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The Impact of Gamification on Motivation in Teacher Education: A Meta-Analysis

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Abstract

Gamification has been gaining increasing attention in the field of education. Although numerous empirical studies have been conducted across various educational levels—particularly in primary and secondary education—relatively few have focused on teacher education. Investigating the use of gamification in teacher training from is essential for synthesizing and clarifying inconsistent findings. The present meta-analysis examined the effects of gamification on motivation in teacher education. Jamovi was used to analyze eight studies published between 2011 and 2025, involving 743 participants in total. Based on the heterogeneity test results, a random-effects model was applied. Publication bias analyses (Fail-safe N, Kendall's Tau, and Egger's regression) suggested that the findings were robust. The results revealed that gamification had a medium positive effect on motivation in teacher education (Hedges' g = .538, 95% CI [.159, .917], p < .001). Overall, the findings indicate that gamification is an effective pedagogical strategy for enhancing motivation in teacher education. The study provides empirical evidence and practical implications for teacher educators and policymakers seeking to promote motivational engagement through gamified learning environments.

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Introduction

Qualified teachers play a pivotal role in recognizing students' potential, inspiring them, and guiding their development. They not only promote academic achievement but also cultivate key 21st-century skills such as critical thinking, problem-solving, and creativity. Investing in teachers' professional development and education is therefore one of the most effective strategies for ensuring the long-term success of an education system. The quality of teacher education directly shapes the quality of learning that students experience. Well-prepared, innovative, and reflective teachers create learning environments that foster curiosity and help students reach their full potential. In this context, motivation in teacher education emerges as a critical factor influencing pre-service teachers' professional growth and overall success in the educational process (Saito, 2024; Yuan & Zhang, 2017; Han & Yin, 2016).

The role of motivation in learning has been conceptualized through various theoretical frameworks. Self-Determination Theory (Deci & Ryan, 1985) links individuals' learning motivation to the fulfillment of three basic psychological needs: autonomy, competence, and relatedness. When these needs are satisfied, learners display stronger intrinsic motivation and sustained engagement (Urhahne & Wijnia, 2023; Hornstra et al., 2023; Ryan & Deci, 2020; Howard et al., 2021). Research consistently shows that supporting intrinsic motivation and autonomy positively affects academic achievement, learning persistence, and psychological well-being (Ryan & Deci, 2020; Howard et al., 2021; Hsu et al., 2019). This theory also clarifies how gamification can address these fundamental psychological needs. In this process, learning emerges as an interaction between intrinsic factors—such as curiosity, interest, and the desire to learn—and extrinsic factors, including rewards, feedback, and social recognition. Flow Theory (Csikszentmihalyi, 2000) highlights the state of deep engagement and enjoyment that sustains motivation. Similarly, Keller's ARCS model (Keller, 1987; Keller, 2009) provides a pedagogical framework showing how gamified learning environments capture learners' attention, enhance confidence, and increase satisfaction.

Motivation in teacher education not only improves academic performance but also strengthens pre-service teachers' attitudes toward the profession, self-confidence, and professional commitment (Yuan & Zhang, 2017; Appova & Arbaugh, 2018). Yuan and Zhang (2017) found that teacher education programs that promote higher levels of motivation foster greater commitment to the teaching profession and increase the likelihood of viewing teaching as a long-term career. Similarly, Appova and Arbaugh (2018) reported that motivated pre-service teachers are more likely to participate in professional development activities and engage in lifelong learning. These findings underscore the importance of integrating motivational elements into teacher education programs. As motivation plays a central role in teacher development, researchers have increasingly focused on innovative strategies, such as gamification, to enhance motivation in this context.

Gamification is recognized as an effective approach to enhancing motivation in teacher education. Rather than relying on full-scale games, gamification involves integrating game elements—such as points, badges, levels, and storytelling—into educational processes. Unlike game-based learning, which focuses on gameplay itself, gamification serves as a complementary strategy to boost motivation and engagement.

