Determinants of gamification acceptance in Higher Education: an empirical model

Determinantes de la aceptación de la gamificación en la educación superior: un modelo empírico

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Recepción: 01 Junio 2024
Aprobación: 20 Agosto 2024

Acceso abierto diamante

Abstract

In recent years, the academic literature suggests the need for innovative pedagogical approaches, especially in higher education, to improve the learning results of younger generations. In line with this, gamification, which combines intrinsic and extrinsic motivation, emerges as a tool with the potential to meet younger generations' expectations. Using the Self-Determination Theory and the Technology Acceptance Model this study focuses on analyzing factors affecting the acceptance of gamification by university students. The combination of these two theories has allowed the proposal and testing of an explanatory model using structural equation modeling to analyze causal relationships between constructs, providing a more robust and detailed understanding of the factors that influence the acceptance of gamification in the applied context. The results of the study suggest that collaborative learning enhances perceived ease of use, perceived usefulness, attitude, and intention to use. Additionally, perceived competence increases perceived usefulness, and autonomy improves ease of use. These findings provide valuable insights to the object of study due to the methodology employed and point out the importance of understanding factors affecting gamification acceptance. Understanding these factors will enable educators and game developers to design more effective strategies when using gamification not only in accounting education but in other higher education disciplines.

Keywords: gamification, accounting education, self-determination theory, Technology Acceptance Model, SEM, simulator.

Resumen

En los últimos años, la literatura académica sugiere la necesidad de innovar en los enfoques pedagógicos, especialmente en la enseñanza superior, con el objetivo de mejorar los resultados de aprendizaje de las generaciones más jóvenes. En este sentido, la gamificación, que combina motivación intrínseca y extrínseca, surge como una herramienta con el potencial de satisfacer las expectativas de los estudiantes más jóvenes. Este estudio se centra en analizar los factores que influyen en la aceptación de la gamificación por parte de los estudiantes universitarios, empleando la teoría de la autodeterminación y el modelo de aceptación de la tecnológica. La combinación de ambas teorías ha permitido proponer y testar un modelo explicativo utilizando ecuaciones estructurales para analizar las relaciones de causalidad entre los constructos, proporcionando una comprensión más robusta y detallada de los factores que influyen en la aceptación de la gamificación en el contexto de aplicación. Los resultados del estudio sugieren que el aprendizaje colaborativo mejora la facilidad de uso percibida, la utilidad percibida, la actitud y la intención de uso de los estudiantes. Además, la competencia percibida aumenta la utilidad percibida y la autonomía mejora la facilidad de uso. Estos hallazgos proporcionan una perspectiva valiosa al objetivo de estudio debido a la metodología empleada y subrayan la importancia de entender los factores que afectan la aceptación de la gamificación. Comprender estos factores permitirá a los educadores y desarrolladores de juegos diseñar estrategias más efectivas, no solo en contabilidad, sino también en otras disciplinas de la educación superior.

Palabras clave: gamificación, educación contable, teoría de la autodeterminación, Modelo de Aceptación de la Tecnología, SEM, simulador.

INTRODUCTION

In accounting education instructors face the need to adopt new methodologies that encompass learning strategies adaptable to both the current educational context and the needs of younger generations (Abd Rahim et al., 2021). Accounting is often perceived as tedious, leading to a lack of enthusiasm due to its association with cumbersome tasks and the difficulty in understanding its content (Rosli et al., 2019). This negative perception contributes to low student motivation and engagement with the discipline (Ferreira & Santoso, 2008). A report by the European Commission in 2015 highlighted the need of adapting higher education to societal and labor market demands (European Commission, 2015). Subsequent initiatives, such as the Commission's communication on achieving the European Education Area by 2025 (European Commission, 2020) and the strategic framework for European cooperation in education and training towards the European Education Area and beyond (2021-2030) (European Union, 2021), have reaffirmed the need to align higher education with social and labor demands, emphasizing the necessity of reforms to ensure graduates' employability and competitiveness. Similarly, the World Forum of 2016 advocates for innovative learning strategies that foster social and emotional skills, recognizing the effectiveness of playful approaches to learning (World Forum on Education, 2016). In line with these ideas, the Pathways Report (2012) underscores the need to develop engaging curricular models that integrate technology to connect with new generations of students. The report highlights the importance of renewing curriculum design and pedagogies in accounting education, aligning them with fundamental objectives. It also emphasizes improving the perception of accounting studies and career opportunities to attract more students to the discipline, proposing an innovative approach to programs and curricula (Pathways, 2012).

In this context, gamification emerges as a pedagogical methodology aimed at enhancing students' intrinsic motivation and improving their learning outcomes (Putz & Treiblmaier, 2015). Gamification can influence both intrinsic and extrinsic motivation by reinforcing utilitarian and hedonic factors. However, a lack of understanding of factors predicting the adoption of gamified systems hinders the design of gamified learning activities (Dicheva et al., 2019). Therefore, it is important to have explanatory models that include constructs related to motivational factors to help predict the adoption of gamification in specific educational contexts (Dimitrijevic & Devedzic, 2021). Moreover, the adoption of a solid theoretical framework is especially relevant in the field of accounting, a field particularly limited in terms of research on educational gamification. Additionally, the study of intrinsic and extrinsic motivational factors suggests combining various theories, adopting a multi-theoretical perspective for a holistic understanding of the phenomenon (Putz & Treiblmaier, 2015). This theoretical combination is essential for the development of effective gamified research.

The primary objective of this research is to gain a better knowledge of the factors that influence the acceptance of a gamified learning methodology, implemented through a simulator, with the aim of promoting a significant methodological shift in accounting education. In this research framework, the Technology Acceptance Model (TAM) is expanded by incorporating constructs from Self-Determination Theory (SDT), specifically competence, autonomy, and social interaction derived from collaborative learning. Understanding and identifying the factors that influence students' attitudes toward a gamified methodology in accounting education can play a crucial role in improving their motivation and learning outcomes in accounting.

This study, unlike most previous research in the accounting curriculum, which has relied on descriptive statistics and mean differences, adopts an empirical approach through the analysis of a structural equation model. Additionally, the study contributes to the existing knowledge regarding the determinants of using gamified activities in accounting education.

