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Research Article

Gamification in e-learning contexts in higher education: Impact on academic performance and student satisfaction

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ABSTRACT

Higher education in e-learning contexts presents the constant challenge of keeping students motivated and engaged in their learning process. For this reason, the primary objective of this study was to assess the impact of implementing a gamified e-learning strategy on academic performance and student satisfaction among early childhood education students at the Technical University of Manabí. A quantitative approach with a quasi-experimental design was employed, utilizing nonparametric techniques in SPSS. The purposive sample consisted of 78 students, equally distributed between a gamified e-learning classroom and a traditional e-learning classroom without gamified elements. Mann-Whitney U, Kruskal-Wallis, Spearman correlation, and cluster analysis tests were applied. The results showed significantly higher academic performance and satisfaction levels in the gamified group compared with the traditional group. Additionally, differentiated profiles were identified based on levels of satisfaction and academic performance. It is concluded that gamification represents an effective pedagogical strategy for supporting academic achievement and fostering student satisfaction with the virtual learning environment. These findings highlight the importance of pedagogically grounded gamification design and teacher competencies in enhancing learning outcomes in virtual environments.

Keywords: e-learning, higher education, academic performance, gamification, student satisfaction

INTRODUCTION

Higher education has undergone rapid transformation due to technological development and the expansion of e-learning. However, maintaining student engagement until the end of online courses remains a major challenge, and lack of commitment continues to affect academic performance (AL-Smadi, 2015). This situation intensified after COVID-19, when the growth of virtual education revealed both its potential and its limitations. Among the most persistent problems are dropout, limited interaction, insufficient personalization, and weak pedagogical engagement in virtual platforms (Khaldi et al., 2023).

In this context, the role of faculty becomes a key factor in ensuring the quality of online education, as the effectiveness of virtual learning environments depends not only on technological infrastructure but also on the pedagogical design, digital competencies, and methodological decisions made by teachers. Therefore,

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strengthening teacher training in the use of innovative strategies is essential to improve student engagement and learning outcomes in e-learning contexts.

Gamification has emerged as a pedagogical strategy that integrates game elements into non-game contexts to influence learning-related behaviors and attitudes (Kashive & Mohite, 2023). In e-learning, it has been used to promote participation, content retention, and academic performance (Garcia-Cabot et al., 2020).

In Latin America, higher education has experienced a rapid expansion of online learning in recent years, driven primarily by digital transformation and the need to ensure academic continuity in crisis contexts. This growth has revealed both opportunities and structural limitations, especially in access, equity, and the quality of learning. Several studies have indicated that the rapid adoption of e-learning environments in the region has been accompanied by challenges related to pedagogical interaction, student engagement, technological conditions, and faculty preparedness for designing online learning experiences (Crawford et al., 2020; Salas-Pilco et al., 2022). Furthermore, it has become clear that while digitalization has expanded educational coverage, it has also revealed significant gaps in the quality of teaching and the student learning experience, particularly in contexts where pedagogical models suitable for online education have not yet been established (Jiménez-Bucarey et al., 2021).

In Ecuador, online higher education has expanded substantially in recent years. By the end of 2022, the current online academic offer had increased to 1,049 degree programs, according to the Consejo de Educación Superior (2022). However, this quantitative growth has not necessarily been accompanied by proportional improvements in educational quality, and difficulties persist in ensuring effective teaching and learning processes in virtual environments.

At the institutional level, the Technical University of Manabí (UTM) has promoted the use of virtual learning platforms as a response to new training scenarios. However, a worrying disconnection has been observed between the technological potentialities available and the pedagogical strategies used. The absence of active methodologies, such as gamification, has led to a lack of student motivation, little commitment to autonomous learning, and, consequently, to persistent dropouts in online courses.

Under this perspective, this research aims to answer the following question: What is the impact of implementing a gamified e-learning strategy on academic performance and student satisfaction among early childhood education students at the UTM, considering personal and platform-use variables?

The general objective was to evaluate the impact of a gamified e-learning strategy on academic performance and student satisfaction in a real higher-education virtual learning environment. The specific objectives were:

(1) to compare academic performance between students who participated in a gamified e-learning environment and those who followed a traditional e-learning methodology;

(2) to analyze differences in academic performance according to gender, age, number of enrollments, completed activities, active days, and type of device;

(3) to examine student satisfaction with the e-learning environment and its relationship with academic performance in both groups; and

(4) to classify students according to academic performance and overall satisfaction through cluster analysis.

This study contributes to the field in three ways. First, it provides empirical evidence from an Ecuadorian higher-education context, where the expansion of online learning has not always been accompanied by pedagogically grounded instructional innovation. Second, it examines a real eight-week gamified intervention implemented in an early childhood education course, comparing it with a traditional e-learning classroom that used the same contents, activities, and assessment structure but without gamified elements. Third, beyond comparing group performance, the study identifies differentiated student profiles through cluster analysis, offering practical evidence for adapting instructional design to diverse levels of academic performance and satisfaction in virtual learning environments.

Gamification and Online Learning in Higher Education

Gamification in higher education has emerged as an innovative pedagogical strategy aimed at strengthening motivation, engagement, and academic performance, particularly in e-learning environments. However, gamification should not be understood as the simple addition of isolated game elements to a virtual classroom. Rather, it requires a pedagogical design that integrates game mechanics, dynamics, and components with learning objectives, assessment criteria, feedback, and student progression.

From a motivational perspective, gamification can be interpreted through self-determination theory, which explains motivation in terms of autonomy, competence, and relatedness (Ryan & Deci, 2000). In a gamified e-learning environment, autonomy may be promoted when students progress at their own pace through learning paths; competence may be supported through levels, points, and progressive challenges; and relatedness may be encouraged through collaborative activities and interaction with peers. Similarly, flow theory suggests that learning experiences may become more engaging when challenges are clearly structured, feedback is immediate, and the level of difficulty is aligned with learners' abilities (Csikszentmihalyi, 1990). These theoretical perspectives help explain why gamification may influence both academic performance and student satisfaction when it is integrated into the pedagogical structure of the course.

Previous research has shown that gamified environments can improve student engagement, learning outcomes, retention, and academic performance in online and blended higher education contexts. Lampropoulos and Sidiropoulos (2024), for example, found that gamified learning environments produced improvements compared with traditional and online modalities, particularly in student success and retention. Similarly, Khaldi et al. (2023) highlight that gamification in e-learning has become a growing field of research because of its potential to redesign digital learning models in higher education institutions. Nevertheless, the literature also warns that the effects of gamification are not automatic; they depend on the coherence between game elements, disciplinary content, instructional design, and the characteristics of the student group. Therefore, a gamified design can contribute to learning outcomes and satisfaction only when it is pedagogically grounded and aligned with the educational purpose of the course.

Impact of Gamification on Academic Performance

The relationship between gamification and academic performance has been widely examined in higher education, although the evidence suggests that its effectiveness depends on the quality of the instructional design and the way game elements are aligned with learning objectives. In virtual environments, gamification can support academic performance by organizing content into progressive challenges, providing feedback, making progress visible, and encouraging students to complete learning activities within a structured sequence.

