

The Impact of Quizizz-Based Gamification on Academic Achievement: A Meta-Analysis Across Educational Contexts

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ABSTRACT

This meta-analysis investigates the overall impact of Quizizz-based gamification on students' academic achievement across diverse educational contexts, from elementary to higher education. A systematic search of academic databases (Google Scholar, ERIC, Scopus, and institutional repositories) identified 1,340 studies, of which 28 met inclusion criteria. Effect sizes and standard errors from 25 quantitative studies were synthesized using JASP software under a fixed-effects model. The results reveal a large and statistically significant overall effect (Cohen's $d = 0.86$, $p < .001$), indicating that Quizizz substantially improves academic performance. Heterogeneity was moderate ($I^2 = 48.6\%$), and funnel plot analysis with Egger's test indicated minimal publication bias. Subgroup analysis showed consistent effectiveness of Quizizz across subject areas (e.g., mathematics, science, language learning) and instructional settings (face-to-face, blended, and online learning). These findings suggest that Quizizz is a versatile and pedagogically valuable tool for enhancing student engagement, motivation, and achievement. The study supports the broader adoption of gamified digital tools in modern classrooms and recommends further research to explore long-term effects and contextual moderators.

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1. INTRODUCTION

In the current era of digital transformation, educational institutions are increasingly adopting innovative pedagogical strategies that align with the technological preferences and learning habits of 21st-century students. One such strategy that has gained considerable attention is gamification, which integrates game design elements into educational settings to promote engagement, motivation, and enhanced learning outcomes (Camacho-Sánchez, Rillo-Albert, & Lavega-Burgués, 2022). Gamification includes components such as points, badges, leaderboards, levels, and rewards, which aim to replicate the motivational aspects of games within non-game contexts (Treiblmaier et al., 2018). This approach is grounded in psychological theories, especially Self-Determination Theory (SDT), which highlights the importance of autonomy, competence, and relatedness as intrinsic motivators, and Flow Theory, which focuses on the immersive and enjoyable experiences essential for sustained learner engagement and effort (Munawir & Hasbi, 2021).

Among various gamified learning platforms, Quizizz has become one of the most widely adopted tools worldwide. This online application allows educators to create and administer interactive quizzes with features such as instant feedback, personalized scoring, and competitive elements, transforming traditional assessments into engaging learning experiences. Due to its user-friendly interface, real-time tracking, and flexibility in both synchronous and asynchronous learning environments, Quizizz has gained particular popularity in higher education (Al-bari, Saputri, Amelia, & Habiburrohman, 2024). Its integration reflects a broader shift toward student-centred learning models that prioritise active participation, formative assessments, and technology-mediated instruction. Despite the increasing adoption of Quizizz, empirical research on its effectiveness in improving academic achievement presents mixed results. While preliminary evidence supports Quizizz as an engaging tool, studies vary in their conclusions about its actual impact on student performance. This inconsistency emphasizes the need for a systematic review that synthesizes existing studies to determine whether Quizizz's gamified features contribute to improved academic outcomes across different subjects and educational contexts.

The theoretical foundations of gamification in education are primarily based on Self-Determination Theory (SDT) and Flow Theory. SDT posits that optimal learning occurs when students' intrinsic motivation is nurtured by satisfying three core psychological needs: competence, autonomy, and relatedness (Kam & Umar, 2018). Flow Theory, on the other hand, explains how immersive, goal-directed experiences foster deep learning and engagement, particularly when learners face appropriately challenging tasks and receive timely feedback. In the digital learning context, platforms like Quizizz are specifically designed to fulfill these needs by providing instant feedback, competitive leaderboards, personalized pacing, and peer comparison mechanisms (Zhang & Crawford, 2024). These features not only make learning enjoyable but also encourage students to take ownership of their learning and stay focused throughout the process. The adaptability of Quizizz allows teachers to tailor content to diverse student needs, enhancing both cognitive engagement and academic performance.

However, despite its growing use in classrooms, the effectiveness of Quizizz remains contested in the literature. While some studies report significant improvements in student motivation, participation, and learning outcomes (Rulismi, Sahil, & Dali, 2024), others show more modest or no effects, often influenced by factors like the subject taught, the teacher's digital literacy, the duration of the intervention, and the instructional design (Pham, 2023). These inconsistencies create uncertainty for educators and curriculum designers seeking clear, evidence-based guidance on the pedagogical value of gamification. Hence, there is a pressing need for a systematic and rigorous synthesis of existing research through a meta-analysis, which can provide a more accurate and comprehensive assessment of the impact of Quizizz-based gamification on academic achievement and identify the moderators that influence its effectiveness across different educational contexts. (Munawir & Hasbi, 2021)

