can contribute to academic performance when it manages to activate significant learning processes. Therefore, it is not gamification in itself that improves grades, but its ability to induce greater participation, persistence, interaction and understanding. This conclusion is especially important to avoid simplistic interpretations that present gamification as an automatic solution to the problems of low performance in higher education.

Finally, regarding the fifth specific objective, aimed at proposing evidence-based pedagogical guidelines to implement gamified strategies, it is concluded that gamification experiences in higher education should be designed based on clear curricular objectives, cognitively challenging activities, frequent feedback, and structured collaboration. Points, badges and levels can be useful as monitoring and recognition mechanisms, but they should not be at the heart of the intervention. The pedagogical core must be made up of active tasks, quality criteria, teaching accompaniment and opportunities for improvement.

## REFERENCES

- Aebli, H. (2020). Teaching factors that favor autonomous learning. *Narcea*.
- Aguiar-Castillo, L., Hernández-López, L., De Saa-Pérez, P., & Pérez-Jiménez, R. (2021). Gamification as a motivation strategy for higher education students in tourism face-to-face learning. *Journal of Hospitality, Leisure, Sport & Tourism Education*, 28, 100267.
- Alamri, M. M. (2021). Using blended project-based learning for students' behavioral intention to use and academic achievement in higher education. *Education Sciences*, 11(5), 207.

- Alsawaier, R. S. (2018). The effect of gamification on motivation and engagement. *The International Journal of Information and Learning Technology*, 35(1), 56–79.
- Bai, S., Hew, K. F., & Huang, B. (2020). Does gamification improve student learning outcome? Evidence from a meta-analysis and synthesis of qualitative data in educational contexts. *Educational Research Review*, 30, 100322.
- Bicen, H., & Kocakoyun, S. (2018). Perceptions of students for gamification approach: Kahoot as a case study. *International Journal of Emerging Technologies in Learning*, 13(2), 72–93.
- Bozkurt, A., & Durak, G. (2021). The effect of gamification on online learners' engagement and achievement. *Educational Technology Research and Development*, 69, 1–23.
- Castro, R. (2019). Blended learning in higher education: Trends and capabilities. *Education and Information Technologies*, 24, 2523–2546.
- Chans, G. M., & Castro, M. P. (2021). Gamification as a strategy to increase motivation and engagement in higher education chemistry students. *Computers*, 10(10), 132.
- Chen, C. H., & Chen, C. M. (2023). Effects of gamified learning mechanisms on students' motivation, engagement and learning achievement. *Interactive Learning Environments*, 31(7), 4015–4032.
- Chiu, T. K. F. (2021). Student engagement in K-12 online learning amid COVID-19: A qualitative approach from a self-determination theory perspective. *Interactive Learning Environments*, 29(4), 1–14.
- Cohen, J. (1988). *Statistical power analysis for the behavioral sciences* (2nd ed.). Lawrence Erlbaum.
- Dichev, C., & Dicheva, D. (2017). Gamifying education: What is known, what is believed and what remains uncertain. *International Journal of Educational Technology in Higher Education*, 14, 9.
- Dindar, M., Ren, L., & Järvenoja, H. (2021). An experimental study on the effects of gamified cooperation and competition on English vocabulary learning. *British Journal of Educational Technology*, 52(1), 142–159.
- Doney, I. (2019). Research into effective gamification features to inform e-learning design. *Research in Learning Technology*, 27, 1–16.
- Domínguez, A., Saenz-de-Navarrete, J., De-Marcos, L., Fernández-Sanz, L., Pagés, C., & Martínez-Herráiz, J. J. (2013). Gamifying learning experiences: Practical implications and outcomes. *Computers & Education*, 63, 380–392.
- Faiella, F., & Ricciardi, M. (2015). Gamification and learning: A review of issues and research. *Journal of e-Learning and Knowledge Society*, 11(3), 13–21.
- Ferrer, J., Ringer, A., Saville, K., A. Parris, M., & Kashi, K. (2020). Students' motivation and engagement in higher education: The importance of attitude to online learning. *Higher Education*, 83, 317–338.
- Freeman, S., Eddy, S. L., McDonough, M., Smith, M. K., Okoroafor, N., Jordt, H., & Wenderoth, M. P. (2014). Active learning increases student performance in science, engineering, and mathematics. *Proceedings of the National Academy of Sciences*, 111(23), 8410–8415.
- García-Iruela, M., & Hijón-Neira, R. (2020). What perception do students have about the gamification elements? *IEEE Ibero-American Journal of Learning Technologies*, 15(4), 353–360.
- Gentry, S. V., Gauthier, A., L'Estrade Ehrstrom, B., Wortley, D., Lilienthal, A., Car, L. T., Dauwels-Okutsu, S., Nikolaou, C. K., Zary, N., Campbell, J., & Car, J. (2019). Serious gaming and gamification education in health professions: Systematic review. *Journal of Medical Internet Research*, 21(3), e12994.
- González, C. S., & Area, M. (2021). Breaking the rules: Gamification of learning and educational innovation. *Education in the Knowledge Society*, 22, e23904.
- Gómez-Carrasco, C. J., Monteagudo-Fernández, J., Moreno-Vera, J. R., & Sainz-Gómez, M. (2020). Effects of a gamification and flipped-classroom program for teachers in training on motivation and learning perception. *Education Sciences*, 10(11), 299.
- Hamari, J., Koivisto, J., & Sarsa, H. (2014). Does gamification work? A literature review of empirical studies on gamification. *Proceedings of the 47th Hawaii International Conference on System Sciences*, 3025–3034.
- Hanus, M. D., & Fox, J. (2015). Assessing the effects of gamification in the classroom: A longitudinal study. *Computers & Education*, 80, 152–161.
- Huang, B., Hew, K. F., & Lo, C. K. (2019). Investigating the effects of gamification-enhanced flipped learning on undergraduate students' behavioral and cognitive engagement. *Interactive Learning Environments*, 27(8), 1106–1126.
- Jaramillo-Mediavilla, L., Basantes-Andrade, A., Cabezas-González, M., & Casillas-Martín, S. (2024). Impact of gamification on motivation and academic performance: A systematic review. *Education Sciences*, 14(6), 639.