Recent studies have reported positive effects of gamification on academic performance in different higher-education contexts. Romsi et al. (2024) found that integrating gamification techniques into a learning management system improved the academic performance and engagement of undergraduate students. Similarly, Latorre-Cosculluela et al. (2025) showed that gamification, when combined with collaborative learning, contributed to academic performance and students' perceptions of transversal competencies. Baldrich et al. (2024) also highlight that gamified experiences can be particularly relevant in virtual contexts and teacher training, especially when they promote content comprehension and intrinsic motivation.

Nevertheless, the literature indicates that gamification should not be interpreted as a universally effective strategy. Its impact may vary according to personal and contextual variables, such as gender, age, study time, completed activities, platform interaction, enrollment status, device used, and access conditions (Khaldi et al., 2023). Therefore, studies that examine not only group differences but also student-related and platform-use variables can provide a more nuanced understanding of when and under what conditions gamification contributes to academic performance.

Satisfaction and Motivation in Learning

Student satisfaction and motivation are relevant dimensions for understanding the pedagogical value of gamified e-learning environments. In this study, student satisfaction is understood as students' perceived

satisfaction with the organization, clarity, autonomy, progression, enjoyment, commitment, and overall value of the virtual learning environment. This distinction is important because satisfaction does not represent the entire student experience, but rather a specific perception-based outcome associated with the instructional design of the course.

Previous studies have shown that gamification can improve students' motivation, participation, and satisfaction when game elements are meaningfully connected to learning activities. Latorre-Cosculluela et al. (2025) reported that gamification combined with collaborative learning improved students' perceptions of academic performance and transversal competencies. Similarly, Han and Lee (2024) found that challenges and ludic elements can contribute to online education satisfaction through engagement and learning outcomes. Mostafa (2019) also emphasized the relevance of analyzing students' emotional responses in gamified digital environments to adapt teaching strategies and promote more satisfying learning experiences.

However, the positive effects of gamification should not be assumed automatically. Almeida et al. (2023) warn that poorly designed gamification may generate negative effects, especially when elements such as badges, leaderboards, competition, or points are used without sufficient pedagogical alignment. Therefore, satisfaction with a gamified e-learning environment depends not only on the presence of game elements, but also on their coherence with the course content, the feedback provided, the level of challenge, and the students' ability to progress through the learning path. This supports the need to evaluate student satisfaction as a specific outcome of the implemented gamified design.

METHODOLOGY

Research Objectives

General objective

To evaluate the impact of a gamified e-learning strategy on academic performance and student satisfaction among early childhood education students at the UTM.

Specific objectives

- To compare the academic performance of students who participated in a gamified e-learning environment with that of those who used a traditional methodology in the early childhood education course at UTM.
- To analyze the differences in academic performance according to personal and platform use variables, including gender, age, number of enrollments, number of activities completed, active days, and type of device, in both methodological environments.
- To examine student satisfaction with the e-learning environment and its relationship with academic performance in both the gamified and traditional groups.
- To classify students according to academic performance and overall satisfaction, identifying differentiated profiles through cluster analysis.

Method

The present study employed a quantitative approach with a comparative and correlational quasi-experimental design. This design was used to analyze the impact of a gamified e-learning strategy on academic performance and student satisfaction, while maintaining the natural conditions of the educational context. Two intact virtual classroom groups were compared: one group participated in a gamified e-learning environment, and the other followed a traditional e-learning methodology without gamified elements. Both groups belonged to the same course and academic period and followed the same contents, number of activities, assessment criteria, and final grade scale. Both groups were taught by the same instructor, which helped reduce possible instructor-related variability. The main difference between the groups was the instructional design of the virtual classroom: the experimental group worked through a gamified learning path, whereas the control group followed a linear structure with fixed activities and deadlines. This design allowed the analysis of differences, relationships, and student profiles.

Population and Sample

The population consisted of university students enrolled in the early childhood education program at the UTM, Ecuador, in a course delivered in virtual modality. A non-probabilistic purposive sample was used, as this type of sampling is appropriate when participants are intentionally selected according to the characteristics and objectives of the study (Lauretto et al., 2012). The sample consisted of 78 students distributed across two virtual classrooms. The experimental group (n = 39) participated in a gamified e-learning environment, whereas the control group (n = 39) followed a traditional e-learning methodology without gamified elements. Both groups received the same disciplinary contents and completed the same number of academic activities; however, they differed in the instructional design, progression structure, and gamification resources implemented in the virtual classroom.

Research Design and Procedure

The study was conducted in two virtual classrooms implemented simultaneously during the same academic period over eight weeks. The experimental group worked in a gamified e-learning environment, while the control group followed a traditional e-learning methodology. Both groups studied the same disciplinary contents, completed the same number of academic activities, and were assessed using the same final grade scale. The difference between the groups was the instructional design of the virtual classroom.

The gamified intervention was titled “discovering academic paths through gamification” and was implemented in Moodle in the course convergence of educational media. The design was organized around the “pirate Morgan” narrative, in which students progressed through a learning path structured as a sequence of missions or sessions. The intervention included eight sessions distributed across unit III and unit IV of the course. Seven sessions corresponded to academic activities, and the eighth session corresponded to the final assessment.

The gamified classroom incorporated several game elements: a learning path format, restricted access to contents and activities, progressive levels, points, role progression, thematic challenges, feedback after each level, and a final badge upon completion of the course. Students began at level 1 and could progress up to level 15 according to their completion of the proposed activities. The level system was associated with progressive roles, such as recruit, soldier, corporal, sergeant, lieutenant, captain, commander, colonel, and brigadier. The maximum score associated with the level system was 1,400 points.

The progression rule was based on activity completion and access restrictions. Students could not access the next session until they had reviewed the required content and completed the corresponding activity. Once the activity was submitted, the next level and the following session were enabled. This structure allowed students to advance autonomously within the eight-week period.

The narrative was integrated into the disciplinary contents through the naming and description of each session. For example, “island of the beginning” introduced methodologies applied in the digital world; “the cave of enigmas” was linked to blended-learning strategies through a crossword activity; “boarding” was connected to digital tools in education through a collaborative forum; and “the discovery of the treasure” corresponded to the final assessment of unit III and unit IV. In this way, the pirate narrative did not replace the academic content but served as a motivational structure to organize progression, challenge, and achievement.

The instructor’s role was to design the learning path, configure the Moodle restrictions and levels, provide guidance during the synchronous sessions, monitor students’ progress, and offer feedback according to the activities completed. The synchronous sessions were used mainly to introduce the course structure and clarify doubts, while most of the learning process was developed asynchronously through Moodle.

The control group worked with the same contents, activities, and assessment structure, but without gamified elements. In this classroom, contents and tasks were presented in a linear format, with fixed dates and without narrative, levels, points, role progression, restricted unlocking, or final badges (**Figure 1**).

