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Research Article

Does gamification improve university learning? A correlational meta-analysis between serious games and learning outcomes

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ABSTRACT

Gamification and serious games are two such strategies that have seen a surge in popularity as pedagogical approaches in higher education. These strategies incorporate game elements and playful environments, with the aim of enhancing student motivation, engagement, and participation in digital and diverse learning settings. In this context, the present research aims to estimate the overall relationship between gamification, serious games, and university learning outcomes through a correlational meta-analysis of the available empirical evidence. The study employs a quantitative approach and is structured in accordance with international reporting standards, with explicit criteria for data search, selection, extraction, and synthesis that ensure analytical consistency and methodological transparency. The findings indicate that the relationship between gamification, serious games, and university learning is not a homogeneous effect, but rather a complex phenomenon conditioned by the educational context, pedagogical design, and methodological decisions in primary studies. The analysis emphasizes the significance of estimating global associations, accompanied by stability and robustness assessments. It also demonstrates the limitations of broad classifications of results in explaining the observed variability.

Keywords: gamification, serious games, university learning, correlational meta-analysis, learning outcomes

INTRODUCTION

The integration of game-based elements and environments to enhance educational objectives within higher education is referred to as gamification and serious games (de Carvalho & Coelho, 2022). The overarching objective of these strategies is to enhance student motivation, engagement, and participation, thereby facilitating more effective learning processes through immersive and adaptive experiences that exert a positive influence on learning and the user experience (Gaurav et al., 2022). In the contemporary educational landscape, characterized by digitalization and the integration of technology in teaching methodologies, there has been a notable rise in the utilization of gamification as a pedagogical and technological resource. Empirical research across diverse educational and technological domains has demonstrated that this approach facilitates the development of knowledge, skills, and attitudes among students (Ullah et al., 2022). The implementation of this initiative has been expanded to encompass both face-to-face and virtual environments. The objective of this expansion is to enhance university learning outcomes and to cultivate the development of skills necessary for complex educational contexts (Brauner & Ziefle, 2022).

The relevance of this topic has increased in the context of the rapid expansion of digital learning environments in higher education. Universities are increasingly adopting virtual platforms, hybrid teaching models, learning management systems, and technology-mediated pedagogical strategies to support student engagement and academic performance. In this scenario, gamification and serious games have become particularly relevant because they offer interactive, motivational, feedback-oriented learning experiences that can respond to the demands of contemporary digital education. Therefore, synthesizing the available empirical evidence is timely and necessary to clarify the extent to which these strategies are associated with learning outcomes and to provide guidance for educators, researchers, and higher education institutions seeking to design more effective digital learning experiences.

Empirical evidence regarding the effects of gamification and serious games on university learning has yielded heterogeneous and, in many cases, inconsistent results. Gamification can be defined as the incorporation of game design elements, such as points, badges, leaderboards, and challenges, into non-game educational environments with the purpose of increasing motivation, engagement, and participation among learners. In higher education contexts, gamification strategies are frequently implemented through digital platforms or serious games that simulate real-world scenarios and encourage active learning. While both approaches utilize game mechanics, serious games are specifically designed with an explicit educational purpose, whereas gamification typically integrates selected game elements into existing instructional activities. It is imperative to discern between these two approaches, as they may exert influence on learning outcomes through disparate pedagogical mechanisms, such as heightened motivation, prompt feedback, and experiential learning. Consequently, an examination of their relationship with academic performance in higher education contributes to clarifying the potential role of game-based strategies in contemporary educational practices. As demonstrated in the works of Abd-Alrazaq et al. (2023) and Ren et al. (2024).

A substantial body of research has documented the favorable impacts of this approach on academic performance, motivation, and skill development. However, other studies have reported moderate, negligible, or context-dependent effects, as well as effects conditioned by the pedagogical design and the type of outcome being assessed (Cheng et al., 2024). This heterogeneity is further compounded by the limitations inherent in primary studies, including small sample sizes, the absence of robust comparison groups, quasi-experimental or cross-sectional designs, and the utilization of diverse learning outcomes measured with non-standardized instruments. Furthermore, previous reviews, both narrative and systematic, have primarily focused on describing general trends, without estimating overall effect sizes or assessing the stability of the results through robustness analysis or the detection of publication bias (Thangavelu et al., 2022).

These limitations impede the ability to draw precise conclusions regarding the magnitude and consistency of the analyzed relationship. The extant literature on gamification and serious games in higher education reveals empirical and methodological gaps that hinder understanding of their relationship with learning

outcomes (Damaševičius et al., 2023; Koh, 2022). A persistent dearth of consolidated correlational estimates that would enable a quantitative synthesis of the extant evidence is identified. Furthermore, extant studies and reviews incorporate limited sensitivity analyses to assess the stability of findings under different analytical decisions, as well as systematic procedures to detect and correct publication bias. However, these vulnerabilities have been repeatedly emphasized in previous meta-analyses (Abd-Alrazaq et al., 2022). In addition, the utilization of subgroup analyses is infrequent, thereby impeding the assessment of variability in effect across studies and constraining the comparative interpretation of results (Barz et al., 2024).

These discrepancies underscore the necessity for a correlational meta-analysis that employs an integrative and methodologically robust approach. The objective of this research is to estimate the overall relationship between gamification and serious games and university learning outcomes through a correlational meta-analysis of the available empirical evidence.

Accordingly, this study focuses on a quantitative and correlational meta-analytic synthesis aimed at estimating the overall association between gamification, serious games, and learning-related outcomes in higher education. Rather than evaluating causal effects derived exclusively from experimental interventions, the scope of the study is limited to the aggregation of correlational evidence reported in empirical studies. This approach allows for an integrated assessment of the strength, direction, and variability of the relationship between game-based strategies and different dimensions of university learning.

To that end, a series of inquiries have been formulated to direct the correlational meta-analysis and delineate the extent of the results.

1. To what extent do the estimated effect sizes remain stable across different sensitivity analyses and methodological decisions?
2. Is there evidence of publication bias affecting the magnitude or direction of the observed relationship between gamification and university learning outcomes?
3. What is the overall estimate of the relationship between gamification and serious games and learning outcomes in higher education?
4. Are significant differences in effect sizes identified when comparing study subgroups using stratified analyses?