Personalized gamification designs strengthen pre-service teachers' intrinsic motivation and deepen learning engagement by fulfilling their psychological needs for autonomy, competence, and relatedness (Guimerà-Ballesta et al., 2025). Gamified assessment systems further enhance satisfaction and motivation through optional and enjoyable tasks, while positively shaping pre-service teachers' attitudes toward innovative teaching methods (Buda & Pesti, 2024; Dasoo, 2024). The effective use of gamification elements—particularly points, badges, and storytelling—also increases students' interest and participation, contributing to the development of essential skills such as critical thinking and teamwork (De Bona et al., 2024).

Recent years have seen a growing interest in gamification within teacher education, leading to an increasing number of experimental studies across diverse contexts. However, the findings remain heterogeneous. Several studies indicate that gamification significantly enhances pre-service teachers' motivation (Yildiz et al., 2021; Dasoo, 2024; Buda & Pesti, 2024; Sánchez, 2023; Jaramillo-Mediavilla et al., 2024), whereas others suggest that its effects may be short-lived, with the so-called "novelty effect" diminishing over time and reducing motivation in the long term (Sailer & Homner, 2019; Ratinho & Martins, 2023; Liv et al., 2024). These inconsistencies highlight the need for a more comprehensive understanding of gamification's impact on motivation in teacher education.

This study aims to provide a systematic and evidence-based contribution to the field by examining experimental studies that investigate the effects of gamification on motivation in teacher education through a meta-analytic approach. In doing so, it offers researchers and practitioners a more reliable and comprehensive framework for understanding the role of gamification in teacher education. In light of these considerations, the present study focuses on examining the effects of gamification on motivation in teacher education between 2011 and 2025. Hence, the research question is as follows: "What is the overall effect size of gamification on motivation in teacher education?"

Method

This study employed a meta-analysis to examine the effects of gamification activities on motivation in teacher education. A meta-analysis is a statistical approach that systematically combines the results of independent studies conducted on a specific topic, allowing for the calculation of an overall effect size (Borenstein et al., 2021). This method overcomes the limitations associated with the small sample sizes of individual studies and enables more reliable and generalizable findings. The overall effect size obtained through meta-analysis provides more comprehensive and statistically meaningful results compared to effect sizes derived from a single study. Accordingly, the primary purpose of a meta-analysis is to comparatively evaluate the impact of a particular intervention and to determine the extent to which this effect differs under normal conditions or in comparison to alternative implementations (Paul & Barari, 2022).

Data Collection Process

This study was designed based on PRISMA 2020 (Preferred Reporting Items for Systematic Reviews and Meta-

Analyses) guidelines. The process involves three steps:

(1) identification,

(2) screening (including eligibility assessment), and

(3) inclusion (Page et al., 2021).

Initially, the Web of Science (WoS) database (including SSCI, SCI, SCI-E, ESCI, and AHCI) was searched with relevant keywords. For this study, Figure 1 shows the PRISMA 2020 flowchart.

A total of 1,815 records were exported from the Web of Science. Screening for empirical studies identified eight documents published between 2011 and August 2025. Studies from this period were included to capture the growing interest and ongoing development of gamification-based interventions in teacher education, particularly since the early 2010s, when gamification emerged as a prominent pedagogical approach. Table 1 provides detailed information on the included studies, including authors, journal of publication, sample sizes for experimental and control groups, and the reported Hedges' g effect sizes.