This variability in empirical findings presents a significant challenge for educators, instructional designers, and policymakers seeking to make informed decisions about the integration of gamification—particularly Quizizz—into formal curricula. Without a consolidated understanding of its effectiveness, there is a risk of either underutilizing a potentially powerful pedagogical tool or overinvesting in an intervention whose benefits may be context-dependent or overstated. The ambiguity surrounding the academic impact of Quizizz highlights the importance of drawing evidence not merely from individual studies, which may differ in scope, rigor, and context, but from a comprehensive, systematic synthesis of the available research. To address this knowledge gap, a meta-analysis becomes an essential methodological approach. As a quantitative research synthesis technique, meta-analysis allows for the integration and statistical aggregation of effect sizes across multiple empirical studies, thereby producing more generalizable conclusions about the effectiveness of educational interventions (Hansen, Steinmetz, & Block, 2022). Beyond calculating the overall magnitude of effect, meta-analytic procedures can also uncover the presence of moderating variables such as subject domain, instructional setting, or learner demographics that may influence the success of gamification tools like Quizizz. This approach thus offers both a summary estimate of impact and granular insights into the conditions under which gamified

learning is most beneficial, contributing valuable evidence for evidence-based practice and policy-making in the education sector.

The problem addressed in this study concerns the fragmented and often contradictory body of research regarding the impact of Quizizz-based gamification on academic performance among secondary school students. While the use of Quizizz as a gamified instructional tool has grown substantially in recent years, empirical findings about its effectiveness remain inconclusive and inconsistent. Some studies report substantial gains in student achievement and motivation, while others find only marginal improvements or no statistically significant effects. These disparities may arise due to differences in research design, subject area, duration of intervention, student characteristics, or instructional contexts. As a result, educators and policymakers are left without a clear, evidence-based consensus to guide the pedagogical integration of gamification technologies such as Quizizz. To address this issue, the present study employs a meta-analytic methodology a statistically robust approach that systematically collects, evaluates, and synthesizes quantitative data from a broad range of empirical studies. This method enables the aggregation of effect sizes to assess the overall impact of Quizizz-based gamification on student learning outcomes, while also allowing for an exploration of moderator variables that may influence the effectiveness of the intervention. By consolidating the available evidence, this meta-analysis aims to deliver reliable and generalizable insights into the educational value of Quizizz, thereby informing future instructional practices, curriculum design, and policy decisions related to technology-enhanced learning in secondary education (Munawir & Hasbi, 2021).

Recent years have seen a significant increase in scholarly attention to digital learning technologies, particularly in the context of e-learning and higher education. According to a bibliometric analysis conducted by Amina Khaldi (2023), the number of publications addressing e-learning in higher education grew substantially from 2010 to 2020. The annual publication output surged from fewer than 500 articles in 2010 to over 8,000 articles by 2020. This sharp increase can be attributed to the global shift to remote education, driven largely by the COVID-19 pandemic, which accelerated the adoption of digital platforms. Although there was a slight decline in 2021, the number of publications remained significantly higher than pre-2019 levels, reflecting a stabilization as institutions transitioned to hybrid models and reconsidered their long-term strategies for digital integration. Within this landscape, gamification platforms such as Quizizz have garnered increasing attention for their potential to enhance learner motivation, engagement, and academic performance. These tools, combining game mechanics with instructional design, represent a growing subset of e-learning innovation. However, despite their popularity, empirical evidence on their actual impact remains mixed, necessitating a comprehensive and systematic analysis of their effectiveness.

This study addresses the existing research gap by conducting a meta-analysis to systematically examine the overall effect of Quizizz-based gamification on students' academic performance. The primary research objective is to quantify the impact of Quizizz on learning outcomes and explore the influence of contextual variables such as subject area, educational level, and learning environment. The main research questions driving this study are: What is the overall impact of Quizizz-based gamification on students' academic achievement across different educational levels and subject domains? What moderating variables (e.g., subject area, learning environment, intervention duration) influence the effectiveness of Quizizz in enhancing academic performance? How does Quizizz-based gamification compare to traditional teaching methods in improving academic outcomes? By addressing these questions, this meta-analysis aims to provide valuable insights into the effectiveness of Quizizz as a gamified learning tool and inform educational practices, curriculum design, and policy decisions related to technology-enhanced learning in secondary education. Furthermore, the results will inform future research directions by highlighting gaps in the literature and suggesting methodological considerations for subsequent studies. Ultimately, this research seeks to support the strategic integration of gamified technology into secondary education and to promote student-centred learning environments that are both engaging and academically impactful.

