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A Meta-Analysis on the Effectiveness of Gamification on Student Learning Achievement

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Abstract

Gamification is an educational strategy that makes learning fun and keeps students interested in learning, which helps them learn more and grow their knowledge. However, given its growing popularity, it is necessary to review empirical studies regarding gamification in education as an intervention for an effective teaching and learning process. Due to this need, the researcher conducted a meta-analysis to examine the impact of gamification on students' learning achievement across five moderator variables. Fifteen studies published between 2018 and 2022 were included in the review based on the inclusion and exclusion criteria. The Meta-essentials v. 1.5 were used to determine effect sizes (Hedge's g) and the outcomes of the forest plot, funnel plot, Begg-Mazumdar test, and moderator analysis. Findings revealed that gamification significantly and positively affected student learning achievement. The five moderator variables were found to be statistically insignificant. The results suggest that gamification would be appropriate across academic courses at all educational levels in Asian regions. Moreover, Kahoot is the gamified platform with the biggest effect size that could be used in well-designed in-person, online, or blended learning classes.

Introduction

Gamification is becoming more popular in many fields, such as service training, business, health, organizational management, politics, retail, education, and more (Ahmed et al., 2022). Research indicates that gamification should be used as a sustainable method for achieving Sustainable Development Goal 4 (SDG 4) of the United Nations on quality education (Alebous, 2021). The findings from Martinez et al.'s 2023 meta-analysis indicate that the advantages of incorporating game-based technologies in education encompass the advancement of sustainability education, aligning with the objectives of SDG 4 (Quality Education).

Furthermore, these technologies enhance educational inclusivity and cultivate social skills such as collaboration and cooperation. However, some research has suggested that learners' academic achievement may vary across cultural differences, educational levels, and school subjects (Alharthi, 2020). With this, the meta-analysis will examine how gamification is interconnected with academic achievement.

Dikmen (2021) recommended conducting more experimental research at students' different school levels and courses to determine gamification's effect on academic achievement. The current study examined how effectively gamification improves students' learning achievement. This paper investigated the effect size of gamification on student learning achievement across the regions of Asia, school level, academic discipline, learning delivery modality, and intervention or gamified applications used. The regional distinction matters when it comes to gamification because, due to cultural differences, gamification strategies that work well with students in one region may work better in another. Understanding these differences allows gamification approaches to be suited to the cultural context, making them more effective.

Gamification is an educational strategy that promotes learning. Moreover, motivation encourages learning that results in the extension of students' knowledge (Puritat, 2019). It is a relatively recent term that refers to the gaming aspects used in various contexts that ordinarily do not involve them, including learning, to foster more beneficial learning experiences. However, while such rewards may initially encourage students, there is a risk that the emphasis on extrinsic motivation will diminish intrinsic motivation for learning (Inayati & Waloyo, 2022). Students are eager to try different technologies to support their learning, primarily because they are proficient with mobile technology and enjoy using games and apps designed for such devices (Licorish et al., 2018).

Many studies on the effectiveness of gamification in learning processes can be found in the literature. The study by Huang et al. (2020) presents that gamification positively and significantly affects student learning outcomes in formal educational settings. In this study (Kalogiannakis et al., 2021), we may receive immediate and helpful feedback from gamification applications and new interactive smart screen technologies, which strengthen and support research findings. This feedback may be a game score, final evaluations, or time spent participating in the activity. Thus, it is vital to consider how teachers could use technology to encourage positive classroom participation and increase learners' achievement (Flanagan, 2008). In addition to reading and writing, being literate in the twenty-first century now means discussing, storing, sharing, and reacting in real-time to digital activities (Muhridza, 2018). The researchers used meta-analysis to synthesize the results of experimental studies that measure the effectiveness of using gamification. This paper conducts a systematic review and synthesizes the findings of relevant documents from various education disciplines, such as journal articles, theses, and dissertations. Specifically, this meta-analysis aims to answer the following research questions:

1. How effective is gamification in improving students' learning achievement?
2. Does the effect size of gamification on student learning achievement differ significantly according to the region of Asia, school level, academic discipline, learning delivery modality, and intervention or gamified apps used?
3. Which gaming apps are more effective at facilitating student learning achievement?

Method

Research Design

The researchers utilized the meta-analysis research design to analyze whether gamification effectively improves students' learning achievement and determine the differences between moderator variables, including regions of

Asia, school level, academic discipline, learning modality, and gamified applications (interventions). Further, Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) are used in reporting items for systematic review.