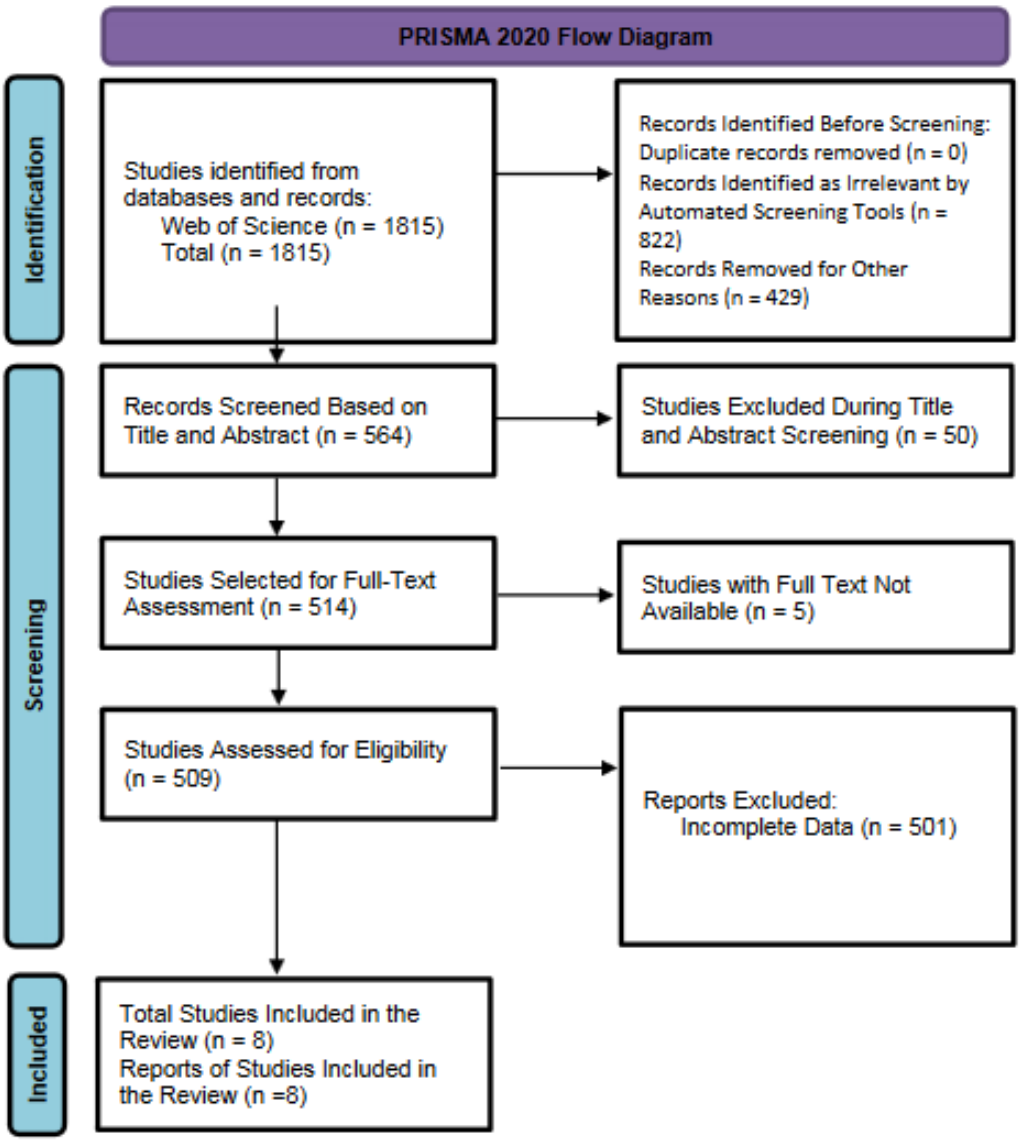

Figure 1. PRISMA 2020 Flow Diagram

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AK=((gamifi*) AND (pre-service* OR preservice* OR prospective* OR teacher* OR instructor* OR tutor*)) OR
TI=((gamifi*) AND (pre-service* OR preservice* OR prospective* OR teacher* OR instructor* OR tutor*)) OR
KP=((gamifi*) AND (pre-service* OR preservice* OR prospective* OR teacher* OR instructor* OR tutor*)) OR
AB=((gamifi*) AND (pre-service* OR preservice* OR prospective* OR teacher* OR instructor* OR tutor*))
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Figure 2. WoS Search Query Preview for Identification

Table 1. Descriptive Statistics of the Studies included in the Review

No	Authors	Journal	Sample Size		*Hedges' g*
			Experimental	Control	
1	Yildiz et al., 2021	Thinking Skills and Creativity	36	20	1.41
2	Saprudin et al., 2020	International Journal of Emerging Technologies in Learning	22	26	.68
3	Yıldırım, 2017	The Internet and Higher Education	48	49	.45
4	Bueno-Baquero et al., 2024	Revista de Educación	39	42	-.45
5	Gómez-Carrasco et al., 2019	Education Sciences	157	52	0.50
6	Yang et al., 2023	International Journal of Educational Technology in Higher Education	18	16	.89
7	Hernández-Ramos & Belmonte, 2020	Education in the Knowledge Society	53	94	.79
8	Ferriz-Valero et al., 2020	International Journal of Environmental Research and Public Health	31	40	.14

Data Analysis

Data analysis was employed using the Jamovi 2.6.44 software. Initially, Hedges' g values were calculated as standardized effect size indices for each study included in the meta-analysis. The interpretation of the direction and magnitude of the effect sizes followed the classification proposed by Cohen et al. (2013), whereby.20,.50, and.80 correspond to small, medium, and large effects, respectively.