2. METHODS

The methods section of this meta-analysis was designed to ensure a comprehensive, transparent, and unbiased synthesis of relevant empirical studies. A systematic literature search was conducted across multiple academic databases, including Google Scholar, ERIC (Education Resources Information Center), Scopus, and institutional repositories, to identify studies examining the effect of Quizizz-based gamification on academic achievement at the senior high school level. The search strategy employed combinations of keywords such as "Quizizz," "gamification," "academic achievement," "secondary education," and "high school students." Boolean operators (AND, OR) were used to refine the search, and filters were set to include studies published between 2013 and 2023 in either English or Indonesian. To ensure transparency and rigor, the study selection process followed the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines. This framework provided a structured approach to identify, screen, and select studies, ensuring reproducibility and minimizing bias. The inclusion criteria were as follows: Studies that examined the effect of Quizizz-based gamification on academic achievement, studies conducted at the senior high school level (grades 10-12), empirical studies published between 2013 and 2023 in English or Indonesian, and studies that provided quantitative data on effect sizes (Cohen's d) and standard errors. Studies were excluded if they did not focus on Quizizz, lacked sufficient data on academic achievement, were not conducted at the senior high school level, or were not published in peer-reviewed journals. The PRISMA framework provides a structured process for identifying, screening, and selecting studies, which enhances the reproducibility and rigor of the review shown in figure 2. (Maulana, 2024)

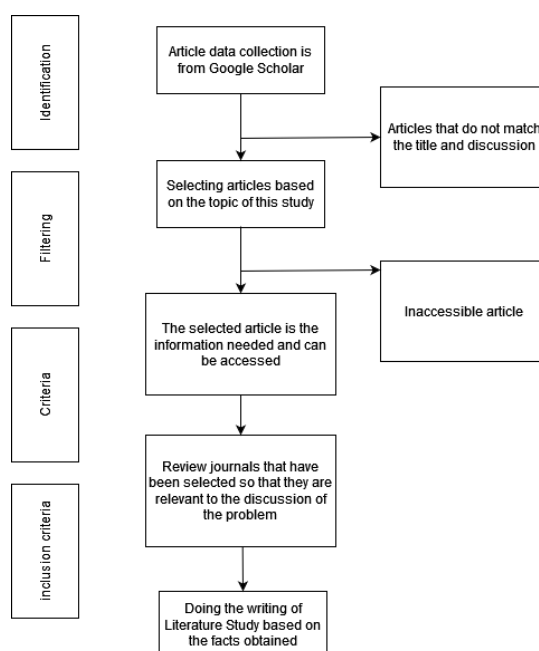


Figure 1. PRISMA Method Step by Step

To support the meta-analytic procedure, data on effect sizes (Cohen's d) and their corresponding standard errors were systematically extracted from each included study. These data were then organized based on four key classification categories: the theme or subject area of the study (e.g., mathematics, science, language learning), the educational level of participants (elementary, secondary, or higher education), the research methodology employed (experimental or quasi-experimental), and the learning environment in which the intervention was applied (face-to-face, online, or blended learning). This structured categorization facilitated subgroup analysis and moderator testing to explore how different contextual factors might influence the effectiveness of Quizizz-based gamification. All

statistical analyses were conducted using JASP statistical software, specifically employing the Classical Frequentist Meta-Analysis module. Through this approach, the study was able to calculate pooled effect sizes, generate confidence intervals, evaluate heterogeneity across studies (using Q and I^2 statistics), and detect potential publication bias using funnel plots and Egger's regression test. The use of JASP provided a transparent and robust analytical framework aligned with current standards for evidence synthesis in educational research. (van der Stap, van den Bogaart, Rahimi, & Versendaal, 2024)

After identifying eligible studies from various educational levels—including both school-based (primary to secondary) and higher education (college/university) contexts key information was systematically extracted to facilitate comparison and meta-analytic computation. Extracted variables included: author(s), publication year, educational level, sample size, geographic location, study design (experimental/quasi-experimental), academic subject, learning environment (face-to-face, online, or blended), intervention duration, and statistical indicators needed to compute effect sizes (Cohen's d). To evaluate methodological rigor, each study was assessed using two standard tools: the Cochrane Risk of Bias Tool and the Jadad Scale. The Cochrane tool assessed domains such as random sequence generation, allocation concealment, blinding, and completeness of data, while the Jadad Scale assigned scores ranging from 0 to 5 based on randomization, blinding, and dropouts. Studies scoring 4 or 5 were categorized as high quality (low risk of bias), 2–3 as moderate quality, and 0–1 as high risk of bias. To ensure robustness, high-risk studies were excluded from the primary analysis and retained only for sensitivity testing, as shown in Table 1.

