

Instructional Game Strategies in Education: A Meta-Analysis of Gamification and Game-Based Learning on Student Engagement, Motivation, and Academic Achievement

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ABSTRACT

This study aims to explore the effects of gamification and game-based learning on learners' behavior, which includes academic performance, involvement, and motivation. It also analyzes the efficacy and prevalence of gamification as well as gaming-oriented learning research across diverse educational stages, regions, and scientific fields. This meta-analysis consists of 60 selected articles published between 2013 and 2023 on Scopus, ERIC, and the Web of Science, that have passed the screening process and met the predetermined criteria. Findings show that gamification generates bigger influence on learners' engagement (0.65 [0.43, 0.87]), while game-based learning has more impact on motivation (0.46 [0.28, 0.64]) and achievement (1.09 [0.60, 1.59]). Results also indicate that the effectiveness of gamification and game-based learning is more prevalent at the university level, in South Asian countries, and in the humanities. On the contrary, research on these learning methods is more popular at the university level, in East Asian countries, and within the sciences field.

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Introduction

Digital technology has experienced a remarkable development within the last few years, and they have brought out a number of substantial transformations, especially in the education sector [1]. This development can be found in a lot of studies regarding integrating digital technologies in educational institutions, for example the integration of learning-based games that have attracted much academic attention [2]. In 2001, Aarseth released a study titled *Computer Game Studies*, which marked the beginning of game studies, along with the launch of the *Game Studies* [3]. It is evident that games are being progressively seen as a practical solution to transform education. Game-oriented learning in the sector has also been significantly growing over the past few years [4]. Game-based learning is highly considered as a good addition in education due to its capability of providing students with interactive, experience-driven, purposeful, and collaborative learning environments [5].

Games play an important role in facilitating the conventional teaching approach, especially in enhancing the learning experience and developing capacities such as problem solving, analytical thinking, creativity, fair play, social interaction, and cooperation [6]. Game is often linked to several terms and serve different purposes, namely game-based learning and gamification [7]. Despite the difference between the two concepts, their similarity lies in their primary goals to solve problems, motivate learners, encourage participation, and application of game-based thinking and techniques [8]. In terms of how they work, gamification indicates an integration of gaming-based components into contexts that are not necessarily game-based [9]–[11], while game-based learning puts games, both the designing process and implementation, as the main focus to achieve educational goals [12].

The idea of gamification was first proposed in 2002 by Nick Pelling, a software developer from the United Kingdom, which quickly became popular [13]. On the other hand, the history of game-based learning could be traced back to the 1970s; the method has been growing for over 30 years, becoming widely known in the early 2000s. Both practices are applicable at all stages of education, starting from kindergarten to university level [14], as well as different disciplines such as science, technology, humanities, health sciences, and social sciences [15]–[19]. Additionally, instructional games in education have become a global trend, with applications in Asia, Europe, America, and Africa [20]–[23].

Previous research has produced mixed results with respect to the impacts of gamification and game-based learning in education. Some suggest that these methods have little impact on the engagement, motivation and academic achievement of learners, while other researchers contend that they are much more effective in enhancing these results [24]–[25]. In addition, most of the existing studies have not included a comprehensive analysis of the contextual factors, including the educational level, the discipline field, and the geographic

distribution of research. In fact, gamification and game-based learning is likely to have different levels of effectiveness, depending on the educational context and learning environment. In order to fill this gap, the present paper will conduct a meta-analysis of the existing empirical research exploring the effect of gamification and game-based learning on student engagement, motivation and learning outcomes. Unlike the previous studies that have analysed these approaches separately, this study provides a direct comparative synthesis, and therefore allow for a better understanding of the relative effectiveness of gamification and game-based learning in educational settings.

Therefore, a meta-analysis review of the effectiveness of gamification and game-based learning with different learning outcomes is needed. Such an analysis can help to provide more clear evidence about which instructional approach shows stronger effects in terms of engagement, motivation, and academic achievement. After taking into account all pertinent elements, this investigation aims to examine the following inquiries:

1. Does the utilization of gamification and game-based learning significantly impact student engagement?
2. Does the utilization of gamification and game-based learning significantly impact student motivation?
3. Does the utilization of gamification and game-based learning significantly impact student achievement?
4. At what level of education is the utilization of gamification and game-based learning most effective and widely applied?
5. In which field of science is the use of gamification and game-based learning most effective and widely applied?
6. In which regions or countries is the use of gamification and game-based learning most effective and widely applied?

Material and Methods

This research used the quantitative research and meta-analytical research design to systematically synthesize empirical research data for investigating the effects of gamification and game-based learning on student engagement, motivation and academic achievement of various educational levels such as primary, secondary and higher education. The meta-analytic approach makes it possible to combine results from several studies and to examine contradictory assumptions in order to make more robust and generalizable conclusions [26].

A. Search Strategy and Article Selection

Literature search was conducted to identify relevant studies published between 2013 and 2023 in three major databases: Scopus, ERIC, and Web of Science. The keywords were

"gamification", "game-based learning", "motivation", "engagement" and "academic achievement", which were put together with Boolean operators (AND, OR) to narrow down the search results. In order to give the rigor and validity to the meta-analysis, inclusion and exclusion criteria mutually agreed upon by the authors were used. The inclusion criteria were as follows: (1) empirical studies published not earlier than 2013; (2) studies included in the selected databases; (3) the studies written in English language; (4) studies analyzing gamification or game-based learning in the educational contexts; (5) the studies providing sufficient quantitative data (e.g., sample size, means, and standard deviations). The exclusion criteria were non-empirical studies (e.g. reviews, book chapters), qualitative-based studies, articles who did not provide enough statistical data, and studies that did not occur in educational settings.

B. Article Screening, Data Extraction, and Data Analysis

Transparency and methodological rigor of the study were ensured by the use of the Preferred Reporting Items of Systematic Reviews and Meta-Analyses (PRISMA) guidelines to select the study [27]. Article selection was performed independently by 3 authors based on Covidence software to manage records, eliminate duplicates and achieve consistency in application of the pre-determined inclusion and exclusion criteria. First all the retrieved records were screened and duplicates were removed. Titles and abstracts then were evaluated and full-text analysis for eligibility was performed. A total of 60 studies passed all criteria and were included in the meta-analysis, which included 36 studies on gamification and 24 studies on game-based learning.