Study Search and Strategy

To ensure a comprehensive search, the researchers conducted an electronic database search using Google Scholar, ERIC, Elsevier, PubMed, ResearchGate, Science Direct, Semantic Scholar, ProQuest, and EBSCOhost. The researchers used the Endnote X9 free package to find duplicates and manage all the journals published from 2018 to 2022. Research and review articles were shortlisted, following Petticrew and Roberts' guidelines, with these keywords: gamification, Kahoot, Quizizz, Class craft, Socrative, ClassDojo, Khan Academy, Quizlet, Gimkit, Duolingo, educational gamification, game-based learning or gamified applications, and learning achievement or academic achievement. The results were narrowed down further by manually screening the titles and abstracts.

Inclusion and Exclusion Criteria

The inclusion criteria used to select the pertinent journals were as follows:

Publication Date: The peer-reviewed journals were published between 2018 and 2022 to capture the latest trends, interventions, and technologies in gamification.

Practicality: Teachers and researchers applied intervention in on-site, online, or blended learning classes.

Research Design: A quasi-experimental design was used in the study, with control and experimental groups. The researcher(s) compared the students taught by the traditional teaching/learning practice to those who received gamification as the intervention.

Discipline or Course: The study examined the intervention in any academic discipline or course.

Population: The intervention was implemented across grade levels (elementary to graduate school) during school hours.

Quantitative Dependent Variable: Students' learning achievement was reported.

Comparability: Posttest mean scores and standard deviations were provided in the paper.

Language. The study could be from any country in Asia, but the paper is written in English.

In addition, collected sources were excluded if the studies:

1. were not related to gamification;
2. do not have distinct gamified applications;
3. did not measure achievement as a learning outcome; and
4. were published before 2018.

Data Evaluation

One thousand six hundred four studies about gamification were examined for this review; 1565 studies were screened by looking into titles and abstracts; 24 papers were excluded for eligibility; and after a thorough assessment, 15 articles were qualified.