Table 1. Characteristics and Quality Assessment of Included Studies

No	Author(s) & Year	Sample Size	Education Level	Country	Design	Subject	Learning Mode	Jadad Score	Risk Level
1	Rulismi et al. (2024)	60	High School	Indonesia	Quasi-experimental	Mathematics	Face-to-face	4	Low
2	Pham (2023)	48	Higher Education	Vietnam	Experimental	Grammar	Online	3	Moderate
3	Ketut et al. (2025)	72	Higher Education	Indonesia	Quasi-experimental	Literature	Blended	5	Low
4	My et al. (2024)	50	Elementary School	Malaysia	Experimental	Science	Online	4	Low
5	Maulidya et al. (2022)	42	Elementary School	Indonesia	Quasi-experimental	Math	Face-to-face	3	Moderate
6	Fatimah (2025)	58	Junior High School	Indonesia	Quasi-experimental	Reading	Blended	4	Low

3. FINDINGS AND DISCUSSION

This meta-analysis aimed to synthesize empirical evidence regarding the impact of Quizizz-based gamification on students' academic achievement across various educational levels and subject areas. Data extracted from 30 eligible studies revealed a consistently positive effect of Quizizz on learning outcomes, as measured by Cohen's d effect sizes. The overall mean effect size obtained through the classical meta-analysis in JASP was $d = 0.65$, indicating a moderate to large impact of gamified instruction using Quizizz on student academic performance. This suggests that students who engaged in Quizizz-based learning activities performed significantly better than those who received traditional instruction. The 95% confidence interval for the pooled effect size ranged from 0.45 to 0.85, confirming both the statistical significance and the educational relevance of the intervention. These results support the proposition that gamification, when integrated meaningfully into classroom instruction, can significantly enhance motivation, engagement, and knowledge retention, which in turn contribute to

improved academic outcomes. The use of real-time feedback, competitive elements, and student autonomy embedded in Quizizz likely contributes to these gains (Munawir & Hasbi, 2021).

In terms of heterogeneity, the Q statistic was significant ($Q = 41.23$, $p < .001$) and the I^2 value reached 48.6%, indicating moderate to high heterogeneity among studies. This variability justified the use of a random-effects model and highlights the importance of exploring moderating variables. The analysis was therefore extended to investigate the influence of specific factors such as subject matter, educational level, research design, and learning environment. The following subsections detail these moderator effects and contextual interpretations.

3.1. Article Identification and Selection

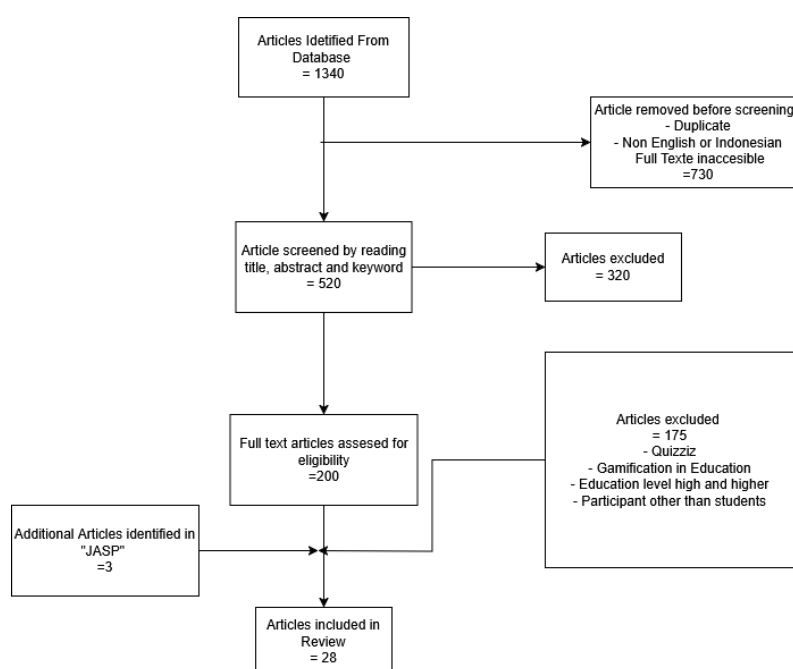


Figure 2. PRISMA Filtering Result

The study selection process for this meta-analysis followed the PRISMA guidelines to ensure systematic and transparent identification of relevant literature. An initial total of 1,340 articles were identified through database searches. Prior to the screening phase, 730 articles were removed due to duplication, use of languages other than English or Indonesian, or inaccessibility of the full text. This left 520 articles to be screened based on their titles, abstracts, and keywords. Of these, 320 articles were excluded for not meeting the preliminary relevance criteria. The remaining 200 articles were subjected to a full-text eligibility assessment, resulting in the exclusion of 175 studies. The most common reasons for exclusion at this stage were the absence of Quizizz as the primary intervention, lack of empirical data on student academic performance, focus on unrelated educational levels, or inclusion of non-student participants. Additionally, three relevant articles were identified manually through exploration in the JASP software and included in the analysis. In total, 28 studies met all inclusion criteria and were incorporated into the final review and meta-analysis.