Relevant data were systematically extracted and coded from each study, including publication details, type of intervention, sample size, mean scores and standard deviations. These data were then used to calculate effect sizes using Microsoft Excel and Jasp software. A random-effect model with Restricted Maximum Likelihood (REML) estimation was used for estimating the pooled effect size as there was likely to be some substantial heterogeneity due to the heterogeneity of the study design, the participants, the intervention and the outcome measures.

This meta-analysis was restricted to published studies, thus there is a potential of publication bias. To address this issue, two methods were used to identify publication bias, the funnel plot and Egger's regression test. The funnel plot was used to visually assess the symmetry of the distribution of effect sizes relative to the standard error, while Egger's regression test was used to statistically examine asymmetry in the funnel plot.

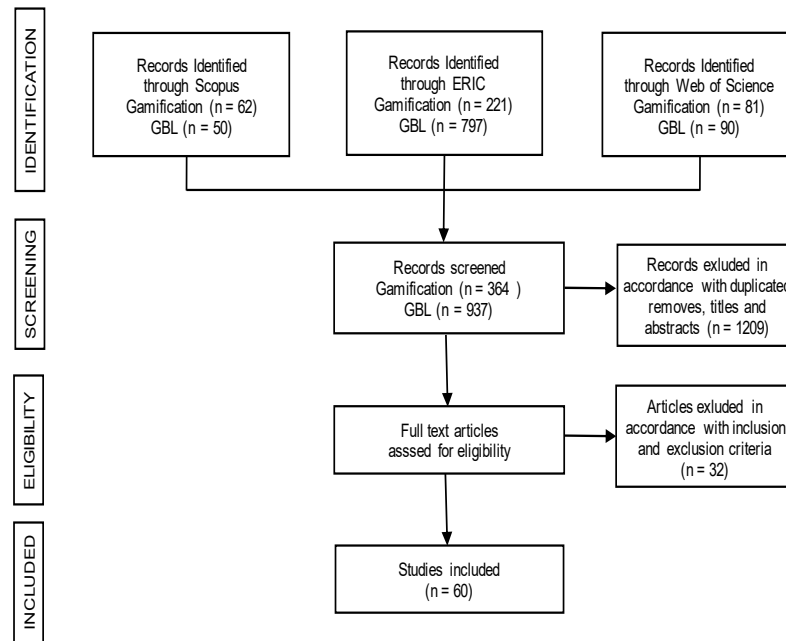


Fig. 1. Study flow diagram

Results

After conducting feasibility assessment, 60 articles were considered eligible for the meta-analysis. These articles consist of 36 publications on gamification and 24 on game-based learning. The heterogeneity analysis showed high variability between the included studies. As revealed in Table 1, the I^2 value for gamification studies was 86,601% which is a high level of heterogeneity. Similarly, the level of heterogeneity in the game-based learning studies was even greater as I^2 value was 93,924%. These values imply that the effect sizes observed are quite different in the studies included in the meta-analysis. The high heterogeneity means that there may be some differences in study characteristics, such as the research design, demographics of the participants, educational settings, length of intervention, and measurement of the outcomes. Therefore, the results are not a uniform effect but variable in different study contexts.

Table 1. Heterogeneity statistics for gamification and game-based learning studies
(2013–2023)

95% Confidence Interval		
Gamification	I^2 (%)	86.601
Game-Based Learning	I^2 (%)	93.924

A. The Effect of Utilizing Gamification and Game-Based Learning on Engagement

As illustrated in Fig. 2, the application of gamification and game-oriented learning yields a positive magnitude of impacts towards learners' engagement. The square marker denotes the estimated effect magnitude, the horizontal bar indicates the range of the 95% confidence

interval, and the diamond marker reflects the combined overall effect magnitude. The aggregated effect size for gamification is 0.65, with a range of confidence of 0.43 to 0.87. Meanwhile, game-based learning shows an overall impact effect size of 0.51, with interval values ranging from 0.24 to 0.77.

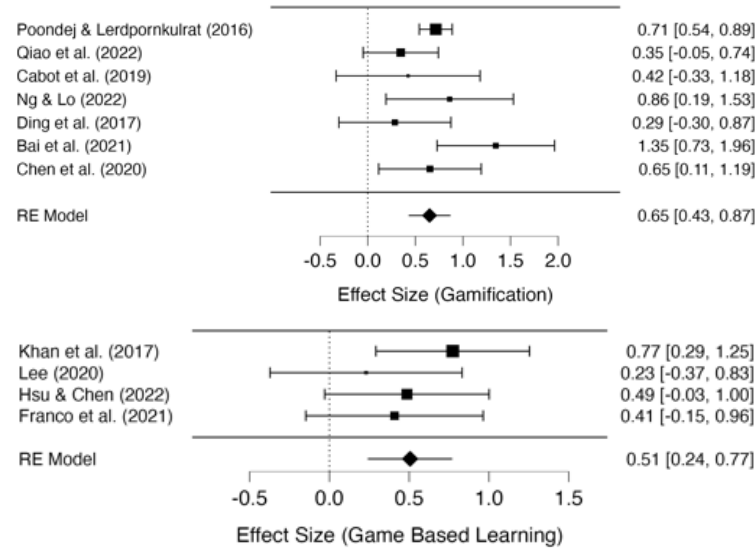


Fig. 2. Forest plot of gamification and game-based learning on engagement, 2013-2023

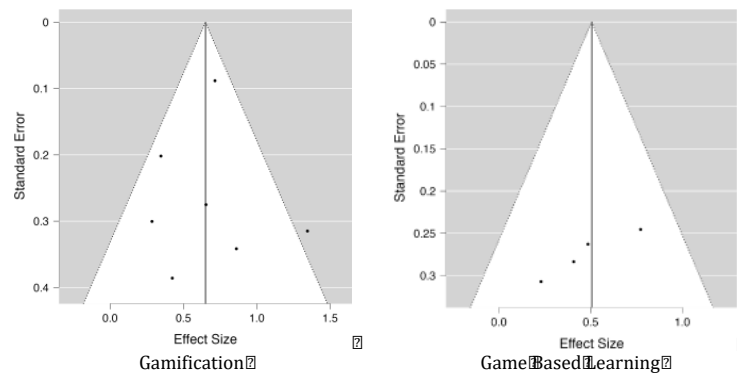


Fig. 3. Funnel plot of gamification and game-based learning on engagement, 2013-2023

Table 2. Egger's Test Results for Publication Bias Assessment

Egger's test		
	z	p
Gamification	0.157	0.876
Game-Based Learning	-1.396	0.163

According to the funnel plot presented in Fig. 3, the studies exhibit a balanced distribution of engagement. This is supported by Egger's test in Table 2, which reports p-values of 0.876 for gamification and 0.163 for game-based learning, both exceeding 0.05. Thus, the plot indicates the absence of publication bias in this meta-analysis. The data indicate that both gamification and game-based learning have a positive effect on engagement, with gamification demonstrating a stronger influence.