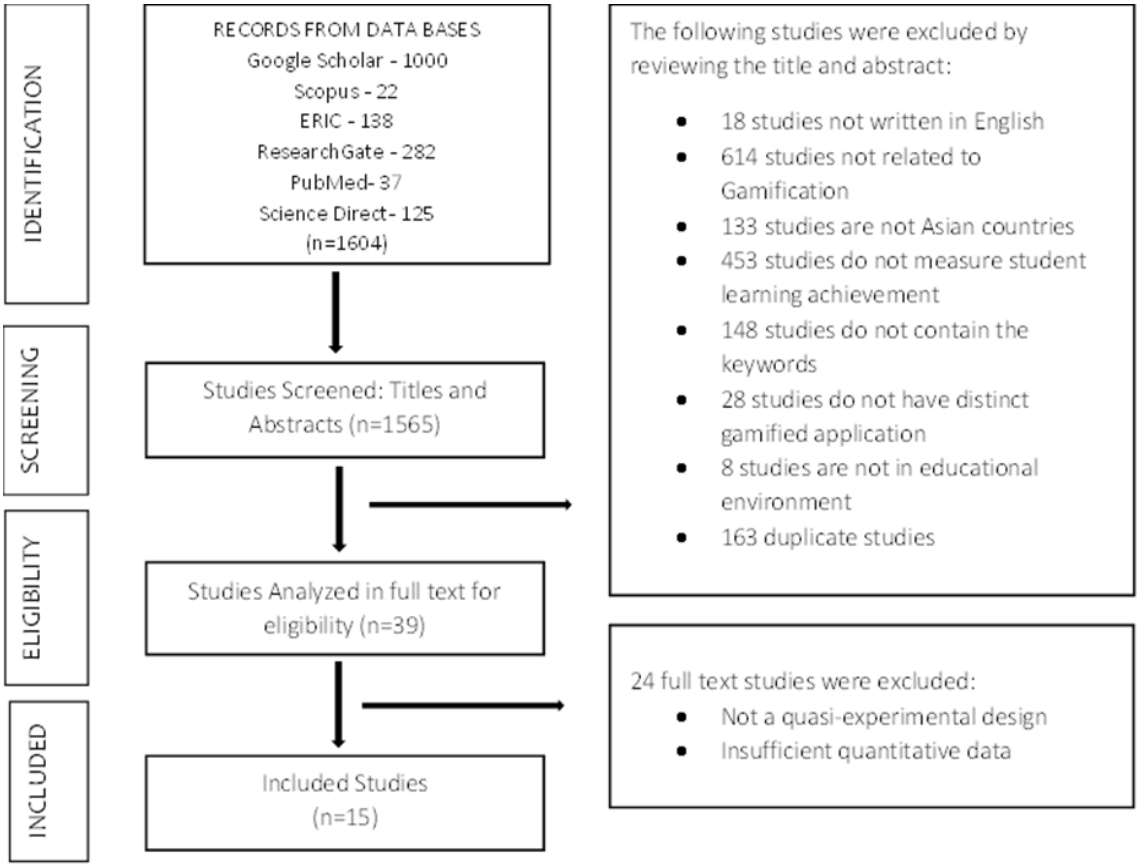

Figure 1. PRISMA Flow Chart of the Literature Search

Coding Procedures

The collected data from the qualified journal articles was coded using the following: (a) study identification (author's last name, year of publication, and country); (b) student's educational level; (c) academic discipline; (d) learning delivery modality; (e) intervention-gamified applications; (f) number of participants (control and experimental group); and (g) statistical data (mean and standard deviation).

Moderators

Five moderator variables were identified as shown in Table 1: regions of Asia (South/East Asia, Southeast Asia, and West Asia), educational level (elementary, high School, tertiary, and not specified), academic discipline (English, Math, Science, and IT), learning delivery modality (traditional face-to-face, online, blended learning, and not specified), and intervention or gamified applications used in the study (Kahoot, Quizizz, and Others: Combination, Gamified-Based Instructional Package, Gamified Learning Activity, Class Craft).

Effect Size Calculations

The effect size has frequently been used to calculate standardized mean differences. In this study, the researchers used Hedges' g to calculate the effect sizes of the data collected. Cohen's d statistic is generally preferred over

Hedge's g statistic. It has better small sample properties and greater characteristics when the sample sizes differ significantly (Goulet-Pelletier & Cousineau, 2018). When interpreting the data,.8,.5, and.2 values were used to describe large, medium, and small effect sizes, respectively (Goulet-Pelletier & Cousineau, 2018). To statistically analyze the data, the researchers used Meta-essentials v. 1.5, which van Rhee et al. (2015) developed. The data were grouped and compared using this software program, and moderator analysis was used to identify other essential statistics like effect sizes, heterogeneity, and forest plots. The researchers also used the Begg-Mazumdar test to determine the p-value. A p-value of less than.05 indicates the presence of publication bias.

Results

This meta-analysis included 1,093 students exposed to the conventional approach and gamification in 15 empirical studies. There were 507 students in the control group (CG) and 586 in the experimental group (EG). Table 1 details the study's author, year of publication, country, educational level, academic discipline, learning modality, type of gamification app, and statistical data from the control and experimental groups.

Table 1. Characteristics and Statistical Data of the Included Studies for the Effects of Gamification

Author & Year	**Country**	**Educational Level**	**Academic Discipline**	**Learning Modality**	**Intervention (Game app)**	**Statistical Data**					
						Control Group (CG)			**Experimental Group (EG)**		
						Mean	**SD**	**n**	**Mean**	**SD**	**n**
Ahmed et al. (2022)	Iran	ES	English (EFL)	NS	Kahoot	13.84	2.30	25	18.12	1.98	25
Alebous (2021)	Jordan	ES (2nd grade)	Science	OL	Kahoot Word wall	11.68	3.46	22	16.36	2.44	22
Alharthi (2020)	Saudi Arabia	Tertiary (male sophomore)	English	TFF	Kahoot	41.2	6.22	16	50.64	9.35	20
binti Yusof (2019)	Malaysia	Co	English	TFF	Quizizz	11.45	2.94	40	14.02	2.96	40
Çinar et al. (2022)	Turkey	ES (5th grade)	English	OL	Kahoot, Quizlet, wordwall.net Padlet, ClassDojo Quizizz	12.32	4.01	44	14.21	3.45	47
Gündüz & Akkoyunlu (2020)	Turkey	Tertiary	Instructional design	TFF	Jigsaw Kahoot Socrative	13	3.01	37	14.41	2.71	37
Gusta et al. (2022)	Indonesia	NS	English	OL	Quizizz	63.51	11.17	37	73.68	12.60	38
Jiang et al.	China	JHS	English	BL	Quizlet	18.77	2.79	53	22.74	2.61	42