- Kalogiannakis, M., Papadakis, S., & Zourmpakis, A. I. (2021). Gamification in science education: A systematic review of the literature. *Education Sciences*, 11(1), 22.
- Khalidi, A., Bouzidi, R., & Nader, F. (2023). Gamification of e-learning in higher education: A systematic literature review. *Smart Learning Environments*, 10, 10.
- Kim, S., Song, K., Lockee, B., & Burton, J. (2018). *Gamification in learning and education: Enjoy learning like gaming*. Springer.
- Klock, A. C. T., Gasparini, I., Pimenta, M. S., & Hamari, J. (2020). Tailored gamification: A review of literature. *International Journal of Human-Computer Studies*, 144, 102495.
- Koivisto, J., & Hamari, J. (2019). The rise of motivational information systems: A review of gamification research. *International Journal of Information Management*, 45, 191–210.
- Landers, R. N. (2014). Developing a theory of gamified learning. *Simulation & Gaming*, 45(6), 752–768.
- Li, M., Ma, S., & Shi, Y. (2023). Examining the effectiveness of gamification as a tool promoting teaching and learning in educational settings: A meta-analysis. *Frontiers in Psychology*, 14, 1253549.
- López-Belmonte, J., Segura-Robles, A., Moreno-Guerrero, A. J., & Parra-González, M. E. (2020). Machine learning and big data in the impact literature: A bibliometric review with scientific mapping in Web of Science. *Symmetry*, 12(4), 495.
- Manzano-León, A., Camacho-Lazarraga, P., Guerrero, M. A., Guerrero-Puerta, L., Aguilar-Parra, J. M., Trigueros, R., & Alias, A. (2021). Between level up and game over: A systematic literature review of gamification in education. *Sustainability*, 13(4), 2247.
- Martí-Parreño, J., Galbis-Córdova, A., & Currás-Pérez, R. (2021). Teachers' beliefs about gamification and competencies development: A concept mapping approach. *Innovations in Education and Teaching International*, 58(1), 84–94.
- Mekler, E. D., Brühlmann, F., Tuch, A. N., & Opwis, K. (2017). Towards understanding the effects of individual gamification elements on intrinsic motivation and performance. *Computers in Human Behavior*, 71, 525–534.
- Mora, A., Riera, D., González, C., & Arnedo-Moreno, J. (2017). Gamification: A systematic review of design frameworks. *Journal of Computing in Higher Education*, 29, 516–548.
- Murillo-Zamorano, L. R., López-Sánchez, J. Á., Godoy-Caballero, A. L., & Bueno-Muñoz, C. (2021). Gamification and active learning in higher education: Is it possible to match digital society, academia and students' interests? *International Journal of Educational Technology in Higher Education*, 18, 15.
- Nacke, L. E., & Deterding, S. (2017). The maturing of gamification research. *Computers in Human Behavior*, 71, 450–454.
- Nicholson, S. (2015). A recipe for meaningful gamification. En T. Reiners & L. C. Wood (Eds.), *Gamification in education and business* (pp. 1–20). Springer.
- Nieto-Escamez, F. A., & Roldán-Tapia, M. D. (2021). Gamification as online teaching strategy during COVID-19: A mini-review. *Frontiers in Psychology*, 12, 648552.
- Oliveira, W., Toda, A., Palomino, P., Shi, L., Isotani, S., Bittencourt, I. I., & Vassileva, J. (2023). Does tailoring gamified educational systems matter? The impact on students' flow experience. *International Journal of Artificial Intelligence in Education*, 33, 1–30.
- Ortiz-Rojas, M., Chiluiza, K., & Valcke, M. (2019). Gamification through leaderboards: An empirical study in engineering education. *Computer Applications in Engineering Education*, 27(4), 777–788.
- Parra-González, M. E., López-Belmonte, J., Segura-Robles, A., & Moreno-Guerrero, A. J. (2021). Gamification and flipped learning and their influence on aspects related to the teaching-learning process. *Heliyon*, 7(2), e06254.
- Pelizzari, E., Tinti, C., & Grion, V. (2023). Gamification in higher education: A systematic literature review. *Tecnologie Didattiche*, 31(1), 1–15.
- Putz, L. M., Hofbauer, F., & Treiblmaier, H. (2020). Can gamification help to improve education? Findings from a longitudinal study. *Computers in Human Behavior*, 110, 106392.
- Ratinho, E., & Martins, C. (2023). The role of gamified learning strategies in student's motivation in high school and higher education: A systematic review. *Heliyon*, 9(8), e19033.
- Ryan, R. M., & Deci, E. L. (2020). Intrinsic and extrinsic motivation from a self-determination theory perspective: Definitions, theory, practices, and future directions. *Contemporary Educational Psychology*, 61, 101860.
- Sailer, M., & Homner, L. (2020). The gamification of learning: A meta-analysis. *Educational Psychology Review*, 32, 77–112.