B. The Effect of Utilizing Gamification and Game-Based Learning on Motivation

Fig. 4 illustrates the magnitude of the effects of gamification and game-based learning on motivation. The square markers represent the estimated effect sizes, while the horizontal bars represent the range of 95% confidence. The diamond marker is used to denote the combined overall effect size. In the case of gamification, even the pooled effect size is 0.42, and the confidence level ranges from 0.16 to 0.68. Meanwhile, for game-based learning, the effect magnitude reaches 0.46, accompanied by a confidence interval of 0.28 to 0.64.

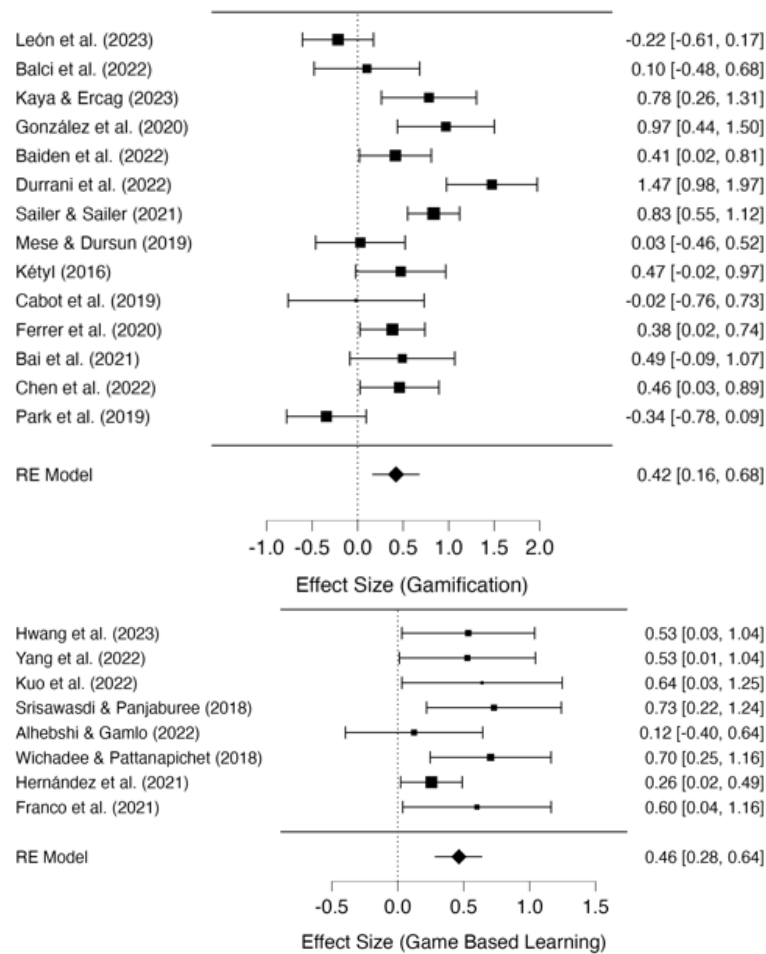


Fig. 4. Funnel plot of gamification and game-based learning on engagement, 2013-2023

Fig. 5 presents a funnel plot indicating that the included studies are distributed symmetrically around the overall effect size. This pattern suggests a balanced distribution of findings and minimizes concerns regarding selective publication. The interpretation is further supported by the results of Egger's test shown in Table 3, where the p-values for gamification (0.816) and game-based learning (0.068) are both higher than the significance threshold of 0.05. Therefore, no significant publication bias was identified in this meta-analysis. The findings also reveal that both gamification and game-based learning positively contribute to increasing student motivation. Nevertheless, game-based learning exhibits a comparatively

stronger effect on motivational outcomes, indicating its greater potential in fostering active participation, engagement, and sustained learner interest in educational settings.

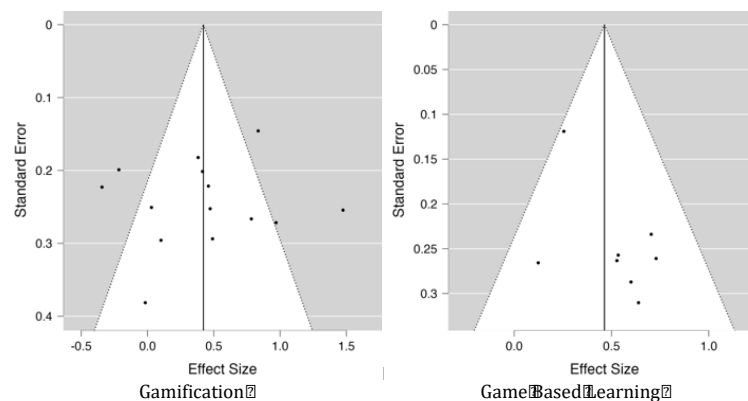


Fig. 5. Funnel plot of gamification and game-based learning on engagement, 2013-2023

Table 3. Egger's Test Results for Publication Bias Assessment

Egger's test		
	z	p
Gamification	-0.233	0.816
Game-Based Learning	1.825	0.068

C. The Effect of Utilizing Gamification and Game-Based Learning on Student Achievement

Fig. 6 illustrates the overall magnitude of the effects produced by gamification and game-based learning on students' academic performance. In the forest plot, the square symbols represent the estimated effect sizes of individual studies, whereas the horizontal lines indicate the corresponding 95% confidence intervals. The diamond symbols at the bottom summarize the combined overall effect size for each instructional approach. The results demonstrate that gamification generated a moderate positive effect, with a cumulative effect size of 0.47 and a confidence interval ranging from 0.15 to 0.79. Meanwhile, game-based learning produced a substantially larger effect size of 1.09, with a confidence interval extending from 0.60 to 1.59. These findings suggest that both approaches improve academic achievement, although game-based learning appears to provide a stronger and more consistent impact on learner performance overall.