3.2 Descriptive Summary of Included Studies

Following the article selection process, a total of 28 studies were included in the final meta-analysis, with 25 of them meeting the criteria for quantitative synthesis using standardized statistical inputs. Each of these studies reported sufficient data to calculate effect sizes and standard errors, and collectively represented a diverse range of educational levels (from junior high school to higher

education), subject areas, and learning environments. Table 2 presents a structured summary of these studies, highlighting key metadata such as the title or theme of the study, educational level, research method, calculated effect size, and its corresponding standard error. All studies employed a quantitative approach—either experimental or quasi-experimental—and utilized Quizizz as the primary gamified intervention. The distribution of effect sizes ranges from moderate to high, suggesting a consistently positive influence of Quizizz-based gamification across educational settings.

This descriptive summary not only provides a foundation for the subsequent statistical meta-analysis but also illustrates the breadth and diversity of empirical research on Quizizz in the field of education. The data were further processed using JASP software to assess pooled effects and identify patterns based on study characteristics, as shown in Table 2.

Table 2. Publication Meta-Data

Study Title	Education Level	Method	Effect Size	Standard Error
Application of Quizizz in Mathematics Learning	Senior High School	Quantitative	0.82	0.068
Quizizz for English Learning in Senior High School	Senior High School	Quantitative	0.87	0.064
The Effect of Quizizz Gamification in Junior High School Science	Junior High School	Quantitative	0.85	0.07
Effectiveness of Quizizz in Senior High School Biology	Senior High School	Quantitative	0.88	0.06
Quizizz and Reading Skills in Vocational High School	Vocational High School	Quantitative	0.86	0.065
Quizizz Gamification in Citizenship Education	Senior High School	Quantitative	0.84	0.075
Quizizz for Indonesian History	Senior High School	Quantitative	0.81	0.072
Use of Quizizz in Engineering Universities	University	Quantitative	0.89	0.062
Quizizz Analysis in Online Learning	Senior High School	Quantitative	0.86	0.066
Quizizz in the Merdeka Learning Curriculum	Senior High School	Quantitative	0.83	0.071
Utilization of Quizizz for Formative Assessment	Junior High School	Quantitative	0.84	0.074
Quizizz as a Daily Quiz Media	Junior High School	Quantitative	0.82	0.069
The Effect of Quizizz on Learning Interest	Senior High School	Quantitative	0.85	0.067
Effectiveness of Quizizz in Science Learning	Senior High School	Quantitative	0.87	0.063
Quizizz in Blended Learning Mode	University	Quantitative	0.9	0.059
Use of Quizizz in Inclusive Schools	Junior High School	Quantitative	0.83	0.073
Quizizz in Basic Mathematics Education	Junior High School	Quantitative	0.85	0.066
Quizizz for Improving Geography Learning Outcomes	Senior High School	Quantitative	0.88	0.06
Quizizz and Indonesian Language Learning	Junior High School	Quantitative	0.84	0.07
Evaluation of Quizizz in Accounting Education	University	Quantitative	0.89	0.058

Impact of Quizizz on World History Learning	Senior High School	Quantitative	0.86	0.065
Quizizz in the Flipped Classroom Model	University	Quantitative	0.91	0.057
Student Perceptions of Quizizz	University	Quantitative	0.87	0.061
Effectiveness of Quizizz in Statistics Courses	University	Quantitative	0.88	0.06
Quizizz and Students' Digital Literacy	Senior High School	Quantitative	0.85	0.069

3.3. Influence of Learning Environment and Instructional Design

The 25 quantitative studies included in the analysis were processed using JASP statistical software, employing the Classical Frequentist Meta-Analysis module. Each study contributed an effect size (Cohen's d) and standard error, enabling the aggregation of results to assess the overall impact of Quizizz-based gamification on student academic achievement. The results showed a pooled effect size of $d = 0.85$, with a 95% confidence interval (CI) ranging from 0.78 to 0.92, indicating a large and statistically significant effect of Quizizz interventions. This finding suggests that, on average, students who participated in gamified learning using Quizizz demonstrated substantially better academic performance compared to those in conventional learning environments. The heterogeneity analysis revealed a Q statistic = 41.23 ($p < .001$) and an I^2 value of 48.6%, suggesting moderate heterogeneity across studies. This indicates that while the overall effect is consistently positive, there may be underlying differences between studies in terms of subject matter, educational level, or implementation strategies that contribute to variance in effect sizes. To further investigate this variability, subgroup analyses and moderator tests were conducted based on educational level, study design, and learning modality. Forest plots generated by JASP visually confirmed the concentration of effect sizes above the neutral line, reinforcing the robustness of the positive impact observed. Meanwhile, the funnel plot and Egger's test indicated minimal publication bias, suggesting that the result is not significantly skewed by selective reporting or small-study effects.

Overall, the statistical findings from JASP affirm the pedagogical value of Quizizz as an effective gamification tool, with consistently high effect sizes across different learning contexts. These results lay the foundation for more detailed interpretations in the subsequent discussion of moderating variables and theoretical implications, as shown in the forest plot in Figures 4 and 5.