In the present study, the computation of Hedges' g first required the calculation of Cohen's d. The following parameters were employed in this calculation:

- n_1: sample size of the experimental group
- n_2: sample size of the control group

- M_1: mean of the experimental group
- M_2: mean of the control group
- SD_1: standard deviation of the experimental group
- SD_2: standard deviation of the control group

First, the pooled standard deviation (SD_Pooled) was calculated.

$$SD\_Pooled = \sqrt{\frac{(n_1 - 1){SD_1}^2 + (n_2 - 1){SD_2}^2)}{n_1 + n_2 - 2}}$$

Subsequently, Cohen's d was calculated using the following formula:

$$d = \frac{M_1 - M_2}{SD\_Pooled}$$

The correction factor (J) was then computed using the following formula:

$$J = 1 - \frac{3}{4(n_1 + n_2) - 9}$$

Finally, Hedges' g was calculated as follows:

$$g = J\ x\ d$$

After calculating effect sizes, heterogeneity tests were conducted to assess variance among the studies. Cochran's Q test and the I^2 statistic were used to determine whether observed differences were due solely to sampling error or reflected additional underlying factors. Given the degree of heterogeneity, a random-effects model was adopted, as it accounts for both within-study and between-study variance and provides more generalizable estimates.

To assess whether the meta-analytic results were influenced by publication bias, funnel plots were examined. As the funnel plot exhibited an asymmetric distribution, additional statistical analyses were conducted to evaluate the robustness of the findings. In this regard, Rosenthal's fail-safe N test was applied to determine the extent to which the meta-analytic results were sensitive to potential publication bias. This method provides an estimate of the number of unpublished or "null-effect" studies that would be required to render the observed effect size statistically non-significant, thereby offering further evidence of the stability and reliability of the results.

Finding

This section presents the findings of the meta-analysis. First, the overall effect size of gamification on motivation in teacher education was calculated. Next, heterogeneity analyses were conducted to examine variability among the included studies. Forest and Funnel plots were generated to visually represent the results. Finally, publication bias tests were performed to evaluate the reliability and robustness of the findings.

Table 2. Meta-Analytic Results on the Overall Effect of Gamification Interventions on Motivation

Random-Effects Model (k = 8)						
	Estimate	**se**	**Z**	**p**	**CI Lower Bound**	**CI Upper Bound**
Intercept	0.538	0.193	2.78	0.005	0.159	0.917

Not. Tau² Estimator: Restricted Maximum-Likelihood

Analysis of Table 2 provides evidence that gamification interventions in teacher education exert a moderate overall effect on motivation (g = 0.538). This effect is statistically significant (Z = 2.78, p = .005) and associated with a 95% confidence interval of [0.159, 0.917]. These results provide evidence that gamification-based applications have a positive and meaningful impact on pre-service teachers' motivation.

Table 3. Statistical Findings on Heterogeneity Among Studies Included in the Meta-Analysis

Heterogeneity Statistics							
Tau	**Tau²**	**I²**	**H²**	**R²**	**df**	**Q**	**p**
0.487	0.2374 (SE= 0.1595)	82.04%	5.569	.	7.000	34.080	<.001

Analysis of Table 3 provides evidence that heterogeneity tests revealed significant differences in effect sizes across the included studies (Q(7) = 34.080, p < .001). Approximately 82.04% of the total variance was attributable to factors beyond sampling error (I^2 = 82.04%), indicating a high level of heterogeneity. Consequently, a random-effects model was employed. The estimated between-study variance (τ^2) was 0.2374, further confirming that these differences were statistically meaningful.