Fig. 7 presents the funnel plot analysis for studies examining the effects of gamification and game-based learning on student achievement. The distribution of studies appears relatively symmetrical around the combined effect size, suggesting the absence of substantial publication bias. Most studies are concentrated near the center of the plot, indicating stable and consistent findings across the included research.

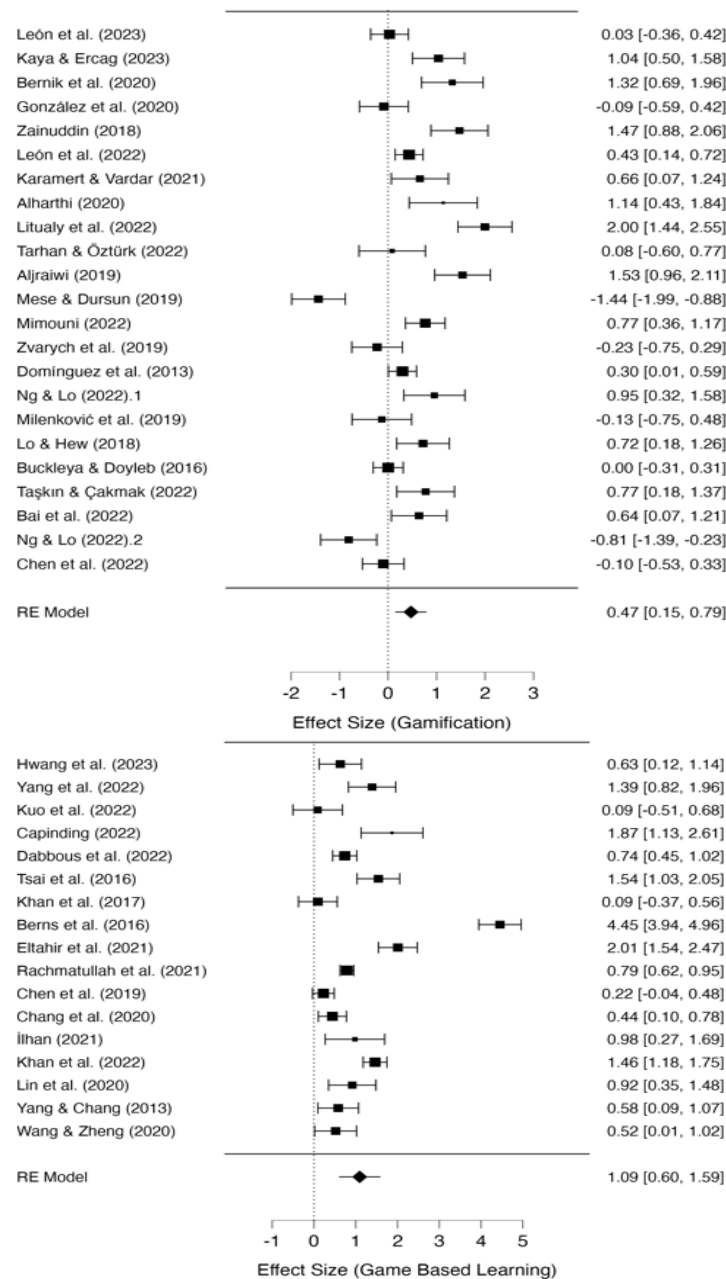


Fig. 6. Forest plot of gamification and game-based learning on student achievement, 2013-2023

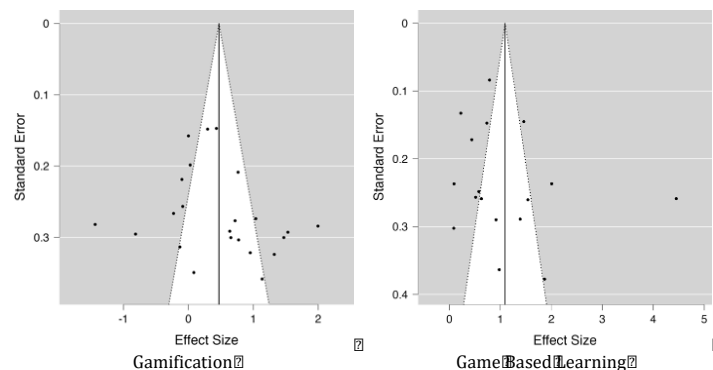


Fig. 7. Funnel Plot of Gamification and Game-Based Learning on Student Achievement

Table 4. Egger's Test Results for Publication Bias Assessment

	z	p
Gamification	1.120	0.263
Game-Based Learning	0.806	0.421

The funnel plot in Fig. 7 illustrates a symmetrical distribution of engagement across the studies. As shown in Table 4, the Egger's test reports p-values greater than 0.05, with 0.263 for gamification and 0.421 for game-based learning. Therefore, it is concluded that in this meta-analysis, the studies used showed no bias. The results offer an evidence that both gamification and game-based learning produce a beneficial impact on learners' academic performance, with game-based learning showing a stronger influence.

D. The Level of Education Most Affected by and Utilizing Gamification and Game-Based Learning

Table 5 displayed the biggest impact being found at the university level, with a value of 0.667, and the lowest impact found the high school level, with a value of 0.518. Based on these results, it may be suggested that both gamification and game-based learning have the highest level of success when implemented in higher education settings.

Table 5. The impact of gamification and game-based learning by level of education

Level of Education	95% Confidence interval		
	Effect size	Lower limit	Upper limit
Elementary School	0.664	0.341	0.986
Middle School	0.590	0.386	0.793
High School	0.518	-0.097	1.134
University	0.667	0.393	0.941

Fig. 8 shows that a total of 13% of the research was conducted at the elementary school level, 23% at the middle school level, 7% at the high school level, and 57% at the university level. It could be implied that publications regarding gamification and game-based learning remain limited at high school level, with most studies concentrated within universities.