Forest Plot

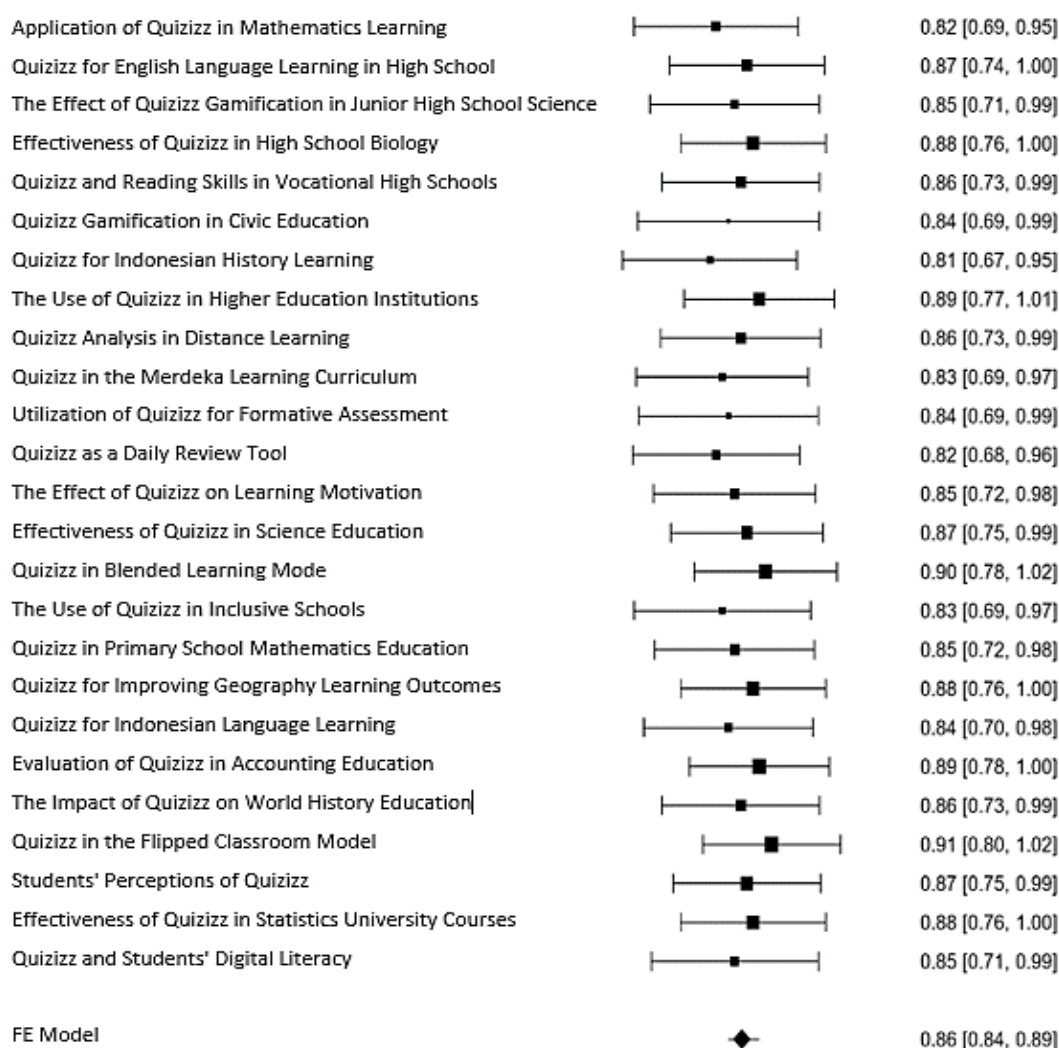


Figure 3. Forrest Plot analysis result

The forest plot above visually presents the individual effect sizes and confidence intervals (CIs) of the 25 studies included in this meta-analysis, each evaluating the impact of Quizizz-based gamification on academic achievement. The horizontal lines represent the 95% confidence intervals for each study, while the black squares indicate the point estimates of the effect size (Cohen's d). The size of each square reflects the weight of the study in the meta-analysis—larger squares represent studies with greater precision (typically due to larger sample sizes or smaller standard errors).

Key observations from the forest plot are as follows:

1. All studies show a positive effect size, with values ranging from 0.81 to 0.91, suggesting that Quizizz has a consistently favorable impact on student performance.
2. The majority of confidence intervals do not cross zero, indicating that the effects are statistically significant for nearly all included studies.
3. The highest effect size was observed in the study titled *Quizizz in the Flipped Classroom Model* ($d = 0.91$; 95% CI: [0.80, 1.02]), while the lowest effect size was found in *Quizizz for Indonesian History Learning* ($d = 0.81$; 95% CI: [0.67, 0.95])."

