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GAMIFIED EDUCATIONAL ENVIRONMENTS: QUANTITATIVE ASSESSMENT OF THE LEVEL OF PARTICIPATION IN ONLINE EDUCATION SYSTEMS

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SUMMARY

Gamification has become an increasingly relevant strategy to foster student engagement in virtual learning environments. This study quantitatively assesses the level of student engagement in online education systems that integrate gamified elements, such as points, badges, and leaderboards. Using a cross-sectional methodology with descriptive and inferential statistical analysis, data were collected from 312 university students who participated in gamified courses during an academic semester. The results show a significant positive correlation between the use of gamified mechanics and the level of active participation, as well as a more favorable perception of the learning process. It is concluded that gamification in virtual environments represents an effective tool to improve student motivation and engagement.

Keywords: gamification, online education, student participation, virtual learning, educational technologies.

INTRODUCTION

In recent decades, online education has evolved from being a secondary alternative to a predominant educational modality, especially after the global impacts of the COVID-19 pandemic. This transformation has led to an accelerated digitalization of pedagogical processes, requiring institutions and teachers to have new strategies to maintain student attention, engagement, and motivation in virtual environments (Bond et al., 2020; Dziuban et al., 2021). One of the most persistent challenges in this context has been the low active participation of students in virtual platforms, due to factors such as isolation, cognitive overload, and lack of meaningful interaction (Hew et al., 2020).

Gamification has emerged as an innovative answer to this problem. This strategy consists of incorporating game design elements, such as rewards, levels, challenges, badges, and leaderboards, into non-gaming environments, in order to improve user engagement, motivation, and performance (Caponetto et al., 2023). In the educational field, gamification seeks to transform the learning process into a more attractive, interactive and personalized experience. Several studies have suggested that gamification can significantly increase participation and knowledge retention in virtual environments, by stimulating intrinsic motivation through achievement dynamics and constant feedback (Pan et al., 2023; Avila-Castro et al., 2021).

However, despite the growing enthusiasm for gamification in higher education, there is still a critical need for empirical evidence to support its real effectiveness. Most previous studies have focused on qualitative approaches or have presented contradictory results on their impact on academic achievement and student interaction (Lopez-Belmonte et al., 2021). Consequently, a more rigorous quantitative analysis is required to identify participation patterns, determine correlations with specific elements of gamification, and generate recommendations based on verifiable data.

This study aims to address this gap through a quantitative assessment of the level of participation of university students in online education systems that incorporate gamified elements. Through the analysis of interaction metrics in virtual learning platforms and structured surveys, it seeks to understand how and to what extent gamification influences the dynamics of participation and the perception of the educational process.

THEORETICAL FRAMEWORK

GAMIFICATION AS AN ONLINE EDUCATIONAL STRATEGY

Gamification has gained relevance in recent years as an innovative pedagogical technique that seeks to transfer elements of game design to non-playful educational contexts, in order to motivate students, promote active learning, and encourage sustained participation (Koivisto & Hamari, 2019). In the digital sphere, gamification is frequently integrated into learning management platforms (LMS), using mechanics such as rewards, levels, badges, challenges, and immediate feedback to make the educational process more engaging (Zainuddin et al., 2020).

Recent studies highlight that gamification has a positive impact on student engagement, especially when it is aimed at meeting specific educational goals (Domínguez et al., 2022). According to a systematic review by Pan et al. (2023), gamified environments can increase intrinsic motivation by activating psychological mechanisms related to autonomy, competence, and recognition.

TYPES OF GAMIFIED ELEMENTS

There are multiple components used in educational gamification. Table 1 summarizes the most common ones, based on recent studies on gamified instructional design.

Table 1. Common Gamified Elements in Virtual Learning Environments

Element	*Short Description*	*Main educational objective*	*Fountain*
Logos	Visual symbols that recognize achievements	Reinforcing progress	Zainuddin et al. (2020)
Points	Numerical rewards for completed tasks	Increase extrinsic motivation	Koivisto & Hamari (2019)
Levels	Stages that mark progressive progress	Generating a sense of self-improvement	Domínguez et al. (2022)
Position Tables	Classification among students	Foster positive competition	Pan et al. (2023)
Missions/Challenges	Complex tasks with defined objectives	Promote meaningful learning	Avila-Castro et al. (2021)
Immediate feedback	Automatic performance feedback	Improve learning control	Muñoz et al. (2021)

Source: Authors' elaboration based on Koivisto & Hamari (2019); Zainuddin et al. (2020); Pan et al. (2023).

STUDENT PARTICIPATION AND ITS RELEVANCE IN VIRTUAL ENVIRONMENTS

Active participation in virtual environments is a critical indicator of academic success. This manifests itself in actions such as the display of content, interaction in forums, timely delivery of tasks, and collaboration with colleagues (Hew et al., 2020). However, one of the main challenges of online education is precisely to maintain that participation in the absence of face-to-face interaction.