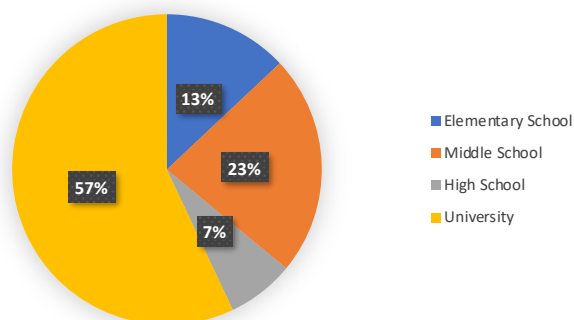


Fig. 4. Distribution of gamification and game-based learning studies by level of education

E. The Fields of Study Most Affected by and Utilizing Gamification and Game-Based Learning

Table 6 signifies that the biggest effect size is evident in the humanities field, with a value of 1.036, and the smallest observed in the technology field, with a value of 0.476. These findings suggest that gamification and game-oriented learning methods are found to be more successful when implemented within the humanities field.

Table 6. The impact of gamification and game-based learning by knowledge field

Knowledge Field (Subject Area)	95% Confidence interval		
	Effect size	Lower limit	Upper limit
Science	0.581	0.360	0.802
Humanities	1.036	0.485	1.588
Social	0.481	0.138	0.824
Health Science	0.548	0.284	0.812
Technology	0.476	0.154	0.798

As shown on Fig. 9, studies regarding gamification and game-based learning have been conducted across various disciplines: 34% within sciences, 22% within humanities, 13% within social, 7% within health studies, and 24% in the technology-related discipline. It could be understood that scholarly interest in this study remains limited within the health sciences, with most of it conducted within the science domain.

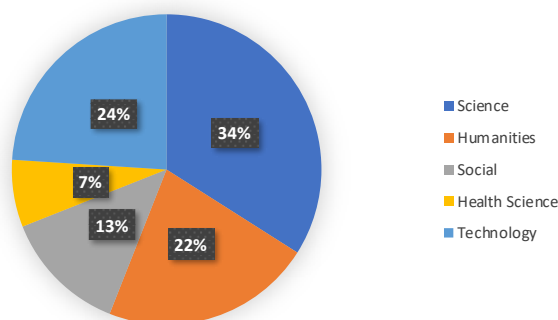


Fig. 9. Distribution of gamification and game-based learning studies by knowledge field

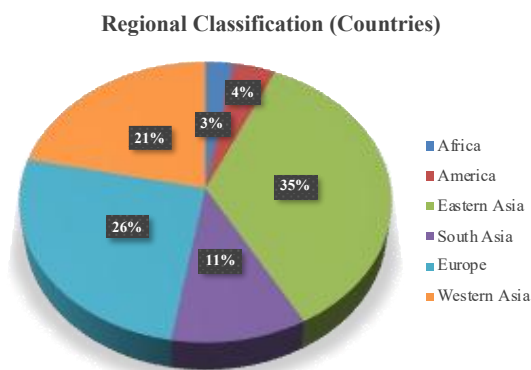
F. Regions/Countries Most Affected by and Utilizing Gamification and Game-Based Learning

Table 7 shows that the highest effect size was identified in South Asia, reaching 1.024, while the lowest effect size was reported in America at 0.471. These findings indicate regional differences in the effectiveness of gamification and game-based instructional strategies. The stronger impact observed in South Asia suggests that contextual, cultural, or educational factors in the region may contribute to higher student responsiveness and improved learning outcomes through game-oriented learning approaches.

Table 7. The effect of gamification and game-based learning by regional classification

Regional Classification (Countries)	95% Confidence interval		
	Effect size	Lower limit	Upper limit
Africa	0.589	0.246	0.932
America	0.471	0.019	0.923
Eastern Asia	0.529	0.337	0.722
South Asia	1.024	0.571	1.477
Europe	0.540	0.074	1.005
Western Asia	0.850	0.422	1.279

In terms of the locations of previous studies, Fig. 10 reveals that 3% of the research was conducted in Africa, 4% in America, 35% in Eastern Asia, 11% in South Asia, 26% in Europe, and 21% in Western Asia. For the Africa region, the areas include Ghana and Morocco; Spain, Croatia, Germany, Hungary, Ukraine, and Serbia for the European region; Taiwan, China, and Korea for the East Asia region; the South Asian region includes Indonesia, the Philippines, Thailand, and Pakistan; the American region which refers the United States; and finally the Western Asian region which includes Turkey, the United Arab Emirates, Saudi Arabia, and Lebanon. Based on these findings, it could be implied that the research interest on gamification and game-based learning is relatively low in the Africa region and more popular within Western Asia region.

**Fig. 10.** Distribution of gamification and game-based learning studies by regional classification

Discussion

The results of the data processed through the meta-analysis show that the implementation of gamification and game-based learning has a positive impact on student engagement and the student's motivation as well as student achievement. Educational activities combined with gaming activities have been found to help improve the learning motivation of students which in turn will naturally lead to active engagement, higher enthusiasm and better performance in school [28]. Based on the evaluation of existing evidences the result suggests that gamification influences more on student engagement over

the game-based learning methods. This finding could be explained in the light of the Self-Determination Theory which calls for the importance of the role of competence, autonomy, and relatedness for intrinsic motivation [29]–[30]. Gamification elements (e.g., points, badges, leaderboards and progress tracking) offer immediate feedback and reinforce students' sense of achievement and can keep students engaged [31]–[32]. Nevertheless game-based learning also plays a crucial role in the process of engagement by creating immersive and interactive experiences that encourage exploration and problem-solving [33]–[34]. These characteristics are substantiated by the constructivist learning theory which suggests that knowledge is actively built on the basis of interaction and meaningful experiences in the learning space [35]. Regardless of the approach taken, educators are still integral in supporting meaningful engagement and directing student participation in learning activities [36].