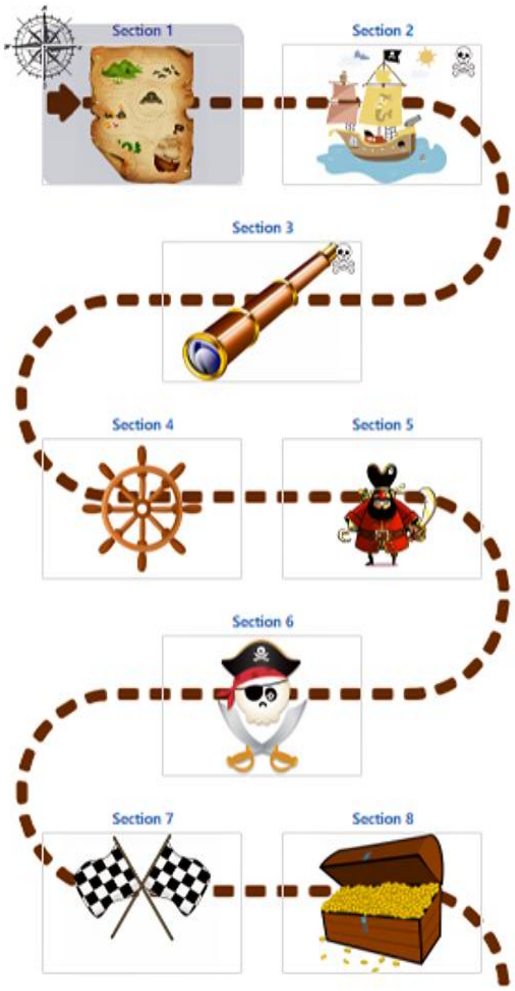


Figure 1. Gamified classroom design (reproduced from Vélez Loor et al., 2025; copyright 2025 by the authors; reproduced with permission of the copyright holders)

Data Collection Techniques and Instruments

Data were collected from the virtual learning platform and from an online satisfaction questionnaire administered at the end of the intervention. The information was organized into three sources: academic performance, personal and platform-use variables, and student satisfaction.

Academic performance was measured through the final grade obtained by each student in the course. The final grade was calculated on a scale from 0 to 50 points and was derived from the academic activities and final assessment completed during the intervention period. The same grading scale and assessment structure were used for both the gamified and traditional groups.

Personal and platform-use variables were obtained from the virtual classroom records and institutional academic information. These variables included gender, age range, number of enrollments in the course, number of completed activities, active days on the platform, and type of device used to access the course. These variables were included to analyze whether student characteristics and interaction with the virtual platform were associated with academic performance in both methodological environments.

Student satisfaction was measured using a 10-item ad hoc questionnaire designed by the authors for this study. The questionnaire was developed according to the pedagogical dimensions of the gamified classroom design and the instructional components of the intervention. It was not a previously published standardized scale; however, its construct validity and internal consistency were examined using the data from the present sample. The questionnaire included items on whether students felt motivated to participate in the course activities, whether the activities supported their understanding of the contents, whether the organization of the virtual classroom facilitated their learning process, whether the pace of work adapted to their learning

needs, whether they enjoyed the learning process, whether the instructions were clear and understandable, whether they perceived progressive development in their learning, whether the course fostered their autonomy, whether they remained committed to completing the proposed activities, and whether they were generally satisfied with the course. Responses were collected using a five-point Likert scale ranging from 1 = strongly disagree to 5 = strongly agree.

Validity and reliability of the satisfaction questionnaire

To examine the validity and reliability of the ad hoc satisfaction questionnaire, preliminary psychometric analyses were conducted using the data from the present sample. The Kaiser-Meyer-Olkin measure was .888, indicating adequate sampling adequacy for factor analysis. Bartlett's test of sphericity was statistically significant, $\chi^2(45) = 309.27$, $p < .001$, confirming that the correlation matrix was suitable for factor extraction. The exploratory factor analysis identified a one-factor structure with an eigenvalue of 4.97, explaining 49.69% of the total variance. The factor loadings ranged from .574 to .806, showing adequate relationships between the items and the underlying satisfaction factor. Internal consistency was also good, with Cronbach's alpha = .886. Therefore, the questionnaire showed preliminary evidence of construct validity and internal consistency in the present sample.

Ethical Considerations

This study was approved by the Human Research Ethics Committee at the UTM (CEISH-UTM), under approval code CEISH-UTM-INT_25-11-05_JMVL_art, dated November 28, 2025. Data collection was conducted after ethics approval and followed the protocol authorized by the committee. Participants were informed about the academic and research purposes of the study, the confidential treatment of the information, the anonymized use of the data, and their right to participate voluntarily. Informed consent was obtained according to the approved research protocol. No personally identifiable information was reported in the analysis or results.

Data Analysis

Data analysis was performed using IBM SPSS statistics software, version 28. Descriptive statistics were calculated for the study variables, including means (M), standard deviations (SDs), frequencies, and percentages. Before conducting the comparative analyses, the assumption of normality was assessed using the Shapiro-Wilk test, which is recognized for its usefulness in detecting deviations from normality in moderate sample sizes (Patrício et al., 2017). As the variables did not meet the assumption of normality, nonparametric statistical techniques were applied.

Before testing the study objectives, the psychometric behavior of the ad hoc student satisfaction questionnaire was examined. The Kaiser-Meyer-Olkin measure of sampling adequacy and Bartlett's test of sphericity were used to determine whether the data were suitable for exploratory factor analysis. An exploratory factor analysis was then conducted to examine the underlying structure of the 10 satisfaction items. Internal consistency was assessed using Cronbach's alpha.

For objective 1, the Mann-Whitney U test was applied to compare academic performance between the gamified and traditional groups, given that this test is suitable for comparing two independent groups when the dependent variable does not meet the assumption of normality (Park, 2025). Effect size was also calculated to complement statistical significance and support the interpretation of the practical relevance of the difference between groups.

For objective 2, Mann-Whitney U and Kruskal-Wallis tests were used to analyze differences in academic performance according to personal and platform-use variables, including gender, age, number of enrollments, completed activities, active days, and type of device. Quantitative variables were categorized according to the analytical requirements of the nonparametric tests. The Kruskal-Wallis test was used when comparing more than two independent groups, as it is appropriate for non-normally distributed dependent variables (Liu & Chen, 2012). When applicable, effect sizes were reported to support the interpretation of the magnitude of the differences.

For objective 3, the Mann-Whitney U test was applied item by item to compare student satisfaction between the gamified and traditional groups. Spearman's correlation coefficient was used to examine the

Table 1. Average overall academic performance by classroom type

Classroom type	M	SD
Gamified classroom	44.24	9.23
Traditional classroom	36.03	15.02

Note. Values reflect final academic performance scores on a 0-50-point scale

Table 2. Comparison of academic performance between the gamified and traditional groups

Test	Value
Mann-Whitney U	1,177.00
p-value	< .001
Rank-biserial correlation	.548

Note. The Mann-Whitney U test was used because the academic performance scores did not meet the assumption of normality

relationship between overall satisfaction and academic performance, as this coefficient is appropriate when normality is not assumed and when the relationship between variables may not be strictly linear (Hauke & Kossowski, 2011). This analysis was conducted separately for the gamified group and the traditional group in order to determine whether the relationship between satisfaction and performance was specific to the gamified environment or reflected a more general pattern across the sample.