To achieve the outlined objectives, the research begins with a review of the literature concerning gamification within accounting education, exploring its interconnection with the selected theoretical frameworks. Next, the gaming experience and methodology employed in this study are described. Third, the results are presented and discussed. Finally, the conclusions, directions for future research, and limitations of the study are provided.

Literature review and research hypotheses

Background

The Pathways Commission, established by the American Accounting Association (AAA) and the American Institute of Certified Public Accountants (AICPA), emphasized the importance of updating accounting education. The Commission proposed renewing educational models to align with labor market needs and incorporating technological elements. Pedagogical innovation, tailored to the learning preferences of new generations, and the creation of engaging, technologically advanced resources to maintain student engagement were identified as priorities. The report underscored the importance of aligning these changes with the fundamental principles of accounting education to ensure the development of ethical and competent professionals. The Commission also identified obstacles, such as delays in the adoption of pedagogical practices and the lack of appreciation for sound pedagogy (Pathways, 2012). Given the diverse information management skills required and the need for interactive learning among new generations, the literature has highlighted the necessity of reforming accounting education (Korcsmaros et al., 2019).

Gamification in Accounting Education

The term "gamification," first documented in 2008 (Paharia, 2010), has been defined as the use of game elements in non-game contexts (Deterding et al., 2011) and allows educators to motivate students by transforming the classroom into a game (Hanus & Fox, 2015). Games not only motivate but also enhance learning (Sathe & Yu, 2021; Carenys et al., 2017). Gamification has proven to be a valuable tool for increasing students' intrinsic motivation and fostering their interest in learning. Gamification captures students' attention and encourages their desire to learn by incorporating playful and challenging elements into educational activities. The intrinsic characteristics of games, such as fun and challenge, are essential for boosting motivation, as highlighted by various studies, including Luarn et al. (2023), Moradkhani et al. (2023), and Telles et al. (2022). Additionally, gamification improves participation, communication, teamwork, and promotes social interaction and collaborative work (Armenia et al., 2024; Xu et al., 2021). Moreover, game mechanics enable personalized cognitive scaffolding, facilitating learning at various paces (Hanus & Fox, 2015). Kapp (2012) emphasizes the role of feedback in gamification through the use of points, badges, and leaderboards. Gamification goes beyond mere entertainment; it is an educational methodology that inspires, engages, and provides meaningful knowledge, as Barr (2018) highlights.

Research on gamification in accounting education reveals a range of cognitive, affective, and behavioral effects. Gamified teaching has been shown to be effective in improving, among other things, teamwork skills (Sidorova et al., 2023), social relationships (Abd Rahim et al., 2021), and students' competence and autonomy (Abd Rahim et al., 2021). In the affective domain, gamification has been noted for the satisfaction and enjoyment it generates (Carenys et al., 2022; Grávalos-Gastaminza et al., 2022;Carenys et al., 2017), which encourages a change in students' attitudes (Selamat & Naglim, 2021), improves their perception of accounting (Silva, et al., 2021), and is preferred over other methodologies (Kuang et al., 2021).

The positive relationship between gamification, learning, and performance is well-documented in the cognitive field (López-Hernández et al., 2023; Ortiz-Martínez et al., 2023; Ortiz-Martínez et al., 2022; Sercemeli & Baydas Onlu, 2023; Chan et al., 2021; Elkelish & Ahmed, 2021). Gamification is also associated with the development of specific cognitive skills, such as communication, problem-solving, critical thinking (Carvalho & Neto, 2023; Rosli et al., 2019), and planning (Ugrin et al., 2021).

There are various ways to implement gamified activities (e.g., board games, video games, etc.). The academic literature highlights the advantages of simulators, conceptualized by Carenys et al. (2017) as computer-based instruction that immerses students in decision-making exercises within an artificial environment, thereby fostering the understanding of complex business interrelationships and facilitating the development of key skills. If the goal of gamification is to increase students' intrinsic motivation to improve their academic performance, when combined with technology, it further enhances their motivation and commitment to learning accounting (Gayao et al., 2021; Tandiono, 2021; Creel et al., 2021). Designed in this way, gamification can shift students' perspectives, presenting itself as an innovative educational methodology that counters the perception of accounting as abstract and dull, which negatively impacts interest and performance.

Self-Determination Theory

Deci and Ryan's (1985) Self-Determination Theory (SDT) proposes three fundamental psychological needs that promote intrinsic motivation and well-being: competence (COMPE), autonomy (AUT), and relatedness (COL). It explores how individuals' intrinsic motivations impact their behavior (Vasconcellos et al., 2020). Competence refers to the desire to be effective and proficient in carrying out an activity, autonomy to the desire to regulate and control one's behavior, and relatedness to the desire to feel connected to others (Nikou & Economides, 2017). Tyack and Mekler (2020) conclude that competence, autonomy, and relatedness strengthen intrinsic motivation in human-computer interactions related to games. Dicheva et al. (2019) highlight competence as key in gamification for driving intrinsic motivation. Li et al. (2024) emphasize that both autonomy and relatedness are essential, while competence has a minimal influence. In the context of gamified accounting, Abd Rahim et al. (2021) suggest that autonomy and competence positively impact student motivation. Abd-Mutalib et al. (2019) observe that gamification provides control and influence, increases engagement and social connections, and fosters competition among groups. These findings underscore the versatility of SDT in explaining the effect on students' intrinsic motivation, which can contribute to greater engagement in the learning process.

Technology Acceptance Theory

The Technology Acceptance Model (TAM), proposed by Davis (1989) and grounded in the theories of reasoned action and perceived self-efficacy, highlights perceived usefulness (PU) and perceived ease of use (PEOU) as key determinants of technology adoption (Davis, 1989; Ajzen & Fishben, 1980). Perceived usefulness refers to the expected improvement in performance, while perceived ease of use relates to the perceived effort involved in its application (Davis, 1989). These factors influence the attitude toward use (ATT) and the intention to use (INT). The literature includes references that analyze how attitudinal perceptions positively influence the acceptance and use of games (Himang et al., 2021; Matute-Vallejo & Melero-Polo, 2019; Bourgonjon et al., 2013). Therefore, our first hypothesis is as follows:

H1. The student's attitude (ATT) positively predicts the intention to use the methodology (INT).