According to González-Zamar et al. (2021), gamification can act as a catalyst for participation by offering constant stimuli that maintain interest and generate frequent connection habits. In addition, tools such as

gamified adaptive learning allow the experience to be personalized according to the profile of each student, which also positively influences participation levels (Reisoğlu & Çebi, 2020).

THEORETICAL MODELS THAT SUPPORT GAMIFICATION

The effective implementation of gamification in virtual education is based on theories of learning and motivation. One of the most relevant is Deci **and Ryan's Self-Determination Theory**, adapted by researchers such as Koivisto and Hamari (2019), which argues that people are more motivated when they feel competent, autonomous, and related to others.
On the other hand, **Flow Theory**, originally proposed by Csikszentmihalyi and updated for digital contexts by Bressler and Bodzin (2021), establishes that a successful gamified design must balance the level of difficulty with the user's skills, generating an immersive experience that promotes sustained engagement.

METHODOLOGY

RESEARCH APPROACH AND DESIGN

This study is framed within a **quantitative** approach, which allows to objectively and systematically measure the relationship between gamification in virtual environments and the level of student participation. The design is **non-experimental, cross-sectional, and correlational**, since it sought to observe phenomena as they occur in their natural context without manipulating the variables, at a single point in time (Creswell & Creswell, 2018).
The choice of correlational design responds to the need to analyze associations between the use of gamified elements (independent variable) and the level of student participation in virtual educational platforms (dependent variable), without implying direct causality (Hernández-Sampieri et al., 2020).

PARTICIPANTS AND SAMPLE

The population was composed of undergraduate university students from virtual programs at four universities in Latin America (Colombia, Mexico, Ecuador, and Peru). A **non-probabilistic convenience sample was selected**, made up of **312 students**, who were taking subjects integrated with gamified tools on LMS platforms such as Moodle, Canvas and Blackboard, during the first semester of 2025.

Table 2. Sociodemographic characteristics of the sample

Variable	*Category*	*Frequency (n)*	*Percentage (%)*
Sex	Female	172	55.1
	Male	140	44.9
Age	18–22 years	196	62.8
	23–29 years	92	29.5
	30 years or older	24	7.7
Study Area	Social Sciences and Humanities	124	39.7
	Engineering and Technology	98	31.4
	Economics and Business Sciences	90	28.8

Source: Authors' elaboration based on data collected in the study (2025).

DATA COLLECTION INSTRUMENTS

Two main instruments were used for data collection:

1. **Structured questionnaire**: Adapted from the instrument validated by Gómez & Barrios (2020), composed of 20 Likert-type items (1 = strongly disagree to 5 = strongly agree), evaluating three dimensions:
    - Perceived motivation
    - Frequency of participation
    - Satisfaction with gamified elements

The reliability of the instrument was measured through Cronbach's alpha coefficient, reaching a value of **0.87**, which indicates a high internal consistency (Oviedo & Campo-Arias, 2020).

2. **Log analysis in LMS platforms**: Automated metrics were collected, such as:
    - Weekly connection time
    - Number of activities completed
    - Participation in forums and questionnaires
    - Access to gamified resources (ranking, challenges, badges)

PROCEDURE

The study was carried out in three phases:

- **Phase 1: Course selection and obtaining ethical permits**. 10 virtual subjects with implemented gamification were identified. Informed consent was obtained from the participants, following the principles of the Ethics Committee of the National University of Colombia (2022).
- **Phase 2: Application of the online questionnaire** through forms distributed through email and internal networks of the universities. The response rate was **87.5%.**
- **Phase 3: Collection and analysis of LMS data**, managed with the consent of the students, guaranteeing anonymity and academic use.

DATA ANALYSIS

Statistical processing was performed with **SPSS v.26 software**. The following were applied:

- **Descriptive statistics**: to summarize averages, frequencies and standard deviations.
- **Pearson correlation**: to identify relationships between the use of gamified elements and engagement metrics ($p < .01$).
- **Multiple linear regression analysis**: to estimate the predictive weight of each gamified dimension on active participation.

Table 3. Summary of techniques and variables analyzed

Statistical technique	*Dependent variable*	*Independent variables*	*Purpose of the analysis*
Descriptive statistics	Participation	N/A	Get the Overview
Pearson correlation	Total participation	Badges, challenges, connected time	Measure Strength and Direction of Relationship
Multiple Linear Regression	Total participation	Motivation, perceived level of gamification	Determine Joint Influence

Source: Authors' elaboration based on the methodological design of the study (2025).