For objective 4, a two-stage cluster analysis was performed using standardized scores for academic performance and overall satisfaction. First, hierarchical cluster analysis using Ward's method was conducted to explore the possible number of student profiles, as this procedure groups cases according to their similarity and facilitates the interpretation of differentiated profiles (Corter, 2023). Then, K-means clustering was applied to classify students into differentiated profiles, following its usefulness for grouping students according to academic performance-related variables (Anita et al., 2024). The cluster analysis was interpreted as an exploratory procedure aimed at identifying pedagogically meaningful student profiles rather than establishing causal relationships.

RESULTS

Objective 1

To address the first objective, academic performance was compared between students who participated in the gamified e-learning environment and those who followed the traditional e-learning methodology. As shown in **Table 1**, students in the gamified classroom obtained a higher M score (M = 44.24, SD = 9.23) than students in the traditional classroom (M = 36.03, SD = 15.02). This descriptive difference suggests a favorable pattern for the gamified group.

As the assumption of normality was previously assessed using the Shapiro-Wilk test, which is recognized for its usefulness in detecting deviations from normality in moderate sample sizes (Patrício et al., 2017), the nonparametric Mann-Whitney U test was applied. The results showed a statistically significant difference in academic performance between the gamified and traditional groups, U = 1177.00, p < .001. The effect size, estimated using the rank-biserial correlation, was rrb = .548, indicating a relevant difference in favor of the gamified group (see **Table 2**).

Figure 2 illustrates the difference in academic performance between the gamified and traditional classrooms.

Objective 2

To address the second objective, academic performance was analyzed according to personal and platform-use variables, including gender, age, number of enrollments, completed activities, active days, and type of device. Since the data did not meet the assumption of normality, Mann-Whitney U tests were used for variables with two groups, and Kruskal-Wallis tests were used for variables with more than two groups (Liu & Chen, 2012; Park, 2025). Effect sizes were also reported to support the interpretation of practical significance.

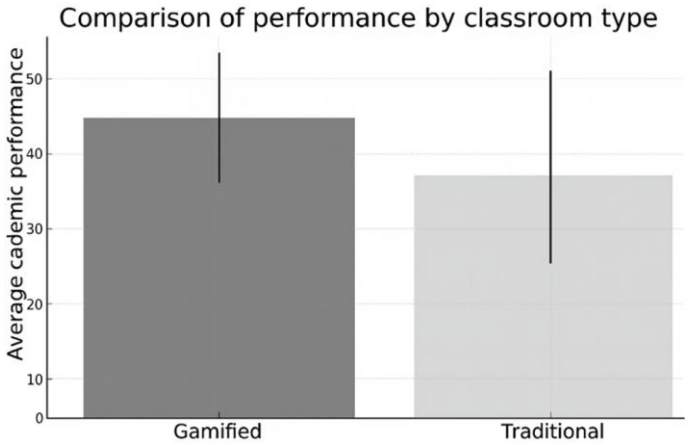


Figure 2. Comparison of academic performance between the gamified and traditional classrooms (the authors' own elaboration based on the study data)

Table 3. Comparison of academic performance by gender using the Mann-Whitney U test

Variable	Classroom type	Group	n	Mean score	U	p-value (Mann-Whitney U)	Effect size |rrb|
Gender	Gamified	Women	36	44.04	49.00	.811	.093
		Men	3	46.67			
	Traditional	Women	36	35.50	48.00	.771	.111
		Men	3	42.33			

Table 4. Kruskal-Wallis test results according to age range

Classroom type	H	Effect size ε²	p-value	n total	Age groups
Gamified	.468	.000	.926	39	4
Traditional	4.916	.027	.296		5

Table 5. Comparison of academic performance according to number of enrollments using Kruskal-Wallis test

Classroom type	H	p-value	Effect size ε²	n total	Enrollment categories
Gamified	3.613	.164	.045	39	3
Traditional	1.700	.427	.000		

Analysis of performance by gender

The Mann-Whitney U test showed no statistically significant differences between women and men in the gamified classroom (U = 49.00, p = .811, |rrb| = .093) or in the traditional classroom (U = 48.00, p = .771, |rrb| = .111). Although men obtained slightly higher M scores in both groups, the effect sizes were small, suggesting that gender did not meaningfully differentiate academic performance in either environment (see **Table 3**).

Analysis of performance by age

The Kruskal-Wallis test showed no statistically significant differences according to age range in the gamified group (H = 0.468, p = .926, ε^2 = .000) or in the traditional group (H = 4.916, p = .296, ε^2 = .027). These results indicate that age was not a determining factor in academic performance in either methodological environment (see **Table 4**).

Analysis of academic performance by number of enrollments

The number of enrollments did not significantly differentiate academic performance in the gamified group (H = 3.613, p = .164, ε^2 = .045) or in the traditional group (H = 1.700, p = .427, ε^2 = .000). However, this result should be interpreted with caution because most students were enrolled in the course for the first time, resulting in unequal subgroup sizes (see **Table 5**).

Analysis of academic performance by completed activities

The number of completed activities, categorized into low, medium, and high completion levels, did not show statistically significant differences in academic performance in the gamified group (H = 1.353, p = .508,

Table 6. Kruskal-Wallis test results according to completed activities

Classroom type	H	p-value	Effect size ε²	n total	Enrollment categories
Gamified	1.353	.508	.000	39	3
Traditional	0.801	.670	.000		

Table 7. Kruskal-Wallis test results according to active days on the platform

Classroom type	H	p-value	Effect size ε²	n total	Enrollment categories
Gamified	1.569	.456	.000	39	3
Traditional	4.014	.134	.056		

Table 8. Mann-Whitney U test results according to type of device

Classroom type	U	p-value	Effect size |rrb|	n mobile	n computer
Gamified	219.50	.412	.155	19	20
Traditional	181.50	.860	.037	25	14

ε^2 = .000) or in the traditional group (H = 0.801, p = .670, ε^2 = .000). Therefore, the categorized number of completed activities did not substantially differentiate academic performance in either group (see **Table 6**).

Analysis of academic performance by active days on the platform

Active days on the platform did not significantly differentiate academic performance in the gamified group (H = 1.569, p = .456, ε^2 = .000) or in the traditional group (H = 4.014, p = .134, ε^2 = .056). The effect sizes were close to zero or small, suggesting that platform access frequency did not substantially explain performance differences within either methodological environment (see **Table 7**).

Analysis of academic performance by type of device

Finally, device type was not significantly associated with academic performance. No statistically significant differences were found between students who used mobile devices and those who used computers in the gamified group (U = 219.50, p = .412, |rrb| = .155) or in the traditional group (U = 181.50, p = .860, |rrb| = .037). These small effect sizes indicate that device type was not a relevant differentiating factor for academic performance (see **Table 8**).

Overall, the results showed no statistically significant differences in academic performance according to gender, age, number of enrollments, completed activities, active days, or type of device. The effect sizes were small or close to zero in most comparisons, suggesting that these variables did not substantially differentiate student performance in either the gamified or traditional e-learning environment.