Although TAM emphasizes the relevance of perceived usefulness as a fundamental factor affecting the attitude toward the use of games, findings across different studies offer divergent results. Regarding perceived usefulness, many studies support its significant impact on attitude (Kuang et al., 2023; Chen & Zhao, 2022; Malaquias et al., 2018), but there are also studies where perceived usefulness was not a significant predictor of attitude or intention to use games (Himang et al., 2021; Lee, 2009; Ha et al., 2007). Thus, we propose our second hypothesis:

H2. Perceived usefulness (PU) positively predicts the student's attitude (ATT).

Another relevant factor for measuring attitude toward games according to TAM is ease of use. However, the results regarding the relationship between ease of use and attitude are also inconclusive. While recent studies confirm a significant relationship between ease of use and attitude (Kuang et al., 2023; Chen & Zhao, 2022; Himang et al., 2021), earlier studies conclude that the relationship is not significant (Davis & Lang, 2012). Therefore, we propose our third hypothesis:

H3. Perceived ease of use (PEOU) positively predicts the student's attitude (ATT).

However, regarding ease of use, some arguments in the literature suggest that, although it does not directly influence the intention to use, it exerts an influence through perceived usefulness (Şahin & Yildiz, 2024; Yoon et al., 2013; Davis & Lang, 2012). For instance, Abdullahm et al. (2016) found that the best predictor of perceived usefulness among students is perceived ease of use. Based on this discussion, we present our fourth hypothesis:

H4. Perceived ease of use (PEOU) positively predicts the perceived usefulness (PU) of the system.

SDT Variables as Determinants of TAM

The lack of specific determinants that may influence perceived usefulness and perceived ease of use to identify factors impacting students' use of ICTs has led to the combination of TAM with other theories (Venkatesh & Bala, 2008). For instance, Suckake (2019) provides a review of combinations of TAM with other theories such as Self-Determination Theory (SDT), the Theory of Planned Behavior (TPB), and Consumer Motivation Theory (CMT), among others. Additionally, Putz and Treiblmaier's (2015) study identifies relevant theories for gamification, suggesting a multi-theoretical perspective to gain a comprehensive understanding of gamification. It has been found that SDT determinants are related to the characteristics of technology-enhanced learning environments in educational settings (He & Li, 2023; Matute-Vallejo & Melero-Polo, 2019; Nikou & Economides, 2017; Lee et al., 2015). For example, Lee et al. (2015) confirmed a significant relationship between SDT and the Unified Theory of Acceptance and Use of Technology (UTAUT). It was discovered that students' intrinsic motivation plays a more important role than extrinsic motivation in influencing their behavioral intention to use cloud services.

Regarding the constructs within SDT and their connection to TAM's extrinsic factors, perceived usefulness and perceived ease of use, the literature presents mixed conclusions. Buil et al. (2020) emphasize the importance of competence in relation to perceived usefulness, while Bitrián et al. (2021) highlight its greater impact on perceived ease of use. Fathali and Okada (2018) identify the relevance of competence in both extrinsic constructs. Conversely, Racero et al. (2020) conclude that competence does not effectively predict either perceived usefulness or perceived ease of use, while He and Li (2023) find a positive relationship between competence and perceived ease of use. Based on these considerations, we propose our fifth and sixth hypotheses:

H5. Perceived competence (COMPE) positively predicts perceived usefulness (PU).

H6. Perceived competence (COMPE) positively predicts the perceived ease of use of the system (PEOU).

Regarding autonomy, the literature highlights it as a key factor in positively strengthening intrinsic motivations related to perceived usefulness and ease of use (Nandi & Mehendali, 2022; Bitrián et al., 2021; Racero et al., 2020; Fathali & Okada, 2018; Nikou & Economides, 2017). In studies conducted by Nandi and Mehendali (2022) and Su and Chen (2022), autonomy was identified as the most significant factor in the constructs analyzed within SDT, and He and Li (2023) emphasize the positive relationship between autonomy and ease of use. However, Hu et al. (2023) found in two experimental studies that chatbots generated a lower level of perceived autonomy compared to website interfaces. This decrease negatively affected the perceived usefulness and perceived ease of use of chatbots for consumers, in turn impacting satisfaction and attitude toward the product. Based on these arguments, we propose our seventh and eighth hypotheses:

H7. Perceived autonomy (AUT) positively predicts perceived usefulness (PU).

H8. Perceived autonomy (AUT) positively predicts perceived ease of use (PEOU).

Finally, we examine social relatedness, as the third construct of SDT, understood in the educational context as the capacity to engage in activities that foster collaboration and communication among peers, which in this study is analyzed as collaborative learning (Sergis et al., 2018). The literature also recognizes that social factors have a significant and positive influence on perceptions of usefulness and ease of use (Chahal & Rani, 2022; Bitrián et al., 2021). Thus, we propose the ninth and tenth hypotheses:

H9. Collaborative learning (COL) positively predicts perceived usefulness (PU).

H10. Collaborative learning (COL) positively predicts perceived ease of use (PEOU).