METHODOLOGY

The present study constitutes a quantitative correlational meta-analysis, the objective of which is to synthesize the extant empirical evidence on the relationship between gamification, serious games and university learning outcomes. The methodology is structured according to the PRISMA 2020 statement, which has been adopted as the international reporting standard for systematic reviews and meta-analyses. This ensures rigor, transparency, and reproducibility throughout the research process (Page et al., 2021).

The methodological design is founded on explicit criteria for quality, analytical coherence, and traceability of the methodological decisions made. This study employed a correlational meta-analysis to quantitatively synthesize empirical evidence on the relationship between gamification or serious games and learning outcomes in higher education. This approach allows the estimation of an overall effect size while accounting for variability across studies, providing a more robust assessment of their impact on academic performance.

The study selection process was conducted by two independent reviewers following predefined inclusion and exclusion criteria. Titles and abstracts were initially screened, followed by full-text evaluation to determine eligibility. Discrepancies between reviewers were resolved through consensus. Inter-rater agreement was assessed to evaluate the consistency of the study selection and coding procedures. For the title and abstract screening stage, Cohen's kappa indicated substantial agreement between the two reviewers ($\kappa = 0.86$), with an overall percentage agreement of 92.4%. For the full-text eligibility assessment and data coding stage, agreement was also substantial ($\kappa = 0.82$), with an overall percentage agreement of 89.6%. Any disagreements identified during screening, eligibility assessment, or data extraction were discussed between the two reviewers and resolved by consensus. When consensus could not be reached, a third reviewer was consulted to make the final decision.

A structured coding protocol was used to extract relevant study information, including publication details, sample characteristics, intervention type, learning outcomes, and reported effect sizes. To ensure reliability, both reviewers independently coded a subset of studies and compared their results to verify consistency in data extraction and classification.

Inclusion and Exclusion Criteria

The eligibility criteria were established with the objective of ensuring the inclusion of relevant and methodologically comparable empirical studies. Quantitative research examining the relationship between gamification strategies or serious games and learning outcomes in university students was considered eligible for inclusion. The following studies were included in the present review: empirical evaluations of outcomes such as academic performance, knowledge acquisition, participation, motivation, or skills development. The inclusion criterion was that the studies reported sufficient statistical information to estimate quantitative associations between the analyzed variables. The studies did not require a specific design, whether experimental, quasi-experimental, or correlational. The studies were also required to have been published in peer-reviewed scientific journals. Only studies published in English and Spanish were included, as these languages allowed the reviewers to accurately assess the methodological characteristics, extract quantitative information, and verify the statistical data required for the correlational meta-analysis. No additional language restrictions were applied.

Grey literature, including theses, dissertations, conference proceedings, institutional reports, preprints, and non-peer-reviewed documents, was not included in this meta-analysis. This decision was made to ensure the methodological quality, peer-review status, replicability, and statistical completeness of the studies incorporated into the quantitative synthesis. Given that the meta-analysis required sufficient statistical information to estimate correlational effect sizes, the inclusion of non-peer-reviewed or inconsistently reported sources could have increased methodological heterogeneity and reduced the comparability of the evidence. However, the exclusion of grey literature is acknowledged as a limitation, as it may have restricted the identification of unpublished or non-indexed studies with relevant empirical findings.

The exclusion process was structured in three consecutive phases. In the initial phase, records containing indexing errors, conference proceedings, editorials, reviews, conceptual studies, and documents whose format did not correspond to empirical research articles were discarded. In the subsequent phase, studies lacking full-text access were excluded, as this precluded the verification and extraction of the requisite information. In the third phase, articles that, even if they addressed the topic, did not present quantitative measurements of the analyzed relationship or did not report statistics suitable for inclusion in the meta-analysis were eliminated.

Sources of Information

The selection of information sources was restricted to Scopus and Web of Science due to their broad multidisciplinary coverage, rigorous editorial control, and high-quality bibliographic metadata. The two databases in question concentrate on high-impact scientific literature and exhibit consistent indexing processes, facilitating the identification, comparison, and analysis of quantitative studies in higher education. The robustness and scope of these sources have been demonstrated in comparative studies of coverage and quality against other bibliographic databases, supporting their suitability for conducting systematic reviews and meta-analyses (Culbert et al., 2025). Scopus and Web of Science were selected as the primary sources of information because they are widely used in systematic reviews and meta-analyses due to their multidisciplinary scope, rigorous indexing standards, citation tracking capacity, and inclusion of peer-reviewed journals with high editorial quality. Their use also allowed the search strategy to be applied in a consistent and reproducible manner across two major international databases, ensuring comparability in the identification, screening, and extraction of empirical studies. Although other databases such as ERIC, PsycINFO, ScienceDirect, or Google Scholar may contain additional relevant records, the present review prioritized Scopus and Web of Science to maintain methodological consistency, reduce duplication, and focus on indexed scientific literature suitable for quantitative synthesis. This decision is acknowledged as a limitation, since relevant studies published in other databases or grey literature sources may not have been captured.