RESULTS

GENERAL DESCRIPTIVE RESULTS

The descriptive statistical analysis allowed us to observe clear trends in terms of the level of participation in the gamified virtual courses. **78.2%** of participants interacted with gamified elements at least once a week, and **62.5%** regularly accessed leaderboards and weekly challenges. The mean weekly participation was **6.8 interactions per student**, with a standard deviation of 1.9.

In addition, participants showed high levels of perceived motivation (mean = 4.3/5), especially in relation to personalized challenges and progress badges, which is consistent with recent findings on the motivational impact of gamification (Avila-Castro et al., 2021; Pan et al., 2023).

Table 4. Descriptive statistics of key variables

Variable	*Stocking*	*Standard deviation*	*Minimal*	*Maximum*
Weekly Engagement (Interactions)	6.8	1.9	2	11
Perceived Motivation (1–5)	4.3	0.6	3.1	5.0

Access to badges (times/month)	8.4	2.2	3	13
Weekly connection time (minutes)	162	45	78	275

Source: Authors' elaboration based on data collected from LMS platforms (2025).

CORRELATION ANALYSIS

Pearson**'s correlation test was applied** to determine the relationship between gamified elements and active participation. The results revealed **significant positive correlations** in all the dimensions evaluated ($p < 0.01$), with the strongest being the relationship between badge use and weekly participation ($r = 0.68$).

Table 5. Correlations between gamified elements and engagement

Variables	*Weekly participation*	*Connected Time*	*Perceived motivation*
Using Badges	0.68**	0.54**	0.61**
Access to leaderboards	0.59**	0.43**	0.55**
Frequency of challenges	0.64**	0.51**	0.60**

Note: **p < 0.01

Source: Authors' elaboration based on analysis of SPSS v.26 (2025).

These results coincide with recent studies that indicate that gamification, when well designed, promotes autonomy and competence, central elements in self-determined motivation (Bressler & Bodzin, 2021; Zainuddin et al., 2020).

REGRESSION ANALYSIS

A multiple linear regression **was performed** to predict the level of weekly participation based on three predictors: perceived motivation, frequency of access to gamified elements, and connection time. The model was **statistically significant** ($F(3, 308) = 31.42$, $p < .001$), explaining **41.3%** of the variance ($R^2 = .413$).

Table 6. Multiple linear regression model

Predictor Variable	*B*	*Standard Error*	*Beta*	*t*	*Gis.*
Perceived motivation	1.42	0.33	0.39	4.30	.000**
Frequency of challenges	0.88	0.27	0.31	3.26	.001**
Weekly connection time	0.02	0.01	0.18	2.09	.038*

Note: *p < .05, **p < .01

Source: Authors' elaboration based on analysis of SPSS v.26 (2025).

The results show that **perceived motivation** and frequency **of challenges** are the best predictors of participation, supporting theoretical models such as Flow Theory and Self-Determination Theory, recently revalidated in gamified virtual environments (Caponetto et al., 2023; González-Zamar et al., 2021).

CONCLUSIONS

The findings of this study confirm that gamification, when strategically applied in online education environments, is a highly effective pedagogical tool to promote student participation. Gamified elements such as badges, challenges, leaderboards, and immediate feedback not only stimulate sustained interaction with the platform, but also reinforce intrinsic motivation, improve the perception of learning, and promote academic self-regulation behaviors (Avila-Castro et al., 2021; Pan et al., 2023).

One of the most relevant conclusions is that **perceived motivation** and frequency **of interaction with gamified challenges** were the factors that contributed the most to the increase in weekly participation, which is in line with the principles of the Self-Determination Theory, which points out the importance of generating an environment that facilitates the sense of competence, autonomy and social connection (Bressler & Bodzin, 2021; Koivisto & Hamari, 2019).

In addition, the study showed that the implementation of gamification does not require large technological resources, but rather an intentional pedagogical design, where the playful elements are aligned with the learning objectives. Multiple linear regression showed that the combination of motivation, connection time, and use of game mechanics significantly predicts active participation, a variable that, according to recent studies, is strongly associated with academic performance and student retention in virtual courses (González-Zamar et al., 2021; Zainuddin et al., 2020).

From a practical perspective, higher education institutions are recommended to incorporate gamified elements in their virtual platforms, especially in introductory or high-dropout courses, as a strategy to capture and maintain student interest. However, it is also necessary to avoid playful overload or excessive competition, as these can generate counterproductive effects if not managed properly (Domínguez et al., 2022).

Finally, it is suggested that future research explore the **longitudinal impact** of gamification, its relationship with variables such as final academic performance, knowledge retention and self-efficacy, as well as comparative studies between different disciplines or educational levels. It is also recommended to use experimental or quasi-experimental designs that allow more robust causal relationships to be established.

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