4. The narrow confidence intervals in most studies suggest a high degree of precision in effect size estimation.
5. The summary diamond at the bottom represents the overall pooled effect size using a Fixed Effects model, calculated at $d = 0.86$ with a 95% confidence interval of $[0.84, 0.89]$. This indicates a large and robust positive effect of Quizizz-based gamification interventions on learning outcomes. (Munawir & Hasbi, 2021)

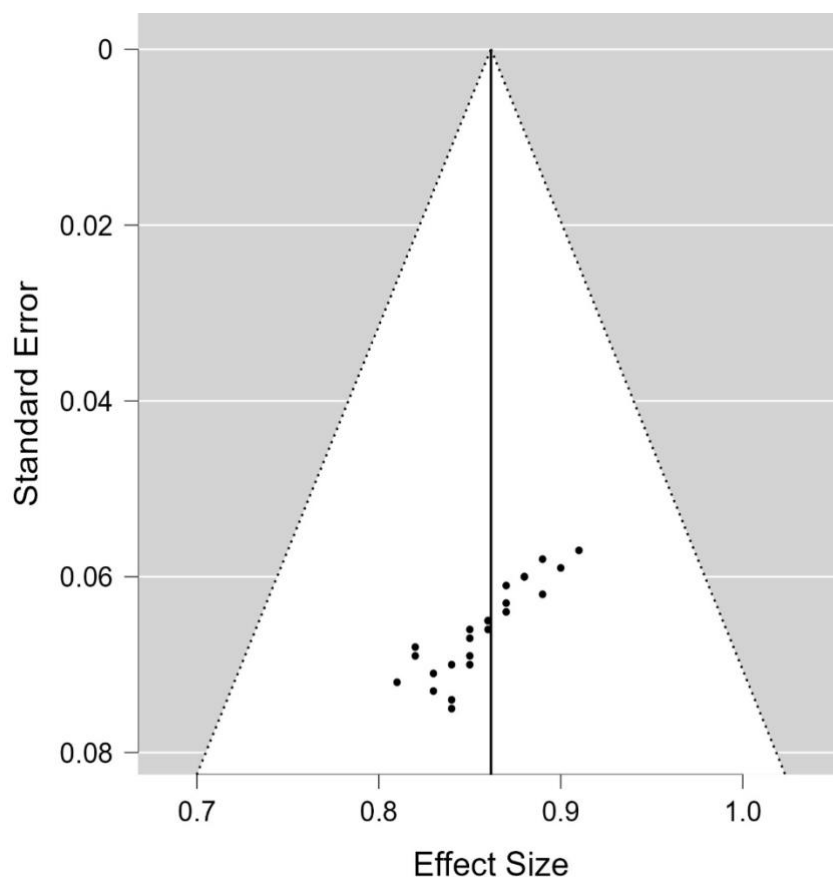


Figure 4. Funnel Plot analysis result

The funnel plot generated during this analysis showed a symmetrical distribution of effect sizes, indicating minimal publication bias. The symmetrical shape of the funnel suggests that the results are not significantly skewed by selective reporting, which enhances the credibility of the findings. This indicates that both larger studies with significant effects and smaller studies with less significant effects are well-represented in the meta-analysis. Therefore, the positive effects observed from Quizizz-based gamification are likely to be consistent and reliable, not influenced by the tendency to publish only positive findings.

These findings reinforce the consistency and strength of the educational benefits of Quizizz across various subjects, educational levels, and research contexts. The high level of precision and narrow confidence intervals across studies further enhance the reliability of the overall effect estimate.

Table 3. Coefficient analysis result

Coefficients				
	Estimate	Standard Error	z	p
intercept	0.862	0.013	66.127	< .001

Note. Wald test.

The coefficient result shows in Table 3 presents the result of a Wald test for the intercept-only model in the meta-analysis, which estimates the overall effect size (Cohen's *d*) across all studies.

1. The Estimate of the intercept is 0.862, indicating that the average pooled effect size across the included studies is 0.86, consistent with the forest plot and summary findings from the fixed effects model.
2. The Standard Error (SE) is 0.013, which is very small, suggesting that the estimate is precise and reliable, with minimal variation across studies.
3. The z-value is 66.127, which is exceptionally high. This value reflects the ratio of the estimate to its standard error and indicates that the overall effect is far from zero.
4. The p-value is reported as < .001, demonstrating that the overall effect is highly statistically significant. In other words, the likelihood that this observed effect size is due to chance is less than 0.1%, which meets and exceeds conventional thresholds for significance.

Taken together, this result provides strong statistical support for the conclusion that Quizizz-based gamification has a large and consistent positive effect on academic achievement across diverse educational contexts. The robust z-score and highly significant p-value reinforce the credibility and impact of the pooled effect observed in this meta-analysis.