- Sailer, M., Hense, J. U., Mayr, S. K., & Mandl, H. (2017). How gamification motivates: An experimental study of the effects of specific game design elements. *Computers in Human Behavior*, 69, 371–380.
- Sanchez, D. R., Langer, M., & Kaur, R. (2020). Gamification in the classroom: Examining the impact of gamified quizzes on student learning. *Computers & Education*, 144, 103666.
- Seaborn, K., & Fels, D. I. (2015). Gamification in theory and action: A survey. *International Journal of Human-Computer Studies*, 74, 14–31.
- Serrano, K. (2019). The effect of digital game-based learning on student learning: A literature review. *Computers in Human Behavior*, 95, 50–60.
- Subhash, S., & Cudney, E. A. (2018). Gamified learning in higher education: A systematic review of the literature. *Computers in Human Behavior*, 87, 192–206.
- Tan, M., & Hew, K. F. (2021). Incorporating meaningful gamification in a blended learning research methods class: Examining student learning, engagement, and affective outcomes. *Australasian Journal of Educational Technology*, 37(5), 1–21.
- Toda, A. M., Klock, A. C. T., Oliveira, W., Palomino, P. T., Rodrigues, L., Shi, L., Bittencourt, I., Gasparini, I., Isotani, S., & Cristea, A. I. (2019). Analysing gamification elements in educational environments using an existing gamification taxonomy. *Smart Learning Environments*, 6, 16.
- Tsay, C. H. H., Kofinas, A., & Luo, J. (2018). Enhancing student learning experience with technology-mediated gamification: An empirical study. *Computers & Education*, 121, 1–17.
- Vesa, M., & Harviainen, J. T. (2019). Gamification: Concepts, consequences, and critiques. *Journal of Management Inquiry*, 28(2), 128–130.
- Wang, A. I., & Tahir, R. (2020). The effect of using Kahoot! for learning: A literature review. *Computers & Education*, 149, 103818.
- Werbach, K., & Hunter, D. (2020). *For the win: The power of gamification and game thinking in business, education, government, and social impact* (Revised ed.). Wharton School Press.
- Zainuddin, Z., Chu, S. K. W., Shujahat, M., & Perera, C. J. (2020). The impact of gamification on learning and instruction: A systematic review of empirical evidence. *Educational Research Review*, 30, 100326.
- Zeng, J., Parks, S., & Shang, J. (2024). Gamification effects on students' motivation and learning achievement in higher education: A quasi-experimental study. *International Journal of STEM Education*, 11, 42.
- Zhao, Y., Pinto Llorente, A. M., & Sánchez Gómez, M. C. (2021). Digital competence in higher education research: A systematic literature review. *Computers & Education*, 168, 104212.
- Zourmpakis, A. I., Papadakis, S., & Kalogiannakis, M. (2022). Education of preschool and elementary teachers on the use of adaptive gamification in science education. *International Journal of Technology Enhanced Learning*, 14(1), 1–16.