Author & Year	Country	Educational Level	Academic Discipline	Learning Modality	Intervention (Game app)	Statistical Data					
						Control Group (CG)			Experimental Group (EG)		
						Mean	SD	n	Mean	SD	n
(2021)											
Marsa et al. (2021)	Indonesia	Co	English	NS	Kahoot	66.67	12.96	9	79.60	10.09	30
Molano (2022)	Philippines	SHS	Math	OL	Gamification-Based Instructional Package	26.80	5.671	40	30.48	5.44	40
Rachman et al. (2020)	Indonesia	Co	English	NS	Kahoot	61.05	9.27	122	84	3.839	122
Ristanto et al. (2022)	Indonesia	JHS (9th grade)	Biology (Genetics)	TFF	FC-DGBL Kahoot	67.04	19.02	23	75.45	16.05	23
Riwanda, et al. (2021)	Indonesia	NS	English	TFF	Kahoot	56.73	15.553	26	85.00	13.734	23
Samortin (2020)	Philippines	JHS (Gr 7-10)	English	TFF	GLA	20.21	8.499	63	39.03	7.457	63
Witari et al. (2021)	Indonesia	PS (1st year)	English	TFF	Class craft	41.29	3.407	13	44.92	3.570	14

Note. TFF (traditional face-to-face), OL (online learning), BL (blended learning), NS (not specified), ES (elementary school), JHS (Junior high school), SHS (Senior High School), Co (College), PS (Graduate & postgraduate), GLA (gamified learning activity), FC-DGBL (flipped classroom-digital game-based learning)

Table 2 shows how many studies were collected for each of the five moderator variables from 2018 to 2022. Based on the table, the sample group mainly came from Southeast, West, South, and East Asia. We conducted a thorough search to include as many Asian nations as possible. Our search only contained studies from Malaysia, Indonesia, Philippines, Jordan, Saudi Arabia, Turkey, Iran, and China. An important finding is that 60% of the articles analyzed were from Southeast Asia, suggesting that gamification research has been active in emerging Asian nations. The study by So & Seo (2018) also generated articles from only four countries: China, Hong Kong, Singapore, and Taiwan. We need empirical studies in developing nations like Bangladesh, Cambodia, Myanmar, Nepal, and Sri Lanka (So & Seo, 2018). Concerning school levels, 40% of the studies included were conducted at tertiary levels. However, this finding is inconclusive because the two articles needed to specify their school type. Similar findings have been seen in the studies of Huang et al. (2020), Sailer & Homner (2020), and Zainuddin et al. (2020) but not in the studies of Dikmen (2021) and So & Seo (2018). It also reveals that more studies focused on gamification in subjects like English (n = 10) than math (n = 1), science (n = 2), or information technology (n = 2). However, these results do not match other meta-analyses (Huang et al., 2020; Dikmen, 2021). Seven studies reported using gamification via traditional face-to-face learning modes, and only five for online or blended

learning. Contrary to the systematic review of Antonaci et al. (2019) from 2014 to 2018 about the effects of gamification in online learning environments. Regarding interventions, Kahoot (n = 7) has the most studies compared to popular gamified apps like Quizizz, Quizlet, Class Craft, ClassDojo, and Socrative. Wang & Tahir (2020) had an extensive literature review of 93 studies between 2015 and 2019 about the effects of Kahoot! on students' learning, anxiety, perceptions, and classroom dynamics.

Table 2. Sources of Effect Sizes according to Five Moderator Variables

Regions of Asia	**Frequency (n=15)**	**Percentage (%)**
South Asia/East Asia (Iran, China)	2	13%
Southeast Asia (Malaysia, Indonesia, Philippines)	9	60%
West Asia (Turkey, Jordan, Saudi Arabia)	4	27%
School Level	**Frequency (n=15)**	**Percentage (%)**
Elementary School	3	20%
High School (JHS/SHS)	4	27%
Tertiary (Undergraduate/Graduate)	6	40%
Not Specified	2	13%
Academic Discipline	**Frequency (n=15)**	**Percentage (%)**
English	10	67%
Math/Science	3	20%
IT	2	13%
Learning Modality	**Frequency (n=15)**	**Percentage (%)**
Traditional face-to-face (in-person)	7	47%
Online/Blended Learning	5	33%
Not Specified	3	20%
Intervention/Gamified Apps	**Frequency (n=15)**	**Percentage (%)**
Kahoot!	7	47%
Quizizz	2	13%
Others- Combination, Gamified-Based Instructional Package, Gamified Learning Activity, Class craft	6	40%

Table 3 shows that a random-effects model yielded an overall effect size of g = 1.30, which is a large effect size. Moreover, this overall effect size had a 95% confidence interval of 0.86 to 1.74 and was statistically significant at Z-value = 6.35, p = 0.000. The individual effect sizes from each of the 15 studies are visually represented in Figure 2. Interestingly, all studies show positive effect sizes (g = 0.47 to g = 3.22), suggesting that gamification has beneficial effects throughout the literature that has been examined. More significant than the findings of Yıldırım & Şen (2021). Their results from the studies between 2010 and 2016 show a moderately positive effect of 0.557, with no publication bias.