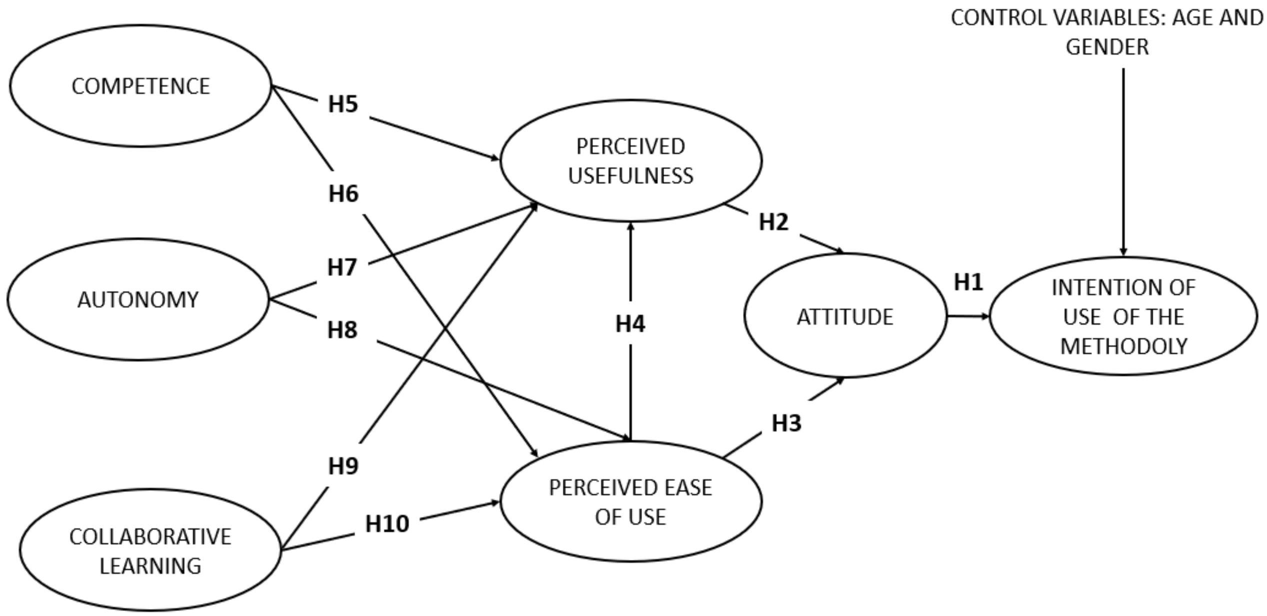

Figure 1
Research Model

Research Model

METHODOLOGY

Research Design and Measurement Instrument

This research adopts a pre-experimental post-test design. The constructs were measured by adapting scales previously validated in academic literature. Intention to use, perceived usefulness, and perceived ease of use were measured using three, five, and three items, respectively, adapted from Bourgonjon et al. (2010) and Filippou et al. (2018). The attitude variable was measured with four items adapted from Matute-Vallejo and Melero-Polo (2019) and Taylor and Todd (1995). The variables of competence and autonomy were measured using six and four items, respectively, adapted from Nikou and Economides (2017) and Lee et al. (2015). Finally, collaborative learning (COL) was measured using eight items adapted from Fu et al. (2009). All constructs were measured using a 7-point Likert scale (where 1 = strongly disagree and 7 = strongly agree). Appendix A contains the measurement instrument. Gender was measured using a dichotomous scale (male/female), and age was measured using a ratio scale.

Sample description

The study sample consisted of 149 undergraduate and postgraduate students from four Spanish universities. The intervention was conducted in various classrooms within each university. To select participants, an initial contact was made with instructors of accounting-related subjects, who then introduced the activity to their students. Students were randomly selected on the condition that they were enrolled in, or had completed, second-level or higher accounting courses. Additionally, all students participated voluntarily and signed an informed consent form at the beginning of the activity.

The participating universities and the distribution of students were as follows: 33.6% of the students were from the European University of Valencia, distributed across the third and fourth years of various undergraduate programs (Business Administration, International Business, and dual degrees in Business Administration + Marketing); 33.6% were from the University of Valencia, all of whom were enrolled in the Master's program in Actuarial and Financial Sciences; 17.4% were from the Catholic University of Valencia, specifically third-year Business Administration students; and the remaining 15.4% were from the European University of Madrid, comprising second, third, and fourth-year students from various programs.

The following table provides detailed information on the students by age, gender, university, and course level.

Tabla 1

Sample characteristics

Characteristics	Category	Quantity	Percentage
Gender	Male	95	64%
	Female	54	36%
Age	19	2	1,30%
	20	23	15,40%
	21	19	12,80%
	22	25	16,80%
	23	20	13,40%
	24	19	12,80%
	25	17	11,40%
	26	7	4,70%
	27	4	2,70%
	28	4	2,70%
	29	2	1,30%
	30	3	2,00%
	Over 30	4	2,70%
University	University of Valencia	50	33,56%
	European University of Valencia	50	33,56%
	European University of Madrid	23	15,44%
	Catholic University of Valencia	26	17,45%
Educational level	Postgraduate	50	33,56%
	Second Year	3	2,01%
	Third Year	67	44,97%
	Fourth Year	25	16,78%
	Fifth Year	4	2,68%

Procedure

The experiment was conducted across various Spanish universities using BUGAMAP, a business strategy simulator developed by the Fundación Mapfre, specifically tailored to the insurance market. This simulator allows students to maximize their company's value by making strategic decisions based on accounting, economic, and business information. The session began with a lecture by actuaries from Mapfre, who introduced the tool and explained the concepts to be used. Students were divided into teams of 4 or 5 members, with each member assuming specific roles such as CEO, sales manager, expense manager, and investment director, although decisions were made collectively. After the lecture, the game dynamics commenced. BUGAMAP is played in three rounds, each representing a fiscal period. Initially, all teams start with the same market share (25% or 20%, depending on the number of teams). In the first round, the market remains stable. In the second, a stock market crash is simulated, and in the third, a natural disaster disrupts market conditions. At the end of each round, the data is entered into the simulator to reflect the interaction of the teams' decisions in a real market environment. Students must make decisions in several key areas. For example, in revenue management, they decide on the premium price and risk acceptance level; in expense control, they decide on budgets for advertising, personnel, information technology, and legal consultancy.

The game's outcomes are measured by key indicators: market share, combined ratio, cumulative pre-tax profit, and solvency margin, reflecting the technical efficiency, profitability, and solvency of the insurance company. After each round, the results are presented graphically and numerically, allowing for analysis and reflection to inform future decisions. The team with the highest company value at the end of the three rounds is declared the winner. In the event of a tie, market share takes precedence, followed by the combined ratio, and if the tie persists, cumulative profit and solvency margin determine the winner. The top three teams received material prizes consisting of university-branded merchandise (t-shirts, etc.). All participants received a certificate of participation. The session lasted a total of 4 hours.

Analysis Technique

The data analysis technique used to test the hypotheses is Structural Equation Modeling (SEM), which allows for the analysis of causal relationships between constructs that are not directly measurable but manifest through certain observable characteristics. The type of analysis employed is Partial Least Squares (PLS) regression, and the analysis was performed using SmartPLS v 3.2.9 software. Notable features of PLS include that it does not necessarily require a strong theoretical foundation (supporting both exploratory and confirmatory research) and is relatively robust to deviations from normality (Ramírez et al., 2014).