With regard to motivation and academic achievement, it was found that game-based learning has more substantial effects in comparison to gamification. This finding is helpful to explain the contradictory results of previous studies, in which gamification has sometimes led to moderate increases, but also to declines in levels of motivation and achievement [37]–[39]. One possible explanation is that gamification frequently involves external rewards, and these rewards can be used to motivate extrinsic motivation. In contrast, game-based learning has the potential to support deeper cognitive engagement by embedding learning content in meaningful game-play, stories and problem solving. From the viewpoint of the Flow Theory, game-based learning environments can generate optimal learning situations, if the degree of difficulty is balanced against the skills of students [40]–[41] and this allows the learner to experience deep concentration and intrinsic motivation. As a result, students tend to engage in sustained learning activities that lead to enhanced academic achievement. These findings highlight the importance of careful instructional design as improving student attention, participation, and achievement level in learning activities is dependent upon the effective implementation of game mechanics and design features regardless of the type of game employed [42].

In terms of implementation context, both approaches are more widely used in the higher education field. This trend is related to the availability of digital technologies and learning management systems that support the integration of game-based instructional strategies in universities. Moreover, from the academic point of view, student motivation may often be influenced by a variety of academic demands such as examination, coursework and project-based learning which exacerbates the relevance of motivational learning strategies such as gamification and game-based learning [43]. However, the results of this study suggest the potential of effective implementation of either approach in different levels of education.

Therefore, future research should consider how to employ game-oriented learning strategies for younger learners, such as in primary and secondary education.

In terms of disciplinary context, the results show that such approaches work especially well in the humanities and especially in language learning contexts [44]–[45]. The interactive and communicative nature of these disciplines fits well with game-based learning environments. However, despite the enormous amount of research that has been conducted in the sciences, the use of gamification and game-based learning in the health sciences field is still relatively small in extent. Given the increasing demand for the use of simulation-based learning and experiential training in medical education, future studies may examine the degree to which these learning methods can aid in facilitating learning in areas of health sciences.

With regards to geography, most of the studies are centred in Asia, especially in South and East Asia. Countries such as Taiwan and China and Korea are showing great adoption of gamification and game-based learning approaches [46]–[48]. This trend is possibly indicative of the rapid integration of digital technologies as well as innovation-driven policies in education in these regions. In contrast, the rather few studies that have been done in African settings indicate the need for more research in exploring the implementation of game-based learning's in different learning environments.

Conclusion

Based on the results drawn on the findings through the meta-analysis, it may be inferred that instructional games, both gamification and game-based learning, generate a positive impact on learning activities, proven by the increase on students' engagement, motivation, and academic performance. The Effect Size Test for gamification demonstrates a stronger influence on engagement, whereas game-based learning is found to be more impactful in improving students' motivation and learning outcomes. In addition, although academic interest in gamification and game-based learning is largely concentrated in the East Asia region, the effect size evidence indicates that these approaches are more effective when implemented in South Asia. The study also found that despite being more frequently conducted within the science discipline, the effect size results indicate that gamification and game-based learning bring a greater impact when applied within the humanities discipline. Lastly, regarding educational stages, most studies focus on the higher education level, with effect size findings suggesting that gamification and game-based learning achieve the greatest effectiveness at the university level.

Limitation and Recommendation

Despite the contributions generated by this meta-analysis, a number of limitations need to be acknowledged. First, the included studies have a high degree of heterogeneity. This

large variability is attributed to differences between studies in regard to research design, intervention characteristics, educational settings, time taken for the intervention implementation, and instruments employed to measure outcomes. Such conditions may affect on the stability and comparability of the aggregated effect sizes. Therefore, future meta-analyses should be carried out in a systematic manner and look into these indicators to find out the sources of heterogeneity in a more comprehensive and informed manner, and come to a more nuanced understanding about the effectiveness of gamification and game-based learning. Second, this study has restricted literature search to three important academic databases, namely Scopus, ERIC and Web of Science. Limited to studies published between 2013 and 2023. Although this database is known for its high-quality and peer-reviewed publications. This limitation may exclude relevant research from other sources. Therefore, future studies are suggested to increase the number of the databases to improve the completeness and validity of the meta-analytic insights.

In addition, drawing from the findings of the research, the recommendations below may be taken into account. First, teachers are encouraged to integrate gamification and game-based learning (GBL) components that are consistent with their instructional approaches, the nature of the subject content, and learners' characteristics in order to improve implementation effectiveness. Second, education authorities are expected to encourage innovation in teacher professional development programs and assist school facilities, such as technological resources and curriculum enhancement. Lastly, subsequent studies are advised to examine the extended effects of the application of gamification and GBL within the instructional process, particularly at the secondary school level and across diverse regional contexts.

Conflict of Interest

The authors declare no conflict of interest.

References

- [1] I. Aldalur and A. Perez, "Gamification and discovery learning: Motivating and involving students in the learning process," *Heliyon*, vol. 9, no. 1, e13135, 2023, doi: 10.1016/j.heliyon.2023.e13135.
- [2] R. E. Mayer, "Computer games in education," *Annual Rev. Psychol.*, vol. 70, no. 1, pp. 531–549, 2019, doi: 10.1146/annurev-psych-010418-102744.
- [3] J. Arjoranta, "How to define games and why we need to," *Comput. Games J.*, vol. 8, no. 3, pp. 109–120, 2019, doi: 10.1007/s40869-019-00080-6.
- [4] S. Y. Cheung and K. Y. Ng, "Application of the educational game to enhance student learning," *Front. Educ. - Sec. Dig. Learn. Innov.*, vol. 6, e623793, 2021, doi: 10.3389/educ.2021.623793.
- [5] C. Udeozor, F. R. Abegão, and J. Glassey, "An evaluation of the relationship between perceptions and performance of students in a serious game," *J. Educ. Comput. Res.*, vol. 60, no. 2, pp. 322–351, 2021, doi: 10.1177/07356331211036989.
- [6] V. S. Zirawaga, A. I. Olusanya, and T. Maduku, "Gaming in education: Using games as a support tool to teach history," *J. Educ. Pract.*, vol. 8, no. 15, pp. 55–64, 2017. [Online]. Available: <https://eric.ed.gov/?id=EJ1143830>