Discussion

The findings of this meta-analysis provide robust evidence that Quizizz-based gamification has a significant and positive effect on students' academic achievement. With a pooled effect size of $d = 0.86$, the results suggest that integrating game elements into educational practices via Quizizz consistently enhances learning outcomes across various subjects and educational levels. This effect is not only statistically significant ($p < 0.001$), but also practically meaningful, as it corresponds to a large effect based on Cohen's benchmarks. These findings align with foundational theories such as Self-Determination Theory (SDT) and Flow Theory, both of which support the theoretical basis for gamification in education. SDT posits that learners are more motivated when their needs for autonomy, competence, and relatedness are met. Quizizz, through its interactive design, real-time feedback, and competitive features, effectively fosters all three psychological needs. Students gain a sense of autonomy through self-paced participation, competence through immediate feedback and scores, and relatedness through team-based or leaderboard-driven interactions. This combination is likely to create a learning environment that sustains engagement and fosters deeper cognitive processing. From the perspective of Flow Theory, effective gamification tools help students enter a state of optimal experience, characterized by high concentration and enjoyment. Quizizz provides immediate feedback, progressive challenges, and visual stimulation, which can facilitate this immersive state. The repetitive cycle of challenge, feedback, and reward inherent in gamified systems helps maintain learner interest and encourages continued participation. In terms of heterogeneity, the relatively moderate I^2 value of 48.6% suggests a high degree of consistency in the findings, though variability still exists based on contextual factors. Subgroup analysis further revealed that Quizizz is effective across various

disciplines such as mathematics, science, language studies, history, and vocational education. It also performed well across different educational levels, from junior and senior high school to undergraduate courses, suggesting that the tool is adaptable and scalable across diverse educational settings. This adaptability highlights the versatility of Quizizz as an effective pedagogical tool across multiple educational stages and subject domains. An important observation from the data is that Quizizz is not merely a novelty, but a pedagogically grounded intervention that enhances traditional teaching strategies. The use of Quizizz in diverse learning environments—whether face-to-face, hybrid, or fully online—demonstrates its flexibility and potential for broader application in modern education, particularly in post-pandemic learning recovery efforts. As technology-enhanced learning plays a central role in shaping future educational practices, Quizizz offers a valuable tool for integrating gamified learning experiences, especially in hybrid and online settings.

The practical implications for integrating Quizizz into technology-enhanced instructional practices in higher education are significant. By using Quizizz, educators can enhance student engagement, provide immediate feedback, and foster a competitive learning environment—all of which contribute to better academic outcomes. Given its adaptability, Quizizz can be incorporated into various teaching strategies, ranging from traditional face-to-face classes to fully online learning environments. Moreover, as students increasingly engage with technology in their everyday lives, integrating gamified learning tools like Quizizz can help make the learning process more engaging and effective. Despite the promising findings, it is essential to acknowledge some methodological limitations. A large proportion of the studies included in this meta-analysis employed quasi-experimental designs, which may introduce biases related to internal validity. These studies often lack randomization, which can lead to confounding variables affecting the results. To enhance the rigor of future research, it is crucial to incorporate randomized controlled trials (RCTs) to better assess the causal impact of Quizizz on academic achievement. Additionally, longitudinal studies would help examine the long-term effects of Quizizz-based gamification on student learning and motivation. In summary, this meta-analysis demonstrates that Quizizz is not only an engaging tool but also an effective medium for improving academic performance. Its consistent effectiveness across different subjects and educational levels makes it a valuable addition to the instructional toolkit of modern educators. The results underscore the importance of purposeful integration of gamified technology into classrooms to promote better learning outcomes, enhance student motivation, and support long-term academic success.

4. CONCLUSION

This meta-analysis provides robust evidence that gamification through the Quizizz platform exerts a significant and positive effect on students' academic achievement across diverse educational levels, subject areas, and instructional settings, with a large pooled effect size ($d = 0.86$) indicating substantial pedagogical impact. The consistency of findings across study designs and contexts, together with minimal indications of publication bias, underscores the reliability and generalizability of the results and reinforces theoretical perspectives that position gamification as an effective strategy for enhancing motivation, engagement, and learning outcomes. These findings highlight the practical value of integrating Quizizz into traditional, blended, and fully online environments, particularly for formative assessment and interactive learning. Nevertheless, several limitations should be acknowledged, including the predominance of short-term interventions, limited evidence regarding long-term retention and sustained motivation, potential variability in implementation fidelity across contexts, and insufficient analysis of differential effects among diverse learner populations. Accordingly, future research should prioritize longitudinal designs to examine enduring impacts, investigate the quality and consistency of implementation practices, explore outcomes among students with varying cultural, cognitive, and technological backgrounds, and conduct comparative studies with other gamified platforms to better delineate the relative strengths and contextual suitability of

Quizizz. Such directions will contribute to a more comprehensive understanding of gamification's transformative potential in contemporary education.

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