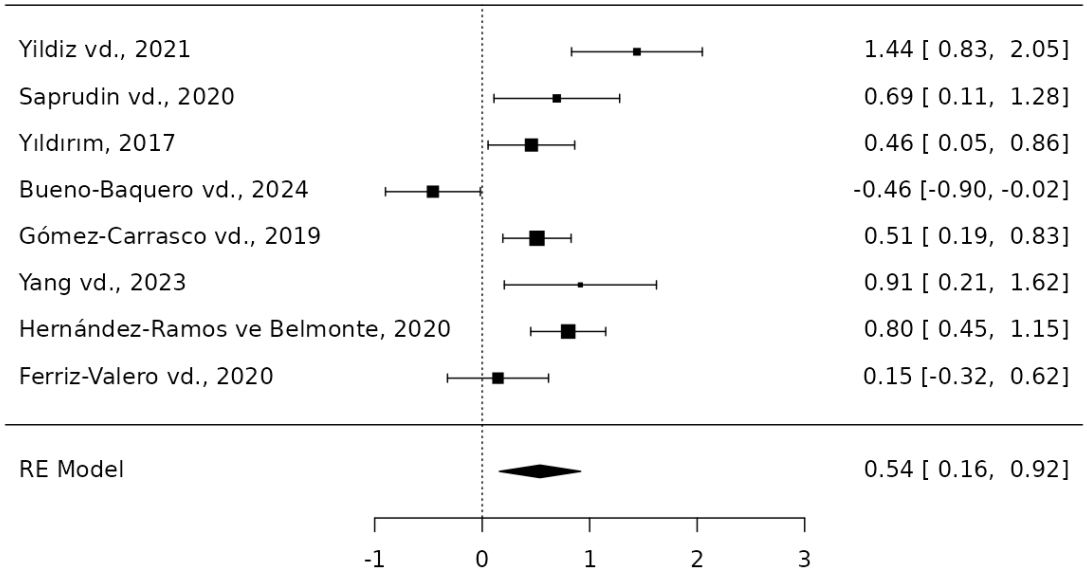

Figure 3. Forest Plot

Analysis of Figure 3 provides evidence that the Forest plot, based on the eight studies included in the meta-analysis, yielded an overall effect size of 0.54, reflecting a moderate and positive effect (95% CI = [0.16, 0.92]). This finding indicates that gamification interventions have a significant and beneficial impact on motivation. At the individual study level, Yıldız (2021) reported notably high effect sizes, whereas Bueno-Baquero (2024) exhibited a statistically significant negative effect. Additionally, Ferriz-Valero (2020) did not reach statistical significance. Overall, these results demonstrate a positive trend while also highlighting substantial heterogeneity among the studies.

Analysis of Figure 4 indicates that the visual asymmetry observed in the funnel plot may suggest potential publication bias; however, it is insufficient to draw definitive conclusions on its own.