- [7] J. L. Plass, B. D. Homer, and C. K. Kinzer, "Foundations of game-based learning," *Educ. Psychol.*, vol. 50, no. 4, pp. 258–283, 2015, doi: 10.1080/00461520.2015.1122533.
- [8] R. Cózar-Gutiérrez and J. M. Sáez-López, "Game-based learning and gamification in initial teacher training in the social sciences: An experiment with MinecraftEdu," *Int. J. Educ. Technol. Higher Educ.*, vol. 13, no. 1, 2016, doi: 10.1186/s41239-016-0003-4.
- [9] E. A. Al Ghawail and S. B. Yahia, "Using the e-learning gamification tool Kahoot! to learn chemistry principles in the classroom," *Procedia Comput. Sci.*, vol. 207, pp. 2667–2676, 2022, doi: 10.1016/j.procs.2022.09.325.
- [10] D. Alajaji and A. A. Alshwiah, "Effect of combining gamification and a Scavenger Hunt on pre-service teachers' perceptions and achievement," *J. Inf. Technol. Educ.: Res.*, vol. 20, pp. 283–308, 2021, doi: 10.28945/4809
- [11] A. A. Funa, R. A. E. Gabay, and J. D. Ricafort, "Gamification in genetics: Effects of gamified instructional materials on the STEM students' intrinsic motivation," *J. Pendidik. IPA Indones.*, vol. 10, no. 4, pp. 462–473, 2021, doi: 10.15294/jpii.v10i4.32143.
- [12] R. Camacho-Sánchez, A. Rillo-Albert, and P. Lavega-Burgués, "Gamified digital game-based learning as a pedagogical strategy: Student academic performance and motivation," *Appl. Sci.*, vol. 12, no. 21, e11214, 2022, doi: 10.3390/app122111214.
- [13] A. Vrcelj, N. Hoić-Božić, and M. H. Dlab, "Use of gamification in primary and secondary education: A systematic literature review," *Int. J. Educ. Methodol.*, vol. 9, no. 1, pp. 13–27, 2023, doi: 10.12973/ijem.9.1.13.
- [14] T. Zhang, "Exploration and practice of gamification in kindergarten curriculum," *Educ. Rev. USA*, vol. 6, no. 10, pp. 549–551, 2022, doi: 10.26855/er.2022.10.005.
- [15] A. Rachmatullah et al, "Modeling secondary students' genetics learning in a game-based environment: Integrating the expectancy-value theory of achievement motivation and flow theory," *J. Sci. Educ. Technol.*, vol. 30, no. 4, pp. 511–528, 2021, doi: 10.1007/s10956-020-09896-8.
- [16] O. S. Kaya and E. Ercag, "The impact of applying challenge-based gamification program on students' learning outcomes: Academic achievement, motivation and flow," *Educ. Inf. Technol.*, vol. 28, no. 8, pp. 10053–10078, 2023, doi: 10.1007/s10639-023-11585-z.
- [17] S. Qiao, S. S.-S. Yeung, Z. Zainuddin, D. T. K. Ng, and S. K. W. Chu, "Examining the effects of mixed and non-digital gamification on students' learning performance, cognitive engagement and course satisfaction," *British J. Educ. Technol.*, vol. 54, no. 1, pp. 394–413, 2023, doi: 10.1111/bjet.13249.
- [18] E. Franco, C. Tovar, A. González-Peño, and J. Coterón, "Effects of a sport education model-based teaching intervention on students' behavioral and motivational outcomes within the physical education setting in the covid-19 scenario," *Sustain.*, vol. 13, no. 22, 2021, doi: 10.3390/su132212468.
- [19] A. Manzano-León, J. M. Rodríguez-Ferrer, and J. M. Aguilar-Parra, "Gamification in science education: Challenging disengagement in socially deprived communities," *J. Chem. Educ.*, vol. 100, no. 1, pp. 170–177, 2023, doi: 10.1021/acs.jchemed.2c00089.
- [20] C. K. Lo and K. F. Hew, "A comparison of flipped learning with gamification, traditional learning, and online independent study: The effects on students' mathematics achievement and cognitive engagement," *Interact. Learn. Environ.*, vol. 28, no. 4, pp. 464–481, 2020, doi: 10.1080/10494820.2018.1541910.
- [21] A. Berns, J.-L. Isla-Montes, M. Palomo-Duarte, and J.-M. Dodero, "Motivation, students' needs and learning outcomes: A hybrid game-based app for enhanced language learning," *SpringerPlus*, vol. 5, no. 1, e1305, 2016, doi: 10.1186/s40064-016-2971-1.
- [22] L. Ding, C. Kim, and M. Orey, "Studies of student engagement in gamified online discussions," *Comput. Educ.*, vol. 115, pp. 126–142, 2017, doi: 10.1016/j.compedu.2017.06.016.
- [23] P. Baiden, H. B. Essel, D. Vlachopoulos, A. Tachie-Menson, and M. Essuman, "The effect of gamification on home economics students' motivation and engagement in drawing activities," *Technol. Knowl. Learn.*, vol. 27, no. 1, pp. 161–182, 2022, doi: 10.1007/s10758-021-09566-7.
- [24] S. Bai, K. F. Hew, M. Sailer, and C. Jia, "From top to bottom: How positions on different types of leaderboard may affect fully online student learning performance, intrinsic motivation, and course engagement," *Comput. Educ.*, vol. 173, e104297, doi: 10.1016/j.compedu.2021.104297.
- [25] C.-H. Tsai, C.-H. Cheng, D.-Y. Yeh, and S.-Y. Lin, "Can learning motivation predict learning achievement? A case study of a mobile game-based English learning approach," *Educ. Inf. Technol.*, vol. 22, no. 5, pp. 2159–2173, 2017, doi: 10.1007/s10639-016-9542-5.
- [26] C. Hansen, H. Steinmetz, J. Block, "How to conduct a meta-analysis in eight steps: A practical guide," *Mgmt. Rev. Qtrly.*, vol. 72, no. 1, pp. 1–19, 2022, doi: 10.1007/s11301-021-00247-4.