Objective 3

To address the third objective, student satisfaction with the e-learning environment was analyzed and its relationship with academic performance was examined in both the gamified and traditional groups. Student satisfaction was measured using the 10-item ad hoc questionnaire described in the methodology section.

The Mann-Whitney U test was applied item by item to compare satisfaction between the gamified and traditional groups. The results showed statistically significant differences in all items, with higher M scores in the gamified group. These differences were observed in motivation, understanding of contents, classroom organization, pace of work, enjoyment of learning, clarity of instructions, progressive advancement, autonomy, commitment, and overall satisfaction. The effect sizes were moderate to large, indicating that the differences were not only statistically significant but also educationally relevant (see **Table 9** and **Figure 3**).

To examine the relationship between overall satisfaction and academic performance, Spearman's correlation coefficient was calculated separately for each group, as this coefficient is appropriate when normality is not assumed and when the relationship between variables may not be strictly linear (Hauke & Kossowski, 2011). In the gamified group, the relationship between overall satisfaction and academic performance was not statistically significant, ρ = -.105, p = .525. Similarly, in the traditional group, no statistically significant relationship was found, ρ = .008, p = .963 (see **Table 10**).

These results suggest that, although the gamified group reported significantly higher satisfaction levels than the traditional group, overall satisfaction was not significantly associated with academic performance

Table 9. Comparison of satisfaction means between the gamified and traditional classrooms

Item	Gamified M	Traditional M	U	p-value	Effect size rrb
Motivation	4.154	3.333	1183.50	< .001	.556
Understanding of contents	4.256	3.000	1352.00	< .001	.778
Classroom organization	4.128	3.179	1245.00	< .001	.637
Pace of work	4.282	3.077	1369.50	< .001	.801
Enjoyment of learning	4.436	3.231	1361.00	< .001	.790
Clarity of instructions	4.359	3.385	1257.00	< .001	.653
Progressive advancement	4.359	3.026	1368.00	< .001	.799
Autonomy	4.333	3.179	1305.50	< .001	.717
Commitment	4.308	3.128	1372.50	< .001	.805
Overall satisfaction	4.333	3.308	1290.50	< .001	.697

Note. The Mann-Whitney U test was used for item-by-item comparison & the rank-biserial correlation was reported as effect size

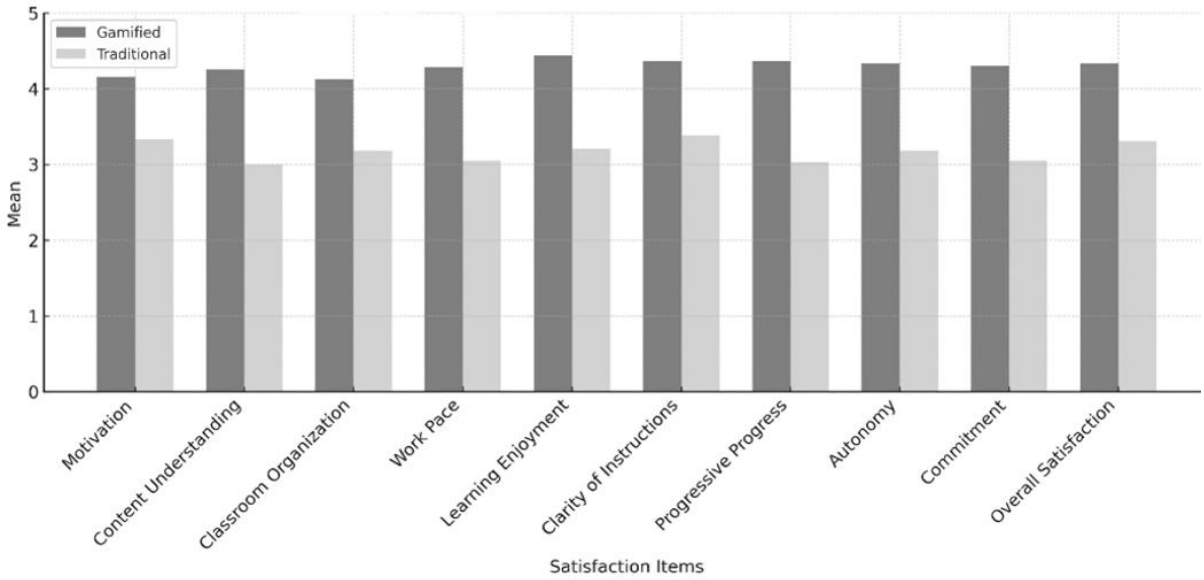


Figure 3. Comparison of student satisfaction by item between the gamified and traditional classrooms (the authors' own elaboration based on the study data)

Table 10. Spearman's correlation between overall satisfaction and academic performance by classroom type

Classroom type	Spearman's ρ	p-value
Gamified classroom	-.105	.525
Traditional classroom	.008	.963

within either group. Therefore, the positive difference observed in academic performance should be interpreted as related to the instructional design of the gamified environment rather than to a direct linear association between satisfaction and final grades.

Objective 4

To address the fourth objective, a two-stage cluster analysis was conducted to identify differentiated student profiles according to academic performance and overall satisfaction. First, hierarchical cluster analysis using Ward's method was applied to explore the structure of the data and determine the possible number of groups (Corter, 2023). The dendrogram suggested a three-cluster solution, which was then used as the basis for K-means clustering. K-means was applied to classify students according to standardized scores of academic performance and overall satisfaction, following its usefulness for grouping students according to academic performance-related variables (Anita et al., 2024) (**Figure 4**).

Based on this segmentation, the 78 students were classified according to their final academic performance scores, measured on a 0-50-point scale, and their overall satisfaction, measured on a 1-5 scale. The K-means cluster centers are presented in **Table 11**.