SEM is a combination of factor analysis and multiple regression. Such a model consists of two types of equations: a set of linear structural equations with latent variables or constructs (SEM) and a series of measurement equations that describe these latent variables in terms of other observable variables (measurement model). The proposed methodology, following Ramírez et al. (2014), is based on three phases:

1. Model description
2. Validity and reliability of the measurement model: internal validity, individual reliability, construct reliability, convergent validity, discriminant validity
3. Evaluation of the structural model: variance of endogenous variables, global fit, regression coefficients, bootstrapping.

To calculate the p-values associated with each of the estimated parameters (loadings, regression coefficients), bootstrapping will be used, which allows examining the stability of the estimates provided by the PLS analysis through a resampling procedure (Chin, 1998). To handle missing values, the Pairwise deletion method is employed, where, to retain as much information as possible, pairwise deletion only excludes cases that show missing values for each pair of variables.

RESULTS

Validity and Reliability of the Measurement Model

This section analyzes the validity of the proposed constructs. All latent variables consist of reflective indicators. The individual reliability of each item is assessed by examining the loadings or simple correlations (λ) of the indicators with their respective construct.

The p-values and statistics associated with the null hypothesis test of the regression coefficients or loadings, which are asymptotically distributed as a Student's t, are shown in Table 2. The criterion for accepting these tests requires that the t-values associated with the estimated parameters exceed 1.65/1.96/2.57 in absolute value (since the large sample size increases degrees of freedom, the t-distribution approximates a standard normal distribution N(0,1) for 90%/95%/99% significance levels). That is, a p-value less than 0.1/0.05/0.01 would indicate rejection of the null hypothesis that any of the measurement model coefficients are zero. All loadings exceed 0.55 (Falk & Miller, 1992) except for the loadings of the items AUT4 from Autonomy and ATT2 from Attitude. However, they are significant, and since they do not deviate much from the acceptance threshold (0.494 and 0.420, respectively) and do not interfere with convergent and discriminant validity (to be discussed later), the decision was made to retain the items in their construct to preserve the original meaning. Thus, individual reliability is confirmed. To test the reliability of the constructs, Cronbach's Alpha (Cronbach, 1951) is analyzed, and Composite Reliability (CR) is calculated, with an optimal value being equal to or greater than 0.7 for both indices (Nunnally, 1978). Only one construct has an Alpha lower than 0.7 (PEOU with Alpha 0.602) but given its proximity to the acceptance threshold and its valid CR and AVE, the reliability and convergent validity of the 7 constructs are considered achieved. For convergent validity, it is checked that the Average Variance Extracted (AVE), i.e., the degree to which a latent variable is explained by its observed variables, is greater than 0.5 (Hair et al., 2010). In Table 2, all CRs are greater than 0.7, and all AVEs are greater than 0.5, indicating that the reliability and convergent validity of the 7 constructs have been achieved.

Table 2
Reliability and convergent validity of the measurement scales

Constructs		t-statistics	Standardized Coefficients
Competence	COMPE1	16,723	0,699***
	COMPE2	28,939	0,861***
	COMPE3	15,781	0,817***
	COMPE4	11,654	0,765***
	COMPE5	15,376	0,817***
	COMPE6	16,744	0,828***
	Composite Reliability	0,911	
	Average Variance Extracted (AVE)	0,632	
	Cronbach's Alpha	0,888	
Autonomy	AUT1	14,464	0,774***
	AUT2	21,340	0,826***
	AUT3	2,423	0,840***
	AUT4	5,037	0,494***
	Composite Reliability	0,826	
	Average Variance Extracted (AVE)	0,545	
	Cronbach's Alpha	0,708	
Collaborative Learning	COL1	19,236	0,761***
	COL2	16,210	0,737***
	COL3	10,976	0,666***
	COL4	7,506	0,650***
	COL5	21,983	0,819***
	COL6	12,365	0,702***
	COL7	21,364	0,791***
	COL8	21,674	0,772***
	Composite Reliability	0,903	
	Average Variance Extracted (AVE)	0,539	
	Cronbach's Alpha	0,873	
Perceived ease of use	PEOU2	15,361	0,785***
	PEOU3	40,132	0,908***
	Composite Reliability	0,832	
	Average Variance Extracted (AVE)	0,714	
	Cronbach's Alpha	0,602	

Perceived usefulness	PU1	6,210	0,517***
	PU2	14,933	0,799***
	PU3	24,922	0,804***
	PU4	13,469	0,721***
	PU5	20,164	0,813***
	PU6	13,496	0,721***
	Composite Reliability	0,872	
	Average Variance Extracted (AVE)	0,536	
	Cronbach's Alpha	0,817	
Attitude	ATT1	19,477	0,810***
	ATT2	3,949	0,420***
	ATT3	50,269	0,918***
	ATT4	34,385	0,870***
	Composite Reliability	0,851	
	Average Variance Extracted (AVE)	0,604	
	Cronbach's Alpha	0,765	
Intention of use	INT1	41,494	0,900***
	INT2	58,661	0,932***
	INT3	47,511	0,915***
	Composite Reliability	0,941	
	Average Variance Extracted (AVE)	0,841	
	Cronbach's Alpha	0,907	

Composite Reliability:

$$CR = \frac{\left(\sum_{i=1}^{n} \lambda_i\right)^2}{\left(\sum_{i=1}^{n} \lambda_i\right)^2 + \left(\sum_{i=1}^{n} \delta_i\right)}$$

Average Variance Extracted (AVE):

$$VE = \frac{\sum_{i=1}^{n} \lambda_i^2}{n}$$

To verify discriminant validity, which assesses the degree of difference between each construct (latent variable) and the other constructs in the model, the HTMT (heterotrait-monotrait ratio of correlations) criterion is used based on the multitrait-multimethod matrix (Henseler et al., 2015). According to this criterion, if the HTMT value is below 0.90, discriminant validity is established between two reflexively measured constructs. All HTMT values are below 0.9, confirming discriminant validity (Table 3).