Table 3. Overall Effect Size, Confidence Interval, and Heterogeneity

		% 95 Confidence Interval			Null Test		Heterogeneity			
Model	**N**	**Effect size Hedges' g**	**Stand. Err.**	**CI Limit**	**Z-value**	**p-value**	**Q-value**	**df**	**P_Q**	**I^2**
Random	15	1.30	0.21	0.86-1.74	6.35	0.000	176.31	14	0.000	92.06%

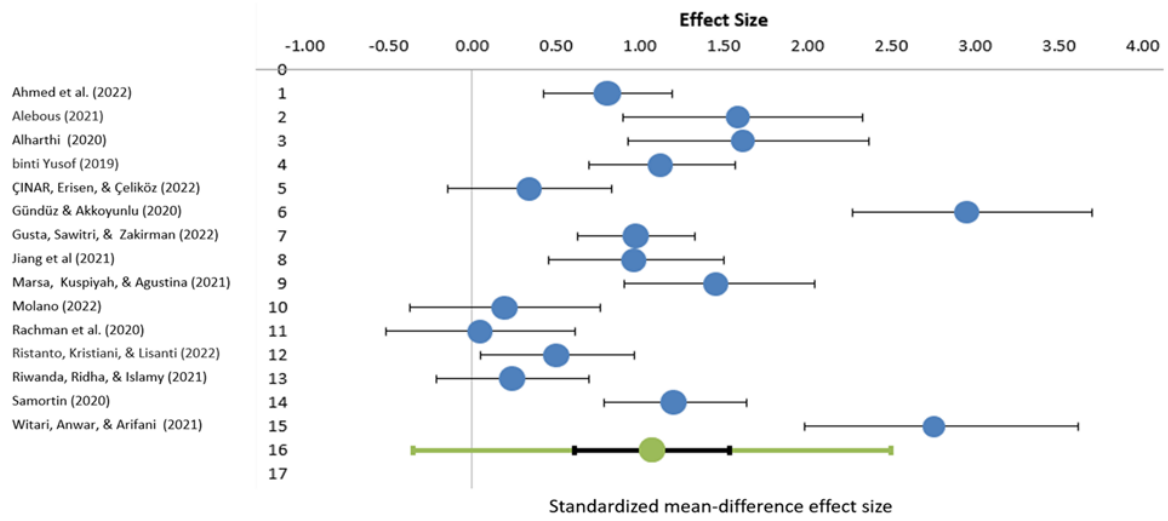

Figure 2. Forest Plot of Random Effects for the Included Studies

Table 4 revealed that 2,001 additional gamification studies on student learning achievement would be needed to disprove the total effect size discovered in this meta-analysis. The Classic Fail-Safe N test results in the table also showed that the meta-analysis of 15 empirical studies is valid ($p < 0.05$) and not easily influenced by publication bias—the Begg-Mazumdar test in Table 5 supports it. The analysis is free of publication bias, with a p-value of 0.729 ($p > 0.05$), indicating that selective reporting is less likely to impact the effect sizes.

Figure 3 presents the funnel plot that manifests asymmetry with five outliers among 15 eligible studies which is not a reliable indicator of publication bias in small research (Harbord et al., 2009), cited in the paper of Funa (2021). As many schools are integrating gamification into their instruction, whether onsite, online, or blended learning classes, supporting this teaching and learning approach with research-based evidence like this meta-analysis is necessary. According to certain studies, learners' academic achievement or performance may differ based on cultural variations, educational levels, and subject matter (Dikmen, 2021). This study looked at its overall

effects and the factors that could have significant moderator effects.