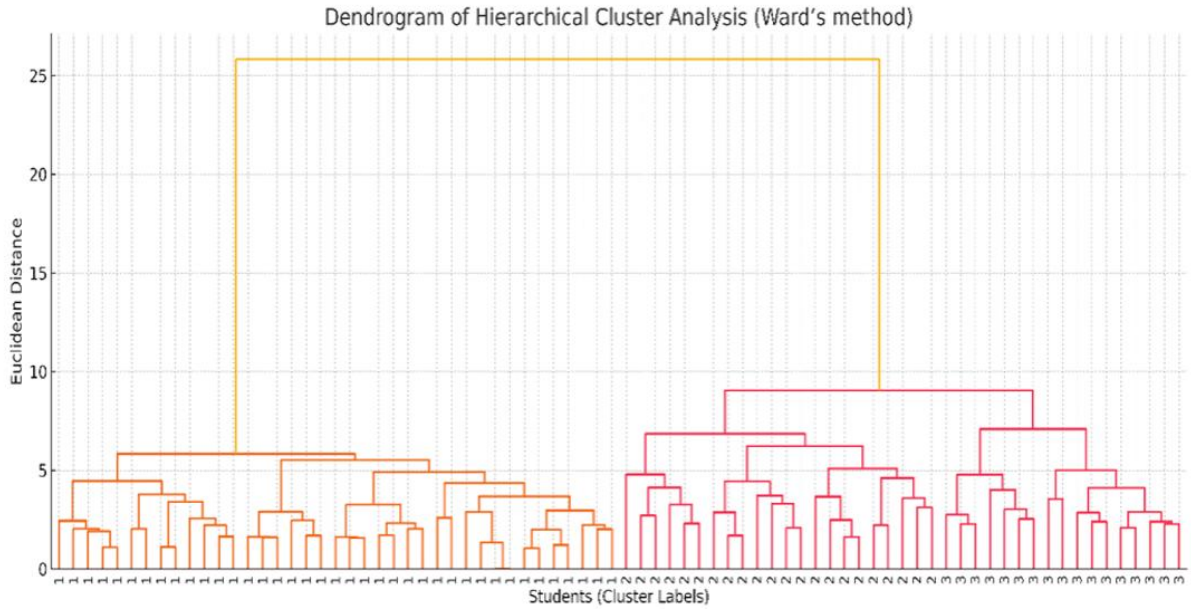


Figure 4. Dendrogram of the hierarchical cluster analysis using Ward's method (the uthors' own elaboration based on the study data)

Table 11. K-means cluster centers according to academic performance and overall satisfaction

Cluster	Academic performance (0-50)	Overall satisfaction (1-5)	Gamified classroom	Traditional classroom
0	41.59	2.87	1	22
1	3.14	3.57	1	6
2	44.83	4.31	37	11

Table 12. Student profiles identified from the K-means analysis: distribution by classroom type

Cluster	Identified profile	Gamified classroom	Traditional classroom	Gamified classroom (%)	Traditional classroom (%)
2	High performance-high satisfaction	37	11	77.1	22.9
0	Intermediate performance-low satisfaction	1	22	4.3	95.7
1	Low performance-moderate satisfaction	1	6	14.3	85.7

Note. Percentages indicate the representation of each classroom type within each cluster

Table 11 shows three differentiated profiles. Cluster 2 represented the most favorable profile, characterized by high academic performance and high overall satisfaction, and was mainly composed of students from the gamified classroom. Cluster 0 grouped students with intermediate academic performance and low satisfaction, most of whom belonged to the traditional classroom. Cluster 1 included students with very low academic performance and moderate satisfaction, indicating that low performance was not necessarily accompanied by low satisfaction.

To facilitate pedagogical interpretation, **Table 12** presents the distribution of each cluster according to classroom type.

Overall, the cluster analysis showed that the gamified classroom was predominantly represented in the high-performance and high-satisfaction profile. However, these findings should be interpreted as exploratory, since cluster analysis identifies patterns of grouping but does not establish causal relationships.

DISCUSSION AND CONCLUSION

The results of this study suggest that the implementation of a gamified e-learning strategy was associated with higher academic performance compared with a traditional e-learning methodology. Students in the gamified classroom obtained higher final grades, and the effect size indicated that this difference was not only statistically significant but also educationally relevant. These findings are consistent with previous studies showing that gamification can support participation, engagement, and academic achievement when game

elements are integrated into a coherent instructional design (Oliveira et al., 2024). Similarly, the use of experience points, levels, and badges has been associated with increased student engagement in higher education contexts (Barata et al., 2013).

From a pedagogical perspective, these findings reinforce that gamification should not be understood as the simple addition of game elements to a virtual classroom. Its effectiveness depends on the alignment between learning objectives, content organization, feedback, assessment criteria, and student progression. In this study, the gamified environment was structured through a learning path, progressive levels, restricted access, points, feedback, and a final badge. These elements may have made progress more visible and organized the learning process in a more motivating way. This interpretation is aligned with studies emphasizing the motivational role of game mechanics in academic performance (Gupta & Gomathi, 2017; Stanescu et al., 2019), although the effect of badges, missions, and other mechanics may vary depending on their design and implementation (Dicheva et al., 2020; Flores & Pinto, 2023).

Regarding personal and platform-use variables, no statistically significant differences in academic performance were found according to gender, age, number of enrollments, completed activities, active days, or type of device. This suggests that the differences observed between the gamified and traditional groups were not substantially explained by these variables. This finding is consistent with Thongkoo and Daungcharone (2025), who reported that gender did not necessarily determine academic performance in gamified learning contexts. However, the unequal distribution of some variables, particularly gender and number of enrollments, should be considered when interpreting these results.

In relation to student satisfaction, the gamified group obtained significantly higher scores across all questionnaire items. This indicates that the gamified e-learning environment was perceived more favorably than the traditional environment, supporting previous studies showing that gamified tools can improve motivation, engagement, and satisfaction in higher education (Ain et al., 2024). However, the correlation analysis showed that overall satisfaction was not significantly associated with academic performance within either group. Therefore, satisfaction should not be interpreted as a direct predictor of final grades. Rather, the results suggest that the gamified instructional design was associated with higher academic performance and higher student satisfaction at the group level.

The cluster analysis provided an exploratory perspective by identifying three differentiated student profiles. The most favorable profile combined high academic performance and high satisfaction and was mainly composed of students from the gamified classroom. The second profile showed intermediate performance and low satisfaction, mainly among students from the traditional classroom. The third profile showed low performance and moderate satisfaction, indicating that low grades were not necessarily accompanied by low satisfaction. These profiles are consistent with previous studies linking academic performance, satisfaction, engagement, and interaction with the learning environment (Chen et al., 2022; Jackson & Mentzer, 2017; Soria-Barreto et al., 2024). They also align with research showing that satisfaction may vary according to perceived value, stimulation, expectations, academic background, socioeconomic conditions, and engagement levels (Blanz, 2014; Griffioen et al., 2018; Helal et al., 2019; Huam et al., 2012; Lazibat et al., 2014; Maniriho, 2024).

The findings have practical implications for higher education institutions that implement e-learning programs. First, gamification should be incorporated as part of a structured instructional design rather than as an isolated motivational resource. Second, institutions should support teacher training in the pedagogical use of gamification, including the design of learning paths, feedback systems, progression rules, and assessment alignment. Third, student profiles obtained through cluster analysis can help instructors design differentiated support strategies. For example, students with intermediate performance and low satisfaction may require motivational support, while students with low performance and moderate satisfaction may need academic reinforcement and closer monitoring.

Overall, this study provides empirical evidence on the use of gamification in an Ecuadorian higher-education e-learning context. The results suggest that a structured and pedagogically grounded gamified design can contribute to higher academic performance and greater student satisfaction when compared with a traditional e-learning methodology. At the same time, satisfaction should not be interpreted as a direct predictor of academic performance. Therefore, the contribution of gamification appears to be related to the

instructional design of the virtual environment as a whole, including progression, feedback, autonomy, narrative, and structured challenges.

In conclusion, gamification represents a promising pedagogical strategy for enriching e-learning processes in higher education when it is intentionally designed and aligned with course objectives. In this study, the gamified environment was associated with better academic results and higher satisfaction levels than the traditional environment. Additionally, the cluster analysis showed the value of identifying differentiated student profiles to support pedagogical decision-making. These results reinforce the need to move beyond isolated game elements and to design gamified e-learning environments that are coherent, contextualized, and pedagogically meaningful.