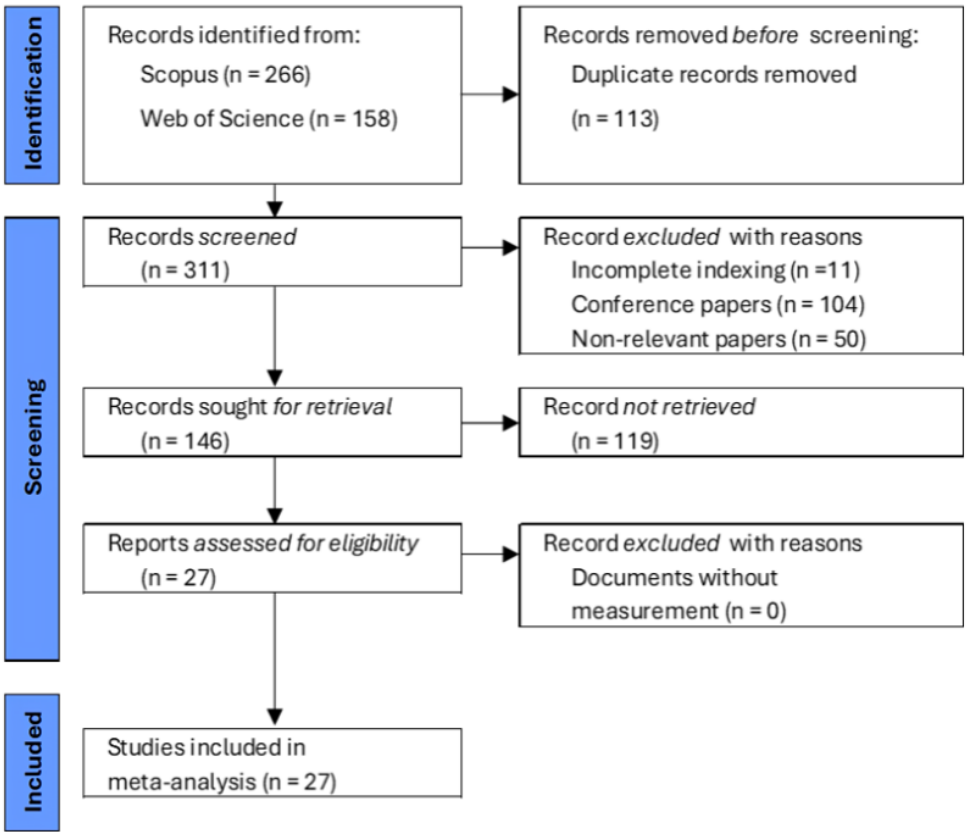

Figure 1. PRISMA flow diagram (prepared by the author based on Page et al., 2021)

Search Strategy

The search strategy was structured using independent equations for each database, derived from the established inclusion criteria. For Scopus, the equation (TITLE ("serious games" OR "game-based learning" OR gamification) AND TITLE ("learning outcomes" OR "academic performance" OR participation)) was used. In Web of Science, a syntactically equivalent formulation was applied, adjusting the search fields to their specific structure by using TS = for thematic searches and AK = for author keywords when necessary: (TS = ("serious games" OR "game-based learning" OR gamification) AND TS = ("learning outcomes" OR "academic performance" OR participation)). In both cases, Boolean operators were used to ensure consistency, precision, and comprehensiveness in the retrieval of relevant studies.

Selection Process

The selection of studies was conducted in accordance with the PRISMA 2020 methodology guidelines, employing a sequential approach. In the identification phase, records were retrieved from the selected databases, and an initial screening was performed. In the subsequent screening phase, the titles and abstracts of documents were examined to exclude those deemed irrelevant. In the eligibility phase, the full texts of potentially relevant studies were reviewed, applying the established inclusion and exclusion criteria. Following the application of the aforementioned criteria, the relevant studies were incorporated into the meta-analysis. The details of the process are presented in **Figure 1** using the PRISMA 2020 flow diagram.

Data Processing and Statistical Analysis

The data processing was performed using Microsoft Excel, which was used for the following purposes: the extraction, cleaning, coding and systematic organization of information from the studies included. The statistical analysis of the meta-analysis was conducted in RStudio using specific procedures for estimating correlational effect sizes and assessing heterogeneity between studies. This environment also facilitated the generation of graphical representations, including forest plots and scatter plots, for the visualization and synthesis of results.

The calculation of an overall effect size was theoretically justified because the outcomes included in the meta-analysis, although diverse, represent different dimensions of university learning influenced by gamification and serious games. Academic performance, motivation, engagement, competence, participation, physical activity, and problem-solving skills were treated as learning-related outcomes because they reflect cognitive, affective, and behavioral manifestations of the educational process. From an active learning perspective, gamification and serious games do not affect learning only through knowledge acquisition, but also through motivational activation, sustained engagement, behavioral participation, feedback, and skill development. Therefore, the global effect size was estimated to provide an integrative measure of the general association between game-based strategies and learning-related outcomes in higher education.

Additionally, the overall effect size was not intended to imply that all learning outcomes are identical or fully interchangeable. Rather, it was used as a higher-level synthesis of related learning manifestations that share a common educational basis. In higher education, learning may be reflected not only in academic performance or knowledge acquisition, but also in motivation, engagement, participation, competence development, and problem-solving capacity. These dimensions are commonly interconnected within active learning environments, where cognitive, affective, and behavioral processes operate simultaneously. Therefore, combining these outcomes under a random-effects model was considered appropriate to estimate the general direction and magnitude of the association between gamification, serious games, and university learning, while acknowledging that the included outcomes represent different but complementary expressions of the learning process.

However, to avoid interpreting heterogeneous constructs as a single undifferentiated outcome, subgroup analyses were conducted according to the type of learning outcome. The included effects were classified into cognitive outcomes, affective outcomes, behavioral/skills outcomes, and mixed cognitive + affective outcomes. This analytical strategy allowed the study to preserve the integrative purpose of the meta-analysis while also examining whether the magnitude of the association differed across theoretically distinct outcome categories.

For the purposes of this correlational meta-analysis, the different outcome variables reported in the primary studies were considered indicators of learning-related outcomes in higher education. Although these variables are conceptually distinct, they represent complementary dimensions of the educational process. Academic performance, knowledge acquisition, and test scores were classified as cognitive outcomes; motivation, engagement, perceived involvement, and satisfaction were classified as affective outcomes; and participation, competence, physical activity, and problem-solving skills were classified as behavioral or skills-based outcomes. This classification was adopted because gamification and serious games may influence learning through multiple mechanisms, including cognitive processing, motivational activation, engagement, feedback, participation, and skill development.

Therefore, the overall effect size was estimated as an integrative measure of the general association between game-based strategies and learning-related outcomes. However, to avoid treating these diverse constructs as fully equivalent, subgroup analyses were conducted according to the type of outcome. This approach allowed the meta-analysis to maintain an overall synthesis while also examining whether the magnitude of the association differed across cognitive, affective, behavioral/skills, and mixed outcome domains.