- [27] M. J. Page et al, "The PRISMA 2020 statement: An updated guideline for reporting systematic reviews," in *BMJ*, vol. 372, no. 71, 2020, doi: 10.1136/bmj.n71.
- [28] K.-H. Yang, H.-C. Chu, C.-C. Hsieh, and F.-R. Kuo, "Promoting students' math learning performance and engagement: A help-seeking mechanism-based mobile gaming approach," *J. Inet. Technol.*, vol. 23, no. 6, pp. 1173–1183, 2022, doi: 10.53106/160792642022112306001.
- [29] J. Krath, L. Schürmann, and H. F. O. von Korflesch, "Revealing the theoretical basis of gamification: A systematic review and analysis of theory in research on gamification, serious games and game-based learning," *Comput. Hum. Behav.*, vol. 125, e106963, 2021, doi: 10.1016/j.chb.2021.106963.
- [30] L. Li, K. F. Hew, and J. Du "Gamification enhances student intrinsic motivation, perceptions of autonomy and relatedness, but minimal impact on competency: A meta-analysis and systematic review," *Educ. Technol. Res. Dev.*, vol. 72, no. 2, pp. 765–796, 2024, doi: 10.1007/s11423-023-10337-7.
- [31] A. Garcia-Cabot, E. Garcia-Lopez, S. Caro-Alvaro, J.-M. Gutierrez-Martinez, and L. de-Marcos, "Measuring the effects on learning performance and engagement with a gamified social platform in an MSc program," *Comput. Appl. Eng. Educ.*, vol. 28, no. 1, pp. 207–223, 2020, doi: 10.1002/cae.22186.
- [32] N. Taşkın and E. Kılıç Çakmak, "Effects of gamification on behavioral and cognitive engagement of students in the online learning environment," *Int. J. Hum. Comput. Interact.*, vol. 39, no. 17, pp. 3334–3345, 2022, doi: 10.1080/10447318.2022.2096190.
- [33] J. Hamari, D. J. Shernoff, E. Rowe, B. Collier, J. Asbell-Clarke, and T. Edwards, "Challenging games help students learn: An empirical study on engagement, flow and immersion in game-based learning," *Comput. Hum. Behav.*, vol. 54, pp. 170–179, 2016, doi: 10.1016/j.chb.2015.07.045.
- [34] J. Park, D. Liu, M. Y. Yi, and R. Santhanam, "GAMESIT: A gamified system for information technology training," *Comput. Educ.*, vol. 142, e103643, 2019, doi: 10.1016/j.compedu.2019.103643.
- [35] R. B. Saad, A. L. Garcia, and J. M. C. Garcia, "Mapping constructivist active learning for STEM: Toward sustainable education," *Sustainability*, vol. 17, no. 13, e6225, 2025, doi: 10.3390/su17136225.
- [36] M. Höyng, "Encouraging gameful experience in digital game-based learning: A double-mediation model of perceived instructional support, group engagement, and flow," *Comput. Educ.*, vol. 179, e104408, 2022, doi: 10.1016/j.compedu.2021.104408
- [37] L. de-Marcos, E. Garcia-Lopez, and A. Garcia-Cabot, "On the effectiveness of game-like and social approaches in learning: Comparing educational gaming, gamification & social networking," *Comput. Educ.*, vol. 95, pp. 99–113, 2016, doi: 10.1016/j.compedu.2015.12.008.
- [38] A. Domínguez, J. Saenz-De-Navarrete, L. de-Marcos, L. Fernández-Sanz, C. Pagés, and J.-J. Martínez-Herráiz, "Gamifying learning experiences: Practical implications and outcomes," *Comput. Educ.*, vol. 63, pp. 380–392, 2013, doi: 10.1016/j.compedu.2012.12.020.
- [39] E. Kyewski and N. C. Krämer, "To gamify or not to gamify? An experimental field study of the influence of badges on motivation, activity, and performance in an online learning course," *Comput. Educ.*, vol. 118, pp. 25–37. doi: 10.1016/j.compedu.2017.11.006
- [40] B. M. F. Abadi, N. K. Samani, A. Akhlaghi, S. Najibi, and M. Bolourian, "Pros and cons of tomorrow's learning: A review of literature of gamification in education context," *Rev. Article*, vol. 3, no. 10, pp. 543–554, 2022, doi: 10.22034/meb.2022.350941.1063.
- [41] A. Perttula, K. Kiili, A. Lindstedt, and P. Tuomi, "Flow experience in game based learning – a systematic literature review," *Int. J. Serious Games*, vol. 4, no. 1, pp. 57–72, 2017, doi: 10.17083/ijsg.v4i1.151.
- [42] P. Martín-Hernández, M. Gil-Lacruz, A. I. Gil-Lacruz, J. L. Azkue-Beteta, E. M. Lira, and L. Cantarero, "Fostering university students' engagement in teamwork and innovation behaviors through Game-Based Learning (GBL)," *Sustain.*, vol. 13, no. 24, e13573, 2021, doi: 10.3390/su132413573.
- [43] T. Alasmari, "Gamification effect on higher education students' motivation," *Psychol. Educ.*, vol. 57, no. 9, pp. 3009–3030, 2020. [Online]. Available: <https://psychologyandeducation.net/pae/index.php/pae/article/view/891>.
- [44] A. Kétyi, "From mobile language learning to gamification: An overlook of research results with business management students over a five-year period," *Porta Linguarum Monográfico I*, pp. 45–59, 2016, doi: 10.30827/Digibug.54087.
- [45] S. J. Litualy, H. Serpara, and E. C. Wenno, "The effect of Kahoot! learning media on learning outcomes of German language students," *J. Educ. Learn. (EduLearn)*, vol. 16, no. 2, pp. 254–261, 2022, doi: 10.11591/edulearn.v16i2.20458.

- [46] S. Bai, K. F. Hew, D. E. Gonda, B. Huang, and X. Liang, "Incorporating fantasy into gamification promotes student learning and quality of online interaction," *Int. J. Educ. Technol. Higher Educ.*, vol. 19, no. 1, e29, 2022, doi: 10.1186/s41239-022-00335-9.
- [47] G.-J. Hwang, C.-M. Hung, N.-S. Chen, "Improving learning achievements, motivations and problem-solving skills through a peer assessment-based game development approach," *Educ. Technol. Res. Dev.*, vol. 62, no. 2, pp. 129-145, 2014, doi: 10.1007/s11423-013-9320-7.
- [48] J. Lee, "Correction to: Problem-based gaming via an augmented reality mobile game and a printed game in foreign language education," *Educ. Inf. Technol.*, vol. 26, no. 3, pp. 3027-3031, 2020, doi: 10.1007/s10639-020-10409-8.

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