Limitations

Although this study provides relevant evidence on the use of gamification in higher-education e-learning contexts, several limitations should be considered. First, the study used a quasi-experimental design with two intact classroom groups. Although both groups belonged to the same course and academic period, were taught by the same instructor, and followed the same contents, number of activities, assessment criteria, and final grade scale, participants were not randomly assigned. Therefore, causal interpretations should be made with caution.

Second, the sample was intentionally selected and consisted of 78 students from a single course in the early childhood education program at one Ecuadorian university. This limits the generalizability of the findings to other programs, disciplines, institutions, or national contexts. In addition, some personal variables, particularly gender and number of enrollments, showed unequal subgroup distributions, which may have reduced the statistical power of some comparisons.

Third, the satisfaction questionnaire was designed ad hoc for this study according to the pedagogical dimensions of the gamified intervention. Although the exploratory factor analysis and Cronbach's alpha provided preliminary evidence of construct validity and internal consistency in the present sample, the instrument should be further examined in future studies with larger samples and confirmatory procedures.

Fourth, the intervention lasted eight weeks, which made it possible to analyze academic performance and satisfaction at the end of the course but did not allow assessment of long-term effects. Future longitudinal studies could examine whether the observed differences are maintained over time.

Finally, the cluster analysis was exploratory and based on two variables: academic performance and overall satisfaction. Although it provided useful pedagogical profiles, it did not include other factors that may influence learning in virtual environments, such as prior academic achievement, self-regulation, digital competence, socioeconomic conditions, or baseline motivation. Future studies should integrate these variables to obtain a more comprehensive understanding of student profiles in gamified e-learning environments.

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Ethics declaration: This study was approved by the Human Research Ethics Committee at the Universidad Técnica de Manabí on 28 November 2025 with approval number CEISH-UTM-INT_25-11-05_JMVL_art. All participants provided voluntary informed consent, and confidentiality and anonymity were ensured throughout the research process. The study complied with national regulations and international ethical standards for research involving human participants.

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REFERENCES

Ain, N. U., Khan, R. A., & Iqbal, S. (2024). Unlocking the potential: Evaluating the impact of online gamified and non-gamified assessment tools on academic performance, motivation, engagement and satisfaction in undergraduate medical education. *Innovations in Education and Teaching International, 63*(1), 208-222. https://doi.org/10.1080/14703297.2024.2439472

Almeida, C., Kalinowski, M., Uchoa, A., & Feijó, B. (2023). Negative effects of gamification in education software: Systematic mapping and practitioner perceptions. *Information and Software Technology, 156*, Article 107142. https://doi.org/10.1016/j.infsof.2022.107142

AL-Smadi, M. (2015). GAMEDUCATION: Using gamification techniques to engage learners in online learning. In M. Ebner, K. Erenli, R. Malaka, J. Pirker, & A. E. Walsh (Eds.), *Immersive education. EiED 2014. Communications in computer and information science, vol 486* (pp. 85-97). Springer. https://doi.org/10.1007/978-3-319-22017-8_8

Anita, Kumar, N., Yadav, M., Karishma, Yadav, Y., & Sharma, R. (2024). The application of K-means clustering to analyze and enhance academic performance. *Nanotechnology Perceptions, 20*(S3), 597-603. https://doi.org/10.62441/nano-ntp.v20iS3.44

Baldrich, K., Pérez-García, C., Domínguez-Oller, J. C., & Amo Sánchez-Fortún, J. M. de. (2024). Gamified experiences in educational academic contexts: A systematic review. *Qualitative Research in Education, 13*(3), 221-242. https://doi.org/10.17583/qre.13552

Barata, G., Gama, S., Jorge, J., & Gonçalves, D. (2013). Improving participation and learning with gamification. In *Proceedings of the 1st International Conference on Gameful Design, Research, and Applications* (pp. 10-17). ACM. https://doi.org/10.1145/2583008.2583010

Blanz, M. (2014). How do study satisfaction and academic performance interrelate? An investigation with students of social work programs. *European Journal of Social Work, 17*(2), 281-292. https://doi.org/10.1080/13691457.2013.784190

Chen, L., Li, M., & Chen, Y. (2022). Research on course score analysis based on k-means clustering algorithm. In *Proceedings of the 2022 2nd Asia-Pacific Conference on Communications Technology and Computer Science* (pp. 485-488). IEEE. https://doi.org/10.1109/ACCTCS53867.2022.00104

Consejo de Educación Superior. (2022). Avances en educación superior: Vol. 2 [Advances in higher education: Vol. 2]. *Consejo de Educación Superior*. https://www.ces.gob.ec/wp-content/uploads/2023/06/Avances-en-Educacio%CC%81n-Superior-Vol2.pdf

Corter, J. E. (2023). Clustering approaches. In R. J. Tierney, F. Rizvi, & K. Ercikan (Eds.), *International encyclopedia of education* (pp. 627-636). Elsevier. https://doi.org/10.1016/B978-0-12-818630-5.10072-7

Crawford, J., Butler-Henderson, K., Rudolph, J., Malkawi, B., Glowatz, M., Burton, R., Magni, P. A., & Lam, S. (2020). COVID-19: 20 countries' higher education intra-period digital pedagogy responses. *Journal of Applied Learning & Teaching, 3*(1), 9-28. https://doi.org/10.37074/jalt.2020.3.1.7

Csikszentmihalyi, M. (1990). *Flow: The psychology of optimal experience*. Harper & Row.

Dicheva, D., Caldwell, R., & Guy, B. (2020). Do badges increase student engagement and motivation? In *Proceedings of the 21st Annual Conference on Information Technology Education* (pp. 81-86). ACM. https://doi.org/10.1145/3368308.3415393

Flores, N. H., & Pinto, R. (2023). Quest-based gamification in a software development lab course: A case study. In *Proceedings of the 9th International Conference on Higher Education Advances* (pp. 541-548). Editorial Universitat Politècnica de València. https://doi.org/10.4995/HEAd23.2023.16110

Garcia-Cabot, A., Garcia-Lopez, E., Caro-Alvaro, S., Gutierrez-Martinez, J. M., & de-Marcos, L. (2020). Measuring the effects on learning performance and engagement with a gamified social platform in an MSc program. *Computer Applications in Engineering Education, 28*(1), 207-223. https://doi.org/10.1002/cae.22186

Griffioen, D. M. E., Doppenberg, J. J., & Oostdam, R. J. (2018). Are more able students in higher education less easy to satisfy? *Higher Education, 75*, 891-907. https://doi.org/10.1007/s10734-017-0176-3

Gupta, A., & Gomathi, S. (2017). A review on gamification and its potential to motivate and engage employees and customers: Employee engagement through gamification. *International Journal of Sociotechnology and Knowledge Development, 9*(1), 42-52. https://doi.org/10.4018/IJSKD.2017010103

Han, H.-C., & Lee, C.-W. (2024). Satisfaction with online education based on gamification design: The mediating role of engagement and learning effectiveness. *Journal of Communication Design, 86*, 327-341. https://doi.org/10.25111/jcd.2024.86.22

Hauke, J., & Kossowski, T. (2011). Comparison of values of Pearson's and Spearman's correlation coefficients on the same sets of data. *Quaestiones Geographicae, 30*(2), 87-93. https://doi.org/10.2478/v10117-011-0021-1

Helal, S., Li, J., Liu, L., Ebrahimie, E., Dawson, S., & Murray, D. J. (2019). Identifying key factors of student academic performance by subgroup discovery. *International Journal of Data Science and Analytics, 7*(3), 227-245. https://doi.org/10.1007/s41060-018-0141-y

Huam, H. T., Jantan, M., & Rasli, A. M. (2012). Self-regulated learning and Tinto's model: An empirical study on university students. *The New Educational Review, 29*(3), 183-191.