Table 3
HTMT values (divergent assessment)

	Attitude	Intention of use	Autonomy	Collaborative Learning	Competence	Perceived ease of use
Attitude						
Intention of use	0,583					
Autonomy	0,740	0,673				
Collaborative learning	0,876	0,667	0,646			
Competence	0,490	0,490	0,756	0,365		
Perceived ease of use	0,786	0,737	0,837	0,828	0,369	
Perceived usefulness	0,806	0,669	0,686	0,832	0,634	0,751

Evaluation of the Structural Model

Next, the structural model is evaluated to test the theoretically proposed hypotheses. As previously mentioned, the relationships are adjusted based on gender and age. Figure 2 presents the optimal model.

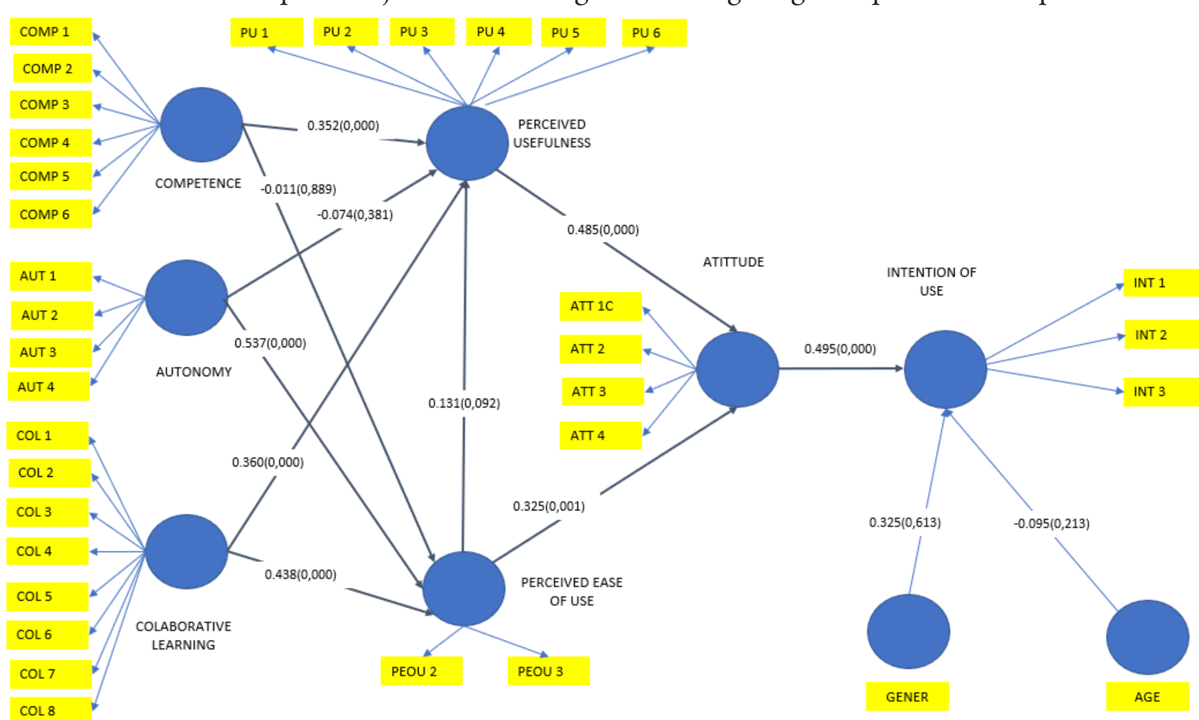

Figure 2
Regression coefficients (ß) with p-values and adjusted R^2 for each exogenous latent variable

Structural models must meet minimum quality fit standards. One such criterion is that the model must exhibit sufficient explanatory power, meaning that the amount of variance in the exogenous variable explained by the constructs that predict it must be adequate. This is measured through the R2, which ranges from 0 to 100%. Falk and Miller (1992) indicate a 10% threshold as acceptable (R2 ≥ 1). In this model, all exogenous variables are adequately explained by their predictors as all R2 values are greater than 0.1, as shown in Table 4.

Additionally, to assess the model fit, the global fit index (GoF) should be calculated (Tenenhaus et al., 2005; Tenenhaus & Vinzi, 2004). This index is calculated by multiplying the square root of the average AVE by the square root of the average R2. To confirm the reliability and fit of the model, the GoF should be ≥ 0.36 (Atker et al., 2011). In this case, the GoF is 0.545, which is above the acceptance threshold (Table 4). Table 4 also presents the values of the coefficients (β), the Student's t-statistic, and the statistical significance value obtained through Bootstrapping. In this case, 500 re-samples and a significance level of 5% ($\alpha = 0.05$) were used. These values support H1, H2, H3, H5, H8, H9, and H10 since their coefficients are significant and greater than 0.3. According to Chin (1998), a causal relationship between two constructs in the model can be affirmed if the β value between them is greater than or equal to 0.2 and is also statistically significant. Hypotheses H4, H6, and H7 are not significant at the 5% level, although H4 is significant at the 10% level.

Table 4

Results of the Structural Model (Regression Coefficients and R2)

Proposed relationships	**Hypotheses**	**Standardizedcoef ficients**	**t-statistic value**	**Hypothesis test**
ATT à INT	**H1**	0.495***	6.656	Accepted
PU à> ATT	**H2**	0.485***	5,671	Accepted
PEOU à ATT	**H3**	0.325**	3,289	Accepted
PEOUà PU	**H4**	0.131º	1.690	Rejected
COMPE à PU	**H5**	0.352***	5.217	Accepted
COMPE à PEOU	**H6**	-0.011***	0.139	Rejected
AUT à PU	**H7**	-0.074	0.876	Rejected
AUT à PEOU	**H8**	0.360***	3.848	Accepted
COL à PU	**H9**	0.537***	6.616	Accepted
COL à PEOU	**H10**	0.438***	4.671	Accepted
GoF (Goodness of fit)	0.545			
R^2				
	Perceived Usefulness		0.628	
	Perceived ease of use		0.485	
	Attitude		0,513	
	Intention of use		0.255	

Note: p<0.10 (t>1.65), *p<0.05 (t>1.96), **p<0.01 (t>2.57), ***p<0.001

DISCUSSION

The study introduces several significant innovations compared to previous research in the application context. First, it expands the Technology Acceptance Model (TAM) by incorporating motivational constructs from Self-Determination Theory (SDT), specifically competence, autonomy, and collaborative learning. This integration offers a multi-theoretical perspective as recommended by studies such as Putz and Treiblmaier (2015). Additionally, this work employs a Structural Equation Model (SEM) to analyze causal relationships between constructs, providing a more robust and detailed understanding of the factors influencing the acceptance of gamification in the application context.