Table 4. Classic Failsafe-N Test (Rosenthal)

The Resistance of the Meta-analysis vs Publication Bias	
z-value	19.07
p-value	0.000
Alpha value	0.050
N	15
No. of missing studies that would bring the p-value to >alpha	2001

Table 5. Publication Bias of Included Studies (Begg & Mazumdar test)

Δ_{x-y}	7.00
Kendall's Tau	0.07
Tau for z-value	0.35
p	0.729

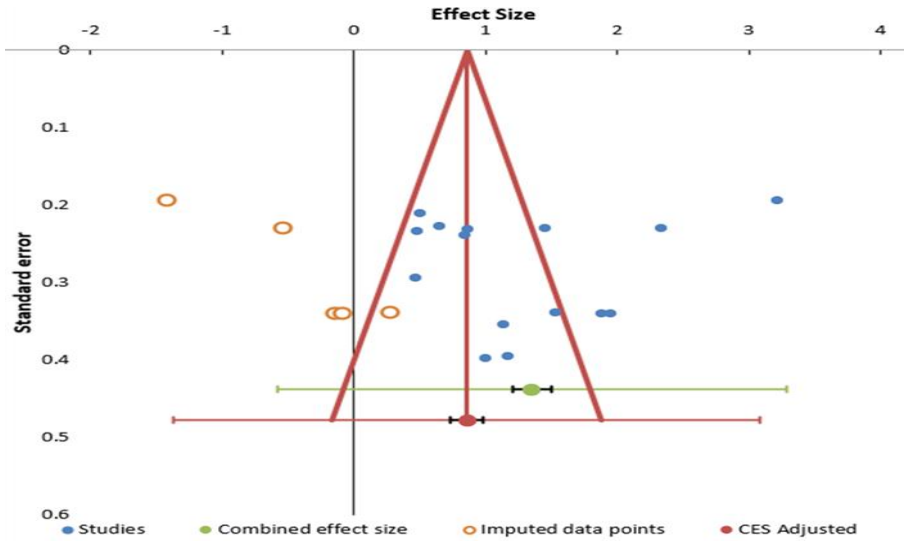

Figure 3. Funnel Plot of Effect Size Data of the Studies Included

Table 6 shows that none of the subgroups had a significant moderator effect ($p > 0.05$). The four regions of Asia had large positive effect sizes. The heterogeneity results ($Q= 5.39$, $p > 0.05$) showed no significant difference, demonstrating that the regions of Asia share standard effect sizes. The three school levels had large positive effect sizes. The heterogeneity results ($Q= 0.03$, $p > 0.05$) did not reveal any statistically significant differences,

demonstrating that the effects of gamification on student learning achievement are not dependent on the school level. English and Math/Science had large positive effect sizes. The lack of a significant difference indicated by the Q value ($Q = 5.78$, $p > 0.05$) suggests that the academic discipline included here did not moderate the effects of gamification on student learning achievement. Gamification in these modalities has large positive effects on student learning achievement. The Q value ($Q = 3.16$, $p > 0.05$) showed no significant difference, indicating that the types of learning modality share standard effect sizes. Gamified apps included in the studies positively affect student learning achievement. The heterogeneity results ($Q = 3.09$, $p > 0.05$) are insignificant, showing the common effect sizes among the applications used. Kahoot is the most popular gamified platform for any learning modality and has the biggest effect size.

Table 6. Subgroup Analysis based on School Level, Academic Discipline, Intervention, Regions of Asia, and Learning Delivery Modality

Subgroup Name	**Effect Size Hedges' g**	**95% Confidence Interval**		**Weight**	**Heterogeneity**		
		Lower Limit	**Upper Limit**		**Q**	**df**	**p**
Regions of Asia	1.29	-0.22	2.81		5.39	2	0.067
South Asia/East Asia	1.64	1.16	2.12	0.36			
Southeast Asia	1.39	0.79	2.00	0.30			
West Asia	0.86	0.36	1.35	0.35			
School Level	1.30	0.06	2.54		0.03	3	0.999
Elementary School	1.30	0.44	2.16	0.25			
High School (JHS/SHS)	1.24	0.40	2.08	0.27			
Tertiary (undergraduate & graduate)	1.33	0.54	2.11	0.30			
Not specified	1.34	0.31	2.37	0.18			
Academic Discipline	1.02	-0.50	2.54		5.78	2	0.056
English	1.56	1.05	2.07	0.33			
Math/Science	0.85	0.23	1.48	0.29			
Information Technology	0.68	0.31	1.05	0.38			

Subgroup Name	Effect Size Hedges' g	95% Confidence Interval		Weight	Heterogeneity		
		