Jackson, A., & Mentzer, N. (2017). Cluster analysis in engineering education. In *Proceedings of the 2017 ASEE Annual Conference & Exposition*. https://doi.org/10.18260/1-2--28044

Jiménez-Bucarey, C., Acevedo-Duque, Á., Müller-Pérez, S., Aguilar-Gallardo, L., Mora-Moscoso, M., & Campos-Valenzuela, M. (2021). Student's satisfaction of the quality of online learning in higher education: An empirical study. *Sustainability, 13*(21), Article 11960. https://doi.org/10.3390/su132111960

Kashive, N., & Mohite, S. (2023). Use of gamification to enhance e-learning experience. *Interactive Technology and Smart Education, 20*(4), 554-575. https://doi.org/10.1108/ITSE-05-2022-0058

Khaldi, A., Bouzidi, R., & Nader, F. (2023). Gamification of e-learning in higher education: A systematic literature review. *Smart Learning Environments, 10*, Article 10. https://doi.org/10.1186/s40561-023-00227-z

Lampropoulos, G., & Sidiropoulos, A. (2024). Impact of gamification on students' learning outcomes and academic performance: A longitudinal study comparing online, traditional, and gamified learning. *Education Sciences, 14*(4), Article 367. https://doi.org/10.3390/educsci14040367

Latorre-Cosculluela, C., Sierra-Sánchez, V., & Vázquez-Toledo, S. (2025). Gamification, collaborative learning and transversal competences: Analysis of academic performance and students' perceptions. *Smart Learning Environments, 12*, Article 2. https://doi.org/10.1186/s40561-024-00361-2

Lauretto, M. D. S., Nakano, F., Pereira, C. A. D. B., & Stern, J. M. (2012). Intentional sampling by goal optimization with decoupling by stochastic perturbation. *AIP Conference Proceedings, 1490*(1), 189-201. https://doi.org/10.1063/1.4759603

Lazibat, T., Baković, T., & Dužević, I. (2014). How perceived service quality influences students' satisfaction? Teachers' and students' perspectives. *Total Quality Management & Business Excellence, 25*(7-8), 923-934. https://doi.org/10.1080/14783363.2014.916036

Liu, Y., & Chen, W. (2012). A SAS macro for testing differences among three or more independent groups using Kruskal-Wallis and Nemenyi tests. *Journal of Huazhong University of Science and Technology [Medical Sciences], 32*, 130-134. https://doi.org/10.1007/s11596-012-0023-9

Maniriho, A. (2024). Satisfaction and academic performance of undergraduate economics students. *Cogent Education, 11*(1), Article 2326707. https://doi.org/10.1080/2331186X.2024.2326707

Mostafa, L. (2019). Student sentiment analysis using gamification for education context. En A. E. Hassanien, A. Taha, K. Shaalan, & M. M. Gaber (Eds.), *Proceedings of the International Conference on Advanced Intelligent Systems and Informatics 2019* (pp. 356-364). Springer. https://doi.org/10.1007/978-3-030-31129-2_30

Oliveira, W., Scaico, P. D., Brambilla, A., Soltiyeva, A., Hamari, J., MilHosseini, S., & Dindar, M. (2024). The effects of gamification on students' academic performance: A controlled experimental study. In *Proceedings of the 2024 IEEE International Conference on Advanced Learning Technologies* (pp. 47-49). IEEE. https://doi.org/10.1109/ICALT61570.2024.00020

Park, Y. (2025). Optimal two-stage group sequential designs based on Mann-Whitney-Wilcoxon test. *PLoS ONE, 20*(2), Article e0318211. https://doi.org/10.1371/journal.pone.0318211

Patrício, M., Ferreira, F., Oliveiros, B., & Caramelo, F. (2017). Comparing the performance of normality tests with ROC analysis and confidence intervals. *Communications in Statistics-Simulation and Computation, 46*(10), 7535-7551. https://doi.org/10.1080/03610918.2016.1241410

Romsi, A., Widodo, J. P., & Slamet, J. (2024). Empowering slow learners: Gamification's impact on students' engagement and academic performance in an LMS for undergraduate students. *International Journal of Information and Education Technology, 14*(2), 193-203. https://doi.org/10.18178/ijiet.2024.14.2.2040

Ryan, R. M., & Deci, E. L. (2000). Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. *American Psychologist, 55*(1), 68-78. https://doi.org/10.1037//0003-066x.55.1.68

Salas-Pilco, S. Z., Yang, Y., & Zhang, Z. (2022). Student engagement in online learning in Latin American higher education during the COVID-19 pandemic: A systematic review. *British Journal of Educational Technology, 53*(3), 593-619. https://doi.org/10.1111/bjet.13190

Soria-Barreto, K., Zuniga-Jara, S., Jaque-Silva, D., & Bortolotti-Nardon, C. (2024). Compromiso académico como determinante del desempeño y la satisfacción en estudiantes universitarios de ingeniería comercial [Academic commitment as a determinant of performance and satisfaction in university students of business engineering]. *Formación Universitaria, 17*(6), 89-98. https://doi.org/10.4067/s0718-50062024000600089

Stanescu, I. A., Stefan, A., Goldbach, I. R., & Hamza-Lup, F. G. (2019). Exploring the use of gamified systems in training and work environments. In *Proceedings of the International Scientific Conference on eLearning and Software for Education* (pp. 11-19). https://doi.org/10.12753/2066-026X-19-001

Thongkoo, K., & Daungcharone, K. (2025). Evaluating the impact of gamification-driven learning interventions: Gender differences in learning motivation and academic performance. In *Proceedings of the 2025 Joint International Conference on Digital Arts, Media and Technology with ECTI Northern Section Conference on Electrical, Electronics, Computer and Telecommunications Engineering* (pp. 119-124). IEEE. https://doi.org/10.1109/ECTIDAMTNCON64748.2025.10962110

Vélez Loor, J. M. V., Pérez Gracia, E. P., & Conde-Jiménez, J. C. (2025). Design and validation of an instrument to evaluate a gamified strategy in e-learning environments in higher education. *Journal of Information Technology Education: Innovations in Practice, 24*, Article 010. https://doi.org/10.28945/5521