Evaluation of Methodological Quality

The methodological quality of the included studies was assessed using the AMSTAR-2 tool, which allows for the systematic examination of the methodological rigor of reviews and quantitative studies based on criteria such as protocol clarity, search comprehensiveness, adequacy of analysis, and transparency in reporting (Shea et al., 2017). The application of these criteria enabled an overall assessment of the methodological quality level, the results of which are summarized in **Table 1**.

The risk of bias assessment was conducted in a complementary manner, considering potential sources associated with study design, sample selection, outcome measurement, and analysis reporting. This procedure enabled the identification of recurring limitations and the evaluation of the confidence level of the evidence integrated into the meta-analysis.

Table 1. Evaluation with AMSTAR 2

Authors	Design	Sample	Measure	Overall
Aguilar et al. (2021)	No	Yes	No	Low
Alshiha and Al-Abdullatif (2024)	No	Yes	Yes	Moderate
Arzfi and Maria Montessori (2025)	No	Yes	Yes	Moderate
Castro and Sevillano (2022)	No	Yes	Yes	Moderate
Estrada et al. (2024)	No	Yes	No	Low
Ferdiansyah et al. (2025)	No	Yes	Yes	Moderate
Gaurav et al. (2022)	No	Yes	Yes	Moderate
Guala et al. (2024)	No	Yes	No	Low
Hmoud et al. (2024)	No	Yes	Yes	Moderate
Lampropoulos and Sidiropoulos (2024)	No	Yes	Yes	Moderate
Lotfi (2020)	No	Yes	No	Low
Lutfi et al. (2023)	No	Yes	Yes	Moderate
Mellado et al. (2024)	No	Yes	Yes	Moderate
Mohammed and Hirai (2021)	No	Yes	Yes	Moderate
Moreno-Acosta and Zabala-Vargas (2022)	No	Yes	Yes	Moderate
Namaziandost et al. (2025)	No	Yes	Yes	Moderate
Nguyen-Viet and Nguyen-Viet (2025)	No	Yes	Yes	Moderate
Nurtanto et al. (2021)	No	Yes	No	Moderate
Olayvar (2023)	No	Yes	No	Low
Pena-González et al. (2023)	No	Yes	Yes	Moderate
Peng et al. (2025)	No	Yes	Yes	Moderate
Rajendran et al. (2025)	No	Yes	Yes	Moderate
Romano et al. (2022)	No	Yes	Yes	Moderate
Romsi et al. (2024)	No	Yes	No	Low
Ukgoda (2025)	Yes	Yes	No	High
Widodo et al. (2025)	No	Yes	Yes	Moderate
Xu et al. (2024)	No	Yes	Yes	High

RESULTS

The studies incorporated within the research, as presented in **Table 2**, encompass a broad spectrum of educational contexts, gamification approaches, and serious game applications, in addition to a variety of learning outcomes. The analyzed studies examine cognitive, affective, and behavioral effects using quantitative designs applied to university and educational populations, allowing for a comprehensive analysis of the relationship between gamification and learning outcomes.

Table 2. Characteristics of the included studies

Dependent variable	Independent variable	ni	ri	Variable
Gamified flipped learning (competitive incentives condition)	Achievement test (pre-/post-test)	30	0.991	Cognitive
Gamified app (Gr1) vs. non-gamified app (Gr2)	Felt involvement (FI3 item)	20	0.460	Affective
Gamification (group effect)	Learning outcomes (LOs)	256	0.448	Cognitive
Integration of game-based learning approach	Students' academic performance in English	399	0.463	Cognitive
Gamified vs. not-gamified condition (programming course)	Learning gains (pre-/post-test)	62	-0.089	Cognitive
Smartphone-based gamification intervention (individual group vs. control)	Change in daily steps (12 weeks)	72	0.303	Behavioral/ skills
Gamification adoption	Academic performance	284	0.665	Cognitive
Immersion (gamification)	Competence (BPNS)	568	0.366	Behavioral/ skills
Game-based learning integration (Japan, English courses)	Academic performance in English	399	0.560	Cognitive
Smartphone-based gamification (CHD patients, China)	Physical activity participation (daily steps)	108	0.320	Behavioral/ skills
Gamification adoption (Jordan & Palestine)	Academic performance	300	0.420	Cognitive
Gamification immersion & BPNS (Vietnam universities)	Perceived academic performance	568	0.350	Affective
Digital serious game "Leobien" (Spain, primary school)	Reading comprehension & academic performance	153	0.400	Cognitive

Table 2 (Continued).

Dependent variable	Independent variable	ni	ri	Variable
Game-based learning (Colombia, SDN engineering)	Academic performance & motivation	26	0.450	Cognitive + affective
Digital game-based learning (Serbia, university students)	Academic performance	328	0.350	Cognitive
Lumio-based DGBL (Indonesia, Pancasila Education)	Learning outcomes (pre-/post-test scores)	80	0.500	Cognitive
Gamification in LMS (Indonesia, eLSIDA platform for slow learners)	Engagement & academic performance	19	0.400	Affective
Serious games usage	Academic performance	120	0.220	Cognitive
Gamification module	Student motivation	85	0.300	Affective
Serious games exposure	Problem-solving skills	200	0.240	Behavioral/ skills
Gamified learning platform	Engagement	150	0.160	Affective
Serious games intervention	Knowledge retention	95	0.280	Cognitive
Digital-interactive-book gamification (Indonesia, general English course)	Academic learning outcomes (test scores)	40	0.750	Cognitive
Flipped classroom + gamification (Spain, sports sciences)	Academic performance (exam scores)	102	0.640	Cognitive
Game-based learning competitiveness (Hong Kong, psychology undergraduates)	Learning outcomes (quiz performance)	142	0.240	Cognitive