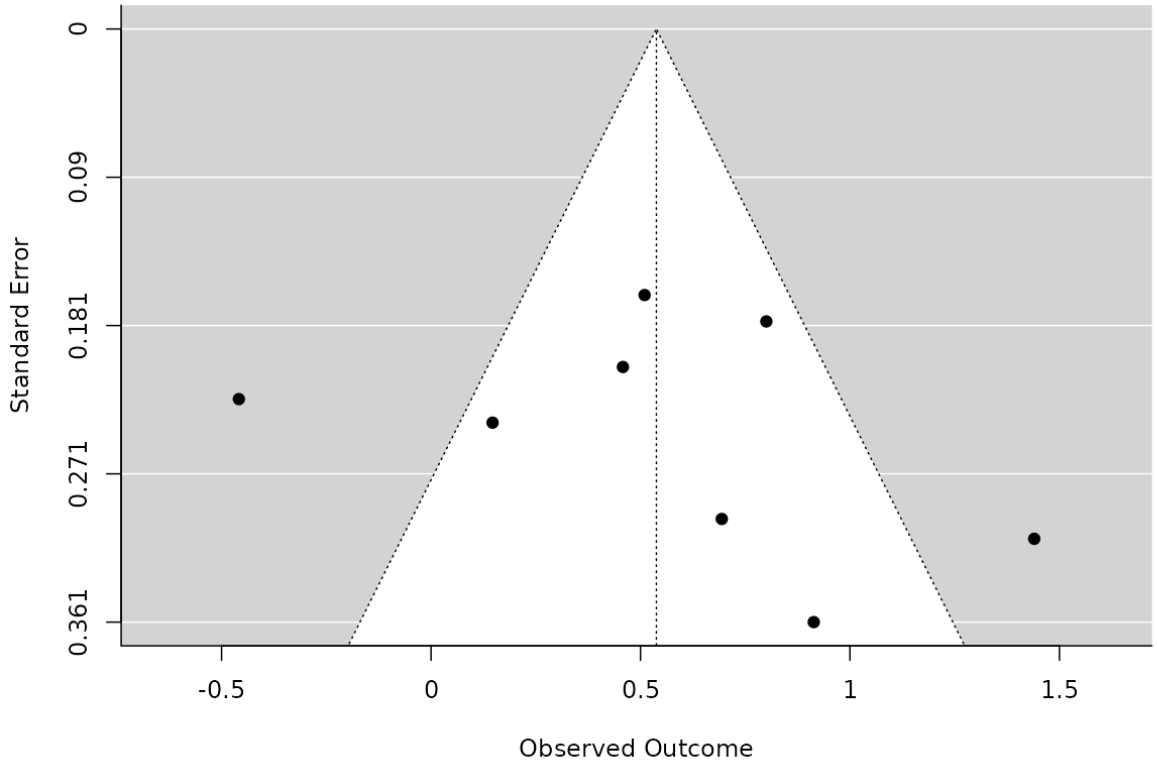

Figure 4. Funnel Plot

Funnel plot interpretations can be subjective and potentially misleading, especially in meta-analyses with a small number of studies. Therefore, applying subsequent quantitative statistical tests after visual inspection is essential for a more reliable and objective assessment of publication bias.

Analysis of Table 4 provides evidence that the meta-analytic findings are robust and unlikely to be affected by unpublished studies. Specifically, the results indicate that 112 unpublished or null-effect studies would be required to render the observed effect size statistically non-significant. According to Rosenthal's criterion, when the fail-safe N substantially exceeds the threshold of [5k + 10] (for k = 8 studies: 5(8) + 10 = 50), the influence of publication bias is considered low. Therefore, the risk of publication bias in this meta-analysis is minimal.

Furthermore, neither Kendall's Tau test ($\tau = 0.214$, $p = 0.548$) nor Egger's regression test (intercept = 1.065, $p = 0.287$) yielded statistically significant results. Together, these findings indicate an absence of notable publication bias, supporting the reliability of the overall observed effect size.

Table 4. Statistical Test Results Assessing Publication Bias in the Meta-Analysis Findings

Publication Bias Assessment		
Test Name	**value**	**p**
Fail-Safe N	112.000	<.001
Kendalls Tau	0.214	0.548
Egger's Regression	1.065	0.287

Not. Fail-safe N Calculation Using the Rosenthal Approach

Discussion and Conclusion

This meta-analysis systematically examined studies conducted between 2011 and 2025 to investigate the effects of gamification on motivation in teacher education and to estimate an overall effect size. The findings provide evidence that gamification has a moderate and statistically significant effect on pre-service teachers' motivation ($g = 0.538$, $p < .01$). These results suggest that, although gamification exerts a robust impact on motivation, its effectiveness may vary depending on contextual factors such as study design, implementation methods, and participant characteristics.

The present findings are consistent with prior research emphasizing motivation as a critical factor in teacher education (Han & Yin, 2016; Yuan & Zhang, 2017; Appova & Arbaugh, 2018). For instance, Li et al. (2024) reported that gamification enhanced intrinsic motivation across various educational levels, particularly by effectively supporting competence and relatedness needs. Consequently, designing gamification interventions should extend beyond extrinsic elements such as rewards and badges, placing greater emphasis on opportunities that foster self-regulation and reinforce pre-service teachers' sense of competence. According to Self-Determination Theory, motivation is driven by the satisfaction of three fundamental psychological needs: autonomy, competence, and relatedness (Deci & Ryan, 1985; Ryan & Deci, 2020). Gamification can address these needs through features such as immediate feedback, points and badge systems, competition and collaboration elements, and narrative-based learning experiences. Recent studies further demonstrate that gamification enhances learning motivation, class participation, and knowledge retention in teacher education (Yıldız et al., 2021; Dasoo, 2024; Buda & Pesti, 2024; Jaramillo-Mediavilla et al., 2024). Overall, these findings suggest that gamification is not merely a novelty or attention-grabbing technique, but a pedagogically meaningful approach capable of producing significant educational outcomes in teacher training.