The research also identifies inconsistencies with previous academic literature results obtained in the analyzed context, highlighting the need for further exploration of the factors that influence students' perceptions in gamified educational contexts. Specifically, the study found that autonomy does not have a significant effect on perceived usefulness, contradicting previous studies like those of Fathali and Okada (2018) and Nikou and Economides (2017). While gamification has been studied in various fields, this work fills a gap in the literature by focusing specifically on accounting education. This study demonstrates that collaborative learning, competence, and autonomy are critical factors influencing the acceptance of gamification in the educational domain. These findings align with previous literature, which has emphasized the importance of these factors in student motivation and engagement.

Moreover, the integration of Self-Determination Theory (SDT) with the Technology Acceptance Model (TAM) in this study provides a multi-theoretical perspective that offers a more holistic understanding of the factors affecting the acceptance of gamification in educational contexts. This approach aligns with the recommendations of Putz and Treiblmaier (2015) and Suckake (2019), who highlighted the need to combine theories to gain a comprehensive view of technological acceptance.

More specifically, collaborative learning shows a significant positive impact on perceived usefulness (PU) and perceived ease of use (PEOU). These results are also consistent with previous studies, such as those by Chahal and Rani (2022), Bitrián et al. (2021), and Hanus and Fox (2015), which have indicated that social factors significantly influence the perception of usefulness and ease of use. Collaborative learning with other students can, through perceived usefulness and ease of use, generate a perceptual and attitudinal shift towards accounting studies. These findings are particularly relevant, considering that the literature recognizes gamification as an effective methodology for promoting activities such as teamwork and social relationships (Armenia et al., 2024; Sidorova et al., 2023; Abd Rahim et al., 2021; Xu et al., 2021).

Competence, in turn, was also identified as a key factor influencing perceived usefulness. This result is again consistent with the conclusions of studies like those of Buil et al. (2020), Fathali and Okada (2018), and Nikou and Economides (2017). Competence enables students to feel effective and capable, increasing their willingness to use gamified tools. However, no significant relationship was found between competence and ease of use, in line with what was shown by Racero et al. (2020) and contrary to what was claimed by He and Li (2023) and Fathali and Okada (2018).

Regarding perceived autonomy, it showed a significant influence on perceived ease of use, which aligns with previous research such as that of Nandi and Mehendali (2022), Bitrián et al. (2021), Hanus and Fox (2015), Fathali and Okada (2018), and Nikou and Economides (2017). Autonomy allows students to have control over their learning, which increases their intrinsic motivation and improves their perception of the ease and usefulness of gamified technologies. However, perceived autonomy did not show a significant effect on perceived usefulness, which contradicts the findings of the previously cited works but is consistent with other studies that found divergent results, such as Hu et al. (2023).

On the other hand, in line with previous studies (Himang et al., 2021; Bourgonjon et al., 2013), intention to use is significantly explained by attitude. Both perceived usefulness and ease of use also show significant coefficients with attitude, corroborating results from other studies that have applied TAM in the context of accounting gamification (Kuang et al., 2023; Malaquias et al., 2018). However, our results question whether ease of use influences attitude through perceived usefulness, as its significance is only fulfilled at the 10% level. This finding contradicts previous works that found that ease of use could influence attitude by exerting its influence through usefulness (Şahin & Yildiz, 2024; Yoon et al., 2013; Davis & Lang, 2012).

Finally, the study not only analyzes the factors influencing the acceptance of gamification but also provides practical recommendations for educators and developers. These include integrating immediate feedback, customizing content, implementing progressive difficulty levels, and generating appropriate challenges to improve the perceived usefulness and ease of use of gamified tools.

CONCLUSIONS

This study offers valuable theoretical contributions to the literature in the field of gamified accounting education in particular and gamified education in general. The combination of Self-Determination Theory (SDT) with the Technology Acceptance Model (TAM) has allowed for the proposal and testing of an explanatory model to better understand the acceptance of gamification by undergraduate and graduate students. This comprehensive theoretical approach provides a richer and more detailed perspective, aligning with the recommendations of Putz and Treiblmaier (2015) and Suckake (2019). By integrating these theories, a deeper understanding is achieved of how psychological and technological factors intertwine to influence student motivation and behavior.

The results highlight the crucial importance of social dynamics in students' intrinsic motivation. This reinforces the theory that social relationships are essential for technological acceptance in gamified educational contexts. The observations of Deci and Ryan (1985) and Tyack and Mekler (2020) also support this conclusion, suggesting that the designers of gamified educational activities should prioritize creating opportunities for collaboration and social interaction in learning environments.

The study emphasizes competence and autonomy as fundamental elements in the design of educational games. Competence primarily influences perceived usefulness, while autonomy affects perceived ease of use. This underscores the importance of focusing on creating educational experiences that are not only useful and effective but also intuitive and that allow students to have control over their learning. These conclusions are consistent with the observations of Buil et al. (2020) and Fathali and Okada (2018).

This research has limitations that offer opportunities for future research. One limitation of this study lies in the convenience sample used and its cross-sectional approach. Future research could use representative samples that would allow for greater generalization of the results obtained. A longitudinal approach could also be adopted to analyze potential variations in the model's results with different student cohorts.

Furthermore, the model's variance obtained suggests the need to continue exploring other factors that may significantly influence students' acceptance of gamification. Therefore, we propose as future research to analyze the causes of the apparent inconsistency regarding autonomy detected in this study compared to the previous literature. Specifically, it would be useful to examine how different educational contexts, levels of technological competence, and individual learning styles might moderate the relationship between autonomy and perceived usefulness. For example, the perception of institutional support could be a new variable to incorporate into the model since the perceived support from the educational institution in terms of technological resources and teacher training could influence students' attitudes toward gamification. Additionally, the effect of continuous feedback and its impact on students' perceptions could be analyzed. Feedback in the form of points, badges, and leaderboards could not only enhance motivation and engagement but also influence the perception of the usefulness and ease of use of gamification and its acceptance.