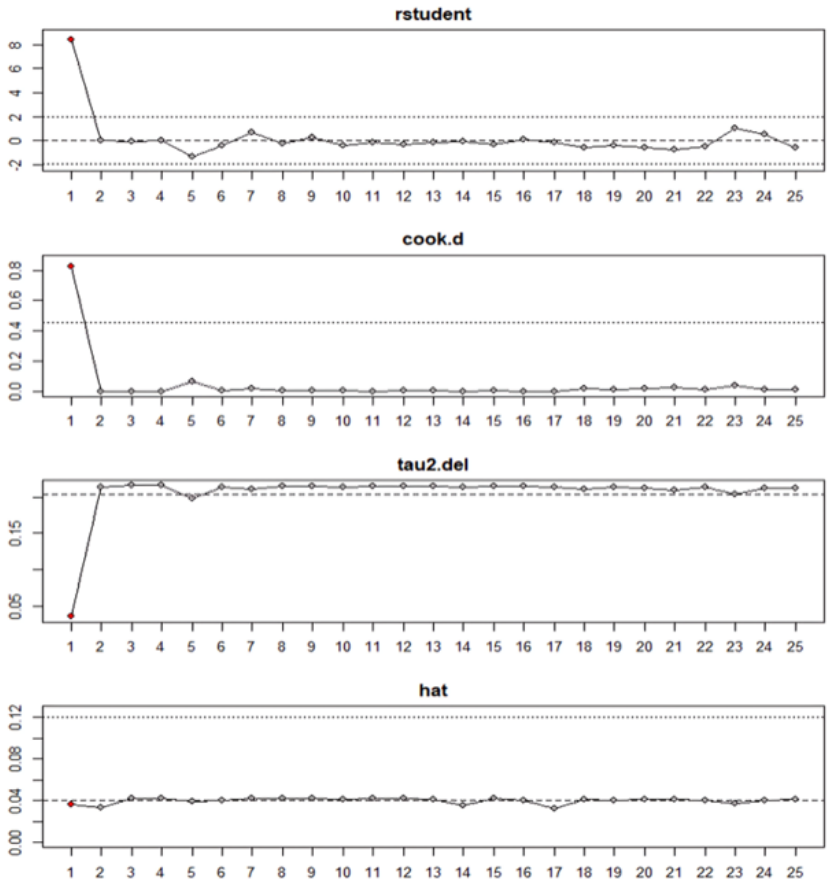

Figure 2. Sensitivity and robustness analysis (the authors' own elaboration)

A sensitivity and robustness analysis was performed to assess the stability of the results under different analytical decisions. A random-effects model (k = 25; τ^2 estimator: REML) was estimated, which demonstrated a significant overall effect (r = 0.5023; standard error [SE] = 0.0934; 95% confidence interval [CI] [0.3192, 0.6854]; p < .0001). The τ^2 (0.2045; SE = 0.0629) and τ (0.4522) values indicate variability between studies. The subsequent influence analysis did not reveal any cases with a disproportionate impact on the overall estimate. The results are presented graphically in **Figure 2**.

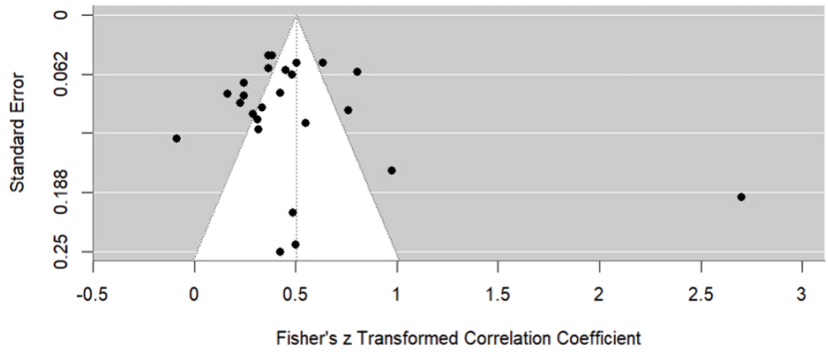

Figure 3. Publication bias (the authors' own elaboration)

The analysis of potential publication bias was performed using a funnel plot presented in **Figure 3**. The graphical representation includes 25 studies, whose Fisher's Z-transformed correlation coefficients cluster around a central value close to 0.50. The SEs are predominantly concentrated between 0.06 and 0.25, with a preponderance of studies situated within the lower SE range and an isolated point at high Fisher's Z values.

To complement the visual inspection of the funnel plot, statistical tests for publication bias were also performed. Egger's regression test and Begg's rank correlation test were applied using Fisher's Z-transformed correlation coefficients and their corresponding SEs. The results of Egger's test did not provide evidence of significant funnel plot asymmetry (intercept = 1.13, $p = 0.484$), while Begg's test also suggested no statistically significant association between effect sizes and their SEs (Kendall's $\tau = 0.037$, $p = 0.797$). These findings indicate that publication bias was not statistically detected in the included studies. However, given the relatively small number of studies and the heterogeneity observed in the meta-analysis, the results should be interpreted with caution.

It is important to clarify that these results should not be interpreted as definitive evidence of the absence of publication bias. Non-significant Egger's and Begg's tests only indicate that statistically significant funnel plot asymmetry was not detected in the present dataset. Given the relatively limited number of studies and the substantial heterogeneity observed across effect sizes, the statistical power of these tests may be reduced. Consequently, publication bias cannot be completely ruled out, and the pooled estimates should be interpreted together with the funnel plot, sensitivity analysis, database restrictions, and the exclusion of grey literature.

As illustrated in **Figure 4**, the primary forest plot was utilized for the comprehensive evaluation of the association between gamification, serious games, and learning outcomes. The present study integrates 25 studies, which vary in terms of sample size, point estimates of correlation, 95% CIs, and weights derived from a random-effects model. The combined effect of these variables is found to be $r = 0.46$, with a 95% CI of [0.31, 0.60]. High heterogeneity was observed, with $I^2 = 91.2\%$ and $\tau^2 = 0.2045$, accompanied by a significant Q test ($p < 0.0001$). This supports the relevance of subsequent subgroup analyses.

Figure 5 presents the forest plot that was utilized for the subgroup evaluation of the relationship between gamification, serious games, and learning outcomes. The classification system identifies four distinct subgroups, each corresponding to a specific type of outcome evaluated: cognitive, effective, behavioral/skills, and cognitive + affective. For each subgroup, the sample sizes, point correlations with 95% CIs, and weights derived from random-effects models are shown. The overall heterogeneity is high ($I^2 = 91.2\%$, $\tau^2 = 0.2045$; $p < 0.0001$), with differing I^2 and τ^2 values among the subgroups.