The high level of heterogeneity observed in the meta-analytic results ($I^2 = 82.04$) indicates that the effects of

gamification vary considerably depending on context, implementation methods, and participant characteristics. While some studies suggest that gamification supports long-term motivation, others highlight that its effects may be short-lived, with the so-called "novelty effect" diminishing over time (Sailer & Homner, 2019; Ratinho & Martins, 2023). These findings underscore that gamification does not produce uniform outcomes across all teacher education settings and must be carefully and pedagogically aligned to achieve meaningful results. Superficial implementations relying solely on rewards and point systems may temporarily enhance motivation but fail to support sustained learning processes. In contrast, personalized, collaborative, and learning-goal-integrated gamification strategies can produce more enduring effects (Guimerà-Ballesta et al., 2025). Analyses assessing publication bias further support the robustness of the meta-analytic findings. The fail-safe N (112) substantially exceeds the critical threshold, indicating that the results are unlikely to be undermined by a small number of unpublished studies. Additionally, non-significant outcomes from both Kendall's Tau and Egger's regression tests suggest an absence of notable publication bias. Together, these findings indicate that the overall observed effect size is robust and representative of the current literature.

The findings of this study offer several implications for policymakers and program developers in teacher education. Gamification should be integrated into programs as an effective tool to enhance pre-service teachers' motivation. However, such implementations must align with pedagogical objectives and move beyond superficial reward systems. Given that both pre-service and in-service teachers are adult learners, gamification should not be treated merely as an entertainment feature but as a pedagogical strategy closely linked to learning goals. Adult learners are more motivated when tasks are perceived as meaningful and professionally relevant (Knowles, 1984). Therefore, to maximize its effectiveness, gamification interventions in teacher education should be structured around intrinsically motivating and meaningful tasks, offering timely feedback and opportunities for peer interaction.

Second, gamification interventions in teacher education can contribute to long-term outcomes, including professional commitment and a sustained desire for lifelong learning (Yuan & Zhang, 2017). Consequently, gamification designs should focus not only on enhancing pre-service teachers' academic performance but also on fostering positive professional attitudes. Narrative-based gamification scenarios and team-oriented competitive elements, in particular, can strengthen professional identity and a sense of belonging among teacher candidates. Collaborative, rather than purely competitive, gamification designs have been shown to promote sustainable motivation in teacher education (Guimerà-Ballesta et al., 2025). These findings also highlight the potential of gamification for integrating digital pedagogies into teacher preparation. Gamification supports the development of technological competencies, provides personalized feedback through learning analytics, and promotes professional commitment—all of which are central to 21st-century teacher competencies. Therefore, gamification should be implemented systematically within teacher education programs, not as a classroom novelty, but as an essential component of professional digital competence development.

As with any research, the present study has several limitations. First, the relatively small number of studies included in the meta-analysis may limit the generalizability of the findings. Additionally, sample sizes varied considerably across studies, which may have contributed to the high heterogeneity observed in effect sizes. Future

research using larger samples, conducted across diverse cultural contexts, and employing longitudinal designs would help clarify the effects of gamification more precisely. Second, this analysis focused exclusively on motivation. Systematic investigations of gamification's impact on other outcomes in teacher education—such as achievement, self-efficacy, professional commitment, and attitudes toward instructional innovation—are warranted. Future meta-analyses should consider adopting multivariate approaches to capture these broader effects. Finally, this meta-analysis included only publications indexed in the Web of Science (WoS), potentially excluding relevant studies available in other international or local databases (e.g., ERIC, Scopus, ProQuest, DergiPark).

In conclusion, this meta-analysis provides evidence that gamification in teacher education has a moderate effect on enhancing motivation. When carefully designed and aligned with pedagogical objectives, gamification can foster sustained motivation throughout pre-service teachers' professional learning processes. Accordingly, it should be considered an innovative and sustainable component of teacher education programs. Nevertheless, further research is needed to examine its long-term effects and to explore its impact on outcomes beyond motivation.

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