Another relevant aspect to consider could be the degree of personalization in the learning experience. The ability of gamified tools to adapt to individual needs and specific learning styles could significantly influence technology acceptance. Future research could explore how personalization affects perceived competence and autonomy, and in turn, how these influence the intention to use. Moreover, it would be pertinent to investigate the impact of perceived relevance of gamified content. If students perceive that the content of the games is aligned with their academic and professional goals, their motivation and engagement are likely to increase, which could enhance their attitude toward using these tools. Additionally, the role of group dynamics and competitiveness among students in gamified environments deserves special attention. How students interact and compete with each other could influence their perception of usefulness and ease of use, and hence, their intention to use gamified tools.

The results of this study on the use of gamification in accounting education have the potential to be extrapolated to other fields. The multi-theoretical integration of Self-Determination Theory (SDT) and the Technology Acceptance Model (TAM) provides a richer understanding of how psychological and technological factors can influence student motivation and behavior, regardless of the field of study.

Finally, it should be noted that this study also opens a space for debate about the predominance of a cognitive and technical view in educational processes, highlighting the need to include discussions about intrinsic and extrinsic motivation. Gamification, when used effectively, has the potential to go beyond a simplistic behaviorist approach, promoting quality learning that fosters both intrinsic and extrinsic motivation, ultimately contributing to deeper and more meaningful learning. It is necessary for future research to continue exploring this balance to maximize the educational benefits of gamification.

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Appendix A

Table 5

Constructs, items, and sources

CONSTRUCTS	ÍTEMS	DESCRIPTION	SOURCE
Intention of use (INT)	INT 1	INT1: I prefer to learn accounting through gamified activities like BUGAMAP over other learning methodologies such as lectures.	Adapted from Bou (2010); Filippou et
	INT 2	INT 2: I prefer to learn accounting through gamified activities like BUGAMAP over other learning methodologies such as project-based learning (PBL).	
	INT 3	INT 3: I prefer to learn accounting through gamified activities like BUGAMAP over other learning methodologies such as creating a portfolio.	
Attitude (ATT)	ATT1	ATT1: My attitude towards BUGAMAP is positive.	Adapted from Mat Melero-Polo (2019 Todd (1995)
	ATT2	ATT2: Playing BUGAMAP has been enjoyable.	
	ATT3	ATT3: I have a favorable attitude towards BUGAMAP.	
	ATT4	ATT4: Playing BUGAMAP was a good idea.	
Perceived usefulness (UP)	PU1	PU1: While playing BUGAMPA, I felt I was on the right track to achieve my goals.	Adapted from Bou (2010); Filippou et
	PU2	PU2: I can learn accounting by playing BUGAMAP.	
	PU3	PU3: BUGAMAP helps me to effectively learn accounting.	
	PU4	PU4: I can get a good grade in accounting.	
	PU5	PU5: BUGAMAP has increased my knowledge of accounting.	
	PU6	PU6: I can learn the practical applications of accounting by playing BUGAMAP	
Perceived ease of use (PEOU)	PEOU1	PEOU1: I Knew how to manage BUGAMAP in the classroom.	Adapted from Bou (2010); Filippou et
	PEOU2	PEOU2: How difficult did you find playing BUGAMAP.	
	PEOU3	PEOU3: I understood the interaction with BUGAMAP in the classroom.	

Competence (COMPE)	COMPE1	COMPE1: I am confident that I can learn accounting.	Adapted from Niko Economides (2017) (2015)
	COMPE2	COMPE2: I am confident that I could take any course related to accounting.	
	COMPE3	COMPE3: I have a lot of self-confidence when it comes to learning accounting.	
	COMPE4	COMPE4: I do not find it difficult to learn new accounting concepts.	
	COMPE5	COMPE5: Even before starting a new accounting topic, I am confident that I will be able to understand it.	
	COMPE6	COMPE6: I believe I am good at learning accounting.	
Autonomy (AUT)	AUT1	AUT1: While playing BUGAMAP, I knew what I wanted to do.	Adapted from Niko Economides (2017) (2015)
	AUT2	AUT2: While playing BUGAMAP, I was completely focused on what I was doing.	
	AUT3	AUT3: While playing BUGAMAP, I felt in control of what I was doing.	
	AUT4	AUT4: I can perform well in courses related to accounting.	
Collaborative Learning (COL)	COL1	COL1: Collaborative learning with BUGAMAP is better than learning alone	Adapted from Fu et
	COL2	COL2: I felt part of a learning community within my group.	
	COL3	COL3: While playing BUGAMAP, I actively exchanged ideas with other group members.	
	COL4	COL4: While playing BUGAMAP, I learned new skills and knowledge from my group members.	
	COL5	COL5: While playing BUGAMAP, I was able to develop problem-solving skills by collaborating with my group members.	
	COL6	COL6: My group's collaborative learning was effective.	
	COL7	COL7: My group's collaborative learning did not require much time.	
	COL8	COL8: Overall, I am satisfied with the collaborative learning experience in BUGAMAP.	

Información adicional

How to cite: Queiro-Ameijeiras, C. M., Seguí-Mas, E., & Martí-Parreño, J. (2025). Determinants of gamification acceptance in Higher Education: an empirical model. [Determinantes de la aceptación de la gamificación en la educación superior: un modelo empírico]. *RIED-Revista Iberoamericana de Educación a Distancia, 28*(1). https://doi.org/10.5944/ried.28.1.41565

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Determinantes de la aceptación de la gamificación en la educación superior: un modelo empírico

RIED-Revista Iberoamericana de Educación a Distancia
vol. 28, núm. 1, 2025
Asociación Iberoamericana de Educación Superior a Distancia, España
ried@edu.uned.es

ISSN: 1138-2783
ISSN-E: 1390-3306

DOI: https://doi.org/10.5944/ried.28.1.41565