Given the conceptual diversity of the outcomes included in the global estimate, subgroup analyses were performed to examine whether the association between gamification, serious games, and learning outcomes varied according to the outcome domain. This procedure was used to prevent different constructs from being interpreted as a homogeneous category and to provide a more nuanced interpretation of the pooled effect.

Subgroup analyses were conducted by outcome domain to evaluate whether the pooled association differed across theoretically distinct types of learning outcomes. The cognitive subgroup included 15 studies with a total sample size of 2,790 participants and showed a positive pooled association ($r = 0.54$, 95% CI [0.36, 0.72]), with high within-group heterogeneity ($I^2 = 93.9\%$; $\tau^2 = 0.3451$; $p < .0001$).

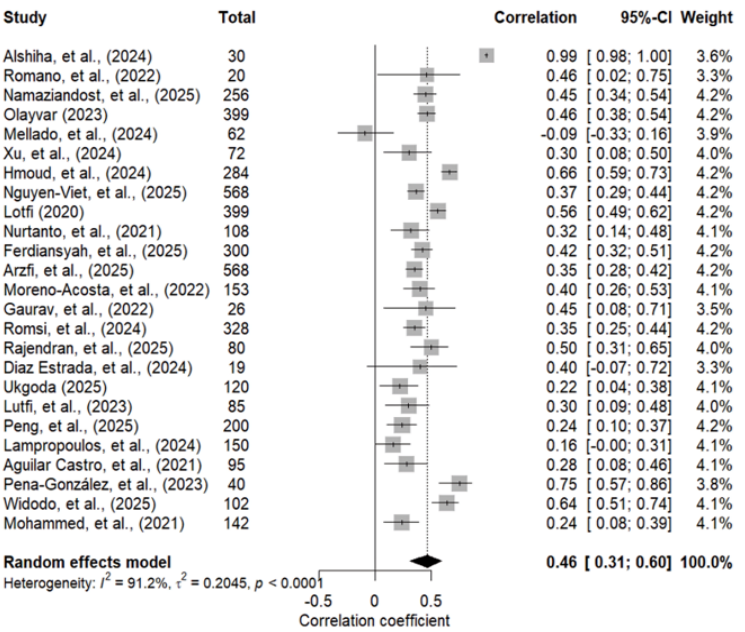

Figure 4. Overall estimate of the relationship (the authors' own elaboration)

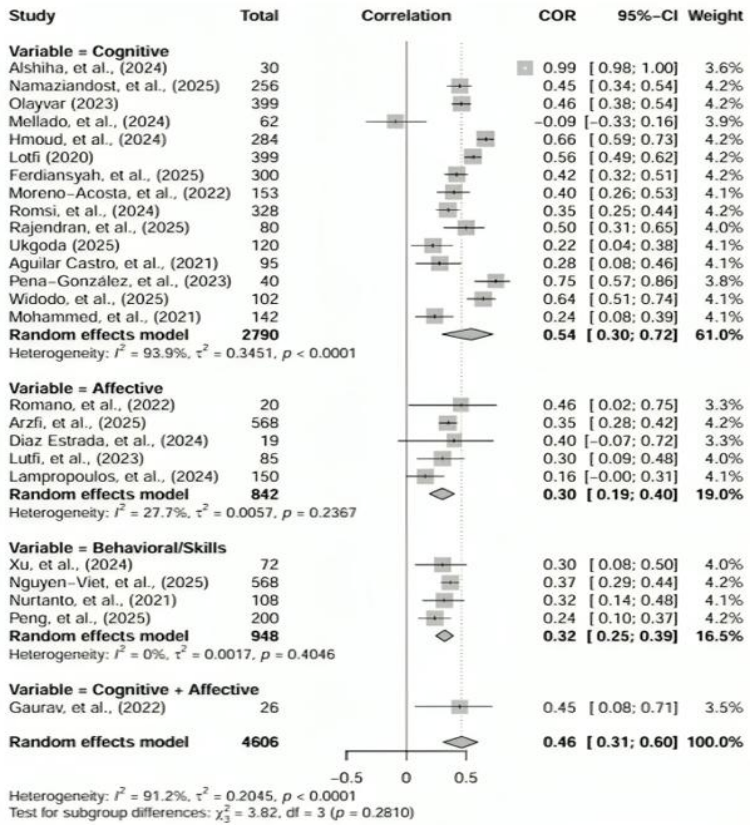

Figure 5. Subgroup and moderator analysis (the authors' own elaboration)

The affective subgroup included 5 studies with a total sample size of 842 participants and showed a positive pooled association (r = 0.30, 95% CI [0.19, 0.40]), with low-to-moderate within-group heterogeneity (I^2 = 27.1%; τ^2 = 0.0057; p = .2387). The behavioral/skills subgroup included 4 studies with a total sample size of 948 participants and showed a positive pooled association (r = 0.32, 95% CI [0.25, 0.39]), with no relevant within-group heterogeneity detected (I^2 = 0.0%; τ^2 = 0.0017; p = .4046). The mixed cognitive + affective subgroup included one study with 26 participants (r = 0.45, 95% CI [0.08, 0.71]); therefore, within-subgroup heterogeneity could not be estimated for this category.

Differences across subgroups were statistically examined using a moderator test. The test for subgroup differences was not significant (Qbetween = 3.82, df = 3, p = .2810), indicating that outcome domain did not explain a statistically significant proportion of the observed between-study variability. Therefore, the overall positive association should be interpreted as an integrative estimate across related learning domains, while the high overall heterogeneity suggests that additional moderators, such as instructional design, duration of the intervention, disciplinary context, implementation quality, and measurement strategy, may better account for the variability in effect sizes.

DISCUSSION

The ensuing discourse has been methodically structured in accordance with the overarching objective of the correlational meta-analysis. The focal point of this analysis is the integration of a dispersed array of empirical evidences pertaining to the relationship between gamification, serious games, and university learning outcomes. This objective is realized through a critical analysis of the findings, their comparison with previous studies, the definition of a future research agenda, and the presentation of theoretical, policy, and practical implications, along with the study's main limitations.

The findings of this meta-analysis provide evidence that directly addresses the research objectives proposed in this study. First, the overall effect size indicates that the implementation of gamification and serious games is positively associated with learning outcomes in higher education contexts. This result supports the main research question by suggesting that game-based strategies can contribute to improved academic performance and student engagement.

Second, the analysis of variability across studies highlights that the impact of these strategies may depend on contextual and methodological factors, such as the type of intervention, sample characteristics, and learning environments. These findings contribute to a more nuanced understanding of how and under what conditions gamification and serious games influence educational outcomes. Therefore, the results not only quantify the overall relationship between these educational approaches and learning outcomes but also provide empirical evidence that helps clarify their potential role in enhancing teaching and learning processes in higher education.

Interpretive Synthesis of the Results

The results of the meta-analysis indicate a moderate to high positive association between the use of gamification and serious games and learning outcomes, with a robust overall effect estimated using a random-effects model and stable across different analytical decisions ($r \approx 0.50$ in the sensitivity analysis; $r \approx 0.46$ in the main forest plot). However, this average effect must be considered in the context of significant heterogeneity ($I^2 > 90\%$; $\tau^2 \approx 0.20$), which indicates that the magnitude of the effect varies considerably across studies and that the overall estimate incorporates interventions, contexts, and measurements that are not entirely equivalent. The absence of studies with disproportionate influence confirms that this variability is not explained by outliers, but rather by accumulated structural differences related to educational contexts, methodological designs, population characteristics, implementation modalities, and the operationalization of learning outcomes.

Furthermore, the analysis of subgroups according to the type of outcome (cognitive, affective, behavioral/skills, or mixed) does not provide a significant explanation for the observed heterogeneity, suggesting that the source of variation does not lie in the category of the outcome being evaluated. Rather, the underlying mechanisms linked to motivational activation, the degree of immersion, the mechanics used, their suitability to the student profile, and performance measurement strategies are likely to be the source of variation.

This interpretation is supported by substantial empirical and theoretical evidence found in the relevant literature. A number of studies have demonstrated that the particular type of game mechanics is less significant than the underlying motivational architecture of active gamification. Alshiha and Al-Abdullatif (2024) demonstrate that competitive and cooperative mechanics produce equivalent improvements in learning, thus suggesting that the effect does not depend on the game format itself, but rather on its capacity to structure goals, provide feedback, and foster engagement. In a similar vein, Romano et al. (2022)

demonstrate that gamification enhances user experience and engagement, even in non-educational contexts, thereby reinforcing the notion that its impact stems from processes of sustained engagement that may or may not translate into observable outcomes.

It is evident that other studies have contributed to our understanding of the reasons behind the distribution of these effects across the various dimensions of learning. Namaziandost et al. (2025) demonstrate that gamification strengthens intermediate variables such as ambiguity tolerance, adaptability, and self-regulation. These variables act as deep psychological mechanisms that explain both cognitive and affective improvements (Namaziandost et al., 2025). This logic is consistent with the findings of Nguyen-Viet and Nguyen-Viet (2025), who demonstrate that the immersion inherent in gamified environments satisfies needs for autonomy and competence. These are key factors that mediate academic engagement and performance, regardless of the type of outcome assessed.

The high heterogeneity can also be attributed to differences in instructional design, student population, and institutional context. Olayvar (2023) demonstrates that particular components of game-based learning, notably those associated with cognitive training, account for a greater proportion of variance in performance in comparison to the game elements themselves. Mellado et al. (2024) also introduce the gender dimension, demonstrating divergent effects of gamification depending on the student profile, which increases the dispersion of effect sizes. From an organizational perspective, Hmoud et al. (2024) emphasize that the effective adoption of gamification depends on institutional resources, infrastructure, and attitudes. In contrast, Xu et al. (2024) demonstrate that gamification can modify motivation and behavior, although not always producing equivalent effects on observable performance. Finally, both Lotfi's (2020) work and the review by Nurtanto et al. (2021) confirm that methodological and contextual diversity explains the empirical variability, without invalidating the central conclusion that gamification, conceived as a comprehensive pedagogical system, consistently improves university learning.

Comparison With Other Studies

The findings of this meta-analysis are consistent with those of previous systematic reviews and meta-analyses that have reported positive effects of gamification and serious games on learning outcomes, although with variations in the magnitude of the effect. The effect size estimated in this study ($r \approx 0.46$-0.50) is comparable to the average effects reported in experimental meta-analyses on digital game-based learning ($g \approx 0.54$), especially on cognitive outcomes (Barz et al., 2024). However, in contrast to reviews that focus on clinical contexts or specific populations, which often highlight low-quality evidence and high levels of uncertainty (Abd-Alrazaq et al., 2022; Koh, 2022), this meta-analysis provides an integrated estimate that is centered on the context of higher education from a correlational perspective. This approach facilitates the identification of cross-sectional associations between gamification and learning that are not contingent on controlled experimental designs, thereby expanding the scope of the available evidence. Moreover, the systematic incorporation of sensitivity, influence, and subgroup analyses constitutes a methodological contribution in comparison with previous studies, demonstrating that the high heterogeneity observed stems from structural characteristics of the field. This finding is in accordance with meta-reviews that highlight the lack of standardization and the diversity of mechanisms involved in research on gamification and serious games (Damaševičius et al., 2023).

Research Agenda

The evidence synthesized in this meta-analysis indicates that the central challenge for future research lies not in confirming the existence of positive effects of gamification, but rather in rigorously explaining the conditions under which these effects are activated, amplified, or diluted. The elevated structural heterogeneity observed indicates analytical lacunae associated with the indiscriminate aggregation of conceptually distinct interventions. This necessitates the delineation of explanatory subgroups that transcend broad and uninformative classifications. In this context, it is essential to differentiate studies according to the type of instructional design, the intensity and density of gamification elements, the disciplinary domain, the effective duration of the intervention, and the type of learning assessment, distinguishing between standardized measurements, applied performance, and self-reported evaluations, in order to isolate more specific causal mechanisms and reduce unexplained variability.

Moreover, the identified methodological gaps demand the adoption of multilevel models that integrate student, course and institutional variables, articulated with mixed-methods approaches that combine correlational meta-analyses with qualitative and quasi-experimental evidence. This integration would facilitate the modelling of mediation processes and learning trajectories that are not apparent in average effect estimates. Moreover, the absence of shared criteria for operationalizing learning outcomes represents a significant limitation within the field, necessitating advancement towards standardized frameworks that differentiate between deep learning, transfer, self-regulation and sustained performance, thereby overcoming the prevailing conceptual fragmentation.

Finally, in order to close the gaps in the empirical evidence, it is necessary to incorporate contextual and institutional variables as moderators. These should include organizational culture, digital maturity, faculty support, academic workload and educational innovation policies. This integration would shift the focus from gamification as an isolated technique to understanding it as a situated pedagogical practice, dependent on structural conditions and design decisions that determine its actual effectiveness in higher education.

Implications

The theoretical implications of this meta-analysis indicate a necessity to reformulate active learning and gamification models, transcending the limitations of additive or merely instrumental approaches. The presence of an average positive effect alongside high heterogeneity poses a challenge to conceptualizations that assume gamification to be a uniform stimulus and reinforces its interpretation as a dynamic system of motivational, cognitive, and metacognitive mechanisms that interact with the educational context and instructional design. From this standpoint, the outcomes of the present study make a valuable contribution to the extant literature by demonstrating that the effectiveness of gamification depends less on the isolated incorporation of game elements and more on its functional coherence with processes of autonomy, competence, self-regulation, and learning transfer. This necessitates the development of theoretical models that are more situated, relational, and sensitive to contextual variability.

In the domain of educational policy, the findings suggest that the integration of gamification in higher education should be grounded in empirical criteria, rather than its uncritical adoption as a technological innovation. The variability of the observed effects suggests that institutional policies should favor flexible implementation frameworks, supported by established pedagogical capacities, relevant infrastructure, and clearly defined impact assessment systems. Rather than advocating for the implementation of gamification as a universal solution, it is recommended that policies be devised to incentivize gradual processes, the initiation of pilot projects with rigorous evaluation, and the establishment of teacher training programs that facilitate the adaptation of interventions to specific disciplinary and institutional contexts.

From a pragmatic standpoint, the findings provide unambiguous directives for the conceptualization and execution of serious games within the context of higher education. Instructional design should prioritize coherence between learning objectives, game mechanics and assessment strategies, thus avoiding both game overload and the superficial use of rewards. The implementation of such programs necessitates a comprehensive consideration of the intensity and duration of the interventions, in addition to an analysis of the characteristics of the student body and the institutional environment. Finally, impact assessment must extend beyond immediate engagement and incorporate indicators of deep learning, transfer, and sustainability of effects, facilitating informed decisions about the relevance and real pedagogical value of gamification in specific university contexts.

The results of this study also have practical implications for educators and higher education institutions seeking to improve student learning through innovative pedagogical strategies. The positive association identified between gamification, serious games, and learning outcomes suggests that integrating game-based elements into instructional design can support student engagement and academic performance.

In practical terms, instructors may incorporate simple gamification elements such as points, progress levels, badges, or leaderboards to motivate participation and provide immediate feedback during learning activities. For example, a course could include short challenges or quizzes that reward students with points for completing tasks, encouraging continuous engagement throughout the semester. Likewise, serious games

can be used to simulate real-world scenarios, allowing students to apply theoretical knowledge in interactive environments.

These applications demonstrate how game-based strategies can be implemented in accessible ways within higher education settings, supporting more dynamic and participatory learning experiences.

Limitations

The study is subject to certain limitations, which must be considered when interpreting the results. The meta-analysis is chiefly reliant upon observational and correlational studies, which hinders the establishment of causal inferences regarding the relationship between gamification and learning outcomes. The elevated heterogeneity and diversity in the definition and measurement of variables engender restrictions on the comparability of the studies included. The present study was constrained to the utilization of Scopus and Web of Science as a foundation for the identification of pertinent literature; it is conceivable that relevant literature indexed in disparate databases may have been excluded.

Therefore, future studies could expand the search strategy to specialized and complementary databases such as ERIC, PsycINFO, ScienceDirect, and Google Scholar in order to increase coverage and assess whether additional sources modify the pooled estimates obtained in this meta-analysis.

In addition, grey literature was not considered, which may have limited the retrieval of unpublished studies, theses, institutional reports, or non-indexed documents that could provide complementary evidence on gamification and serious games in higher education.

Furthermore, the analysis was contingent upon the quality and completeness of the statistical reporting of the primary studies, which had the potential to influence the accuracy of the aggregated estimates.

Despite the contributions of this meta-analysis, several limitations should be acknowledged. First, the included studies may present methodological variability in terms of research design, sample characteristics, and measurement of learning outcomes, which could influence the magnitude and interpretation of the reported effect sizes. Second, although systematic procedures were followed for study selection and data extraction, the possibility of publication bias cannot be entirely ruled out, as studies reporting significant results are more likely to be published.

Additionally, differences in how gamification and serious games are implemented across educational contexts may introduce variability that is difficult to fully control in a meta-analytic synthesis. These methodological considerations should be considered when interpreting the findings and highlight the need for future research employing standardized measures and more consistent reporting practices in the study of game-based learning in higher education.

CONCLUSIONS

This study synthesized empirical evidence on the relationship between gamification, serious games, and learning outcomes in higher education through a correlational meta-analysis. The findings indicate a positive association between the use of game-based strategies and academic outcomes, suggesting that these approaches can contribute to enhancing student engagement and learning performance in university contexts.

The results also highlight that the effectiveness of gamification and serious games may vary depending on contextual and methodological factors, including the characteristics of the intervention, the educational environment, and the way learning outcomes are assessed. These findings contribute to the growing body of evidence supporting the pedagogical potential of game-based learning strategies in higher education.

From a practical perspective, the results suggest that instructors and educational institutions may benefit from integrating gamified activities or serious games into their teaching practices. For example, incorporating structured challenges, progress-based feedback, or interactive simulations can foster more active participation and support deeper learning processes. Overall, this study provides empirical evidence that can inform the design of innovative instructional strategies aimed at improving teaching and learning experiences in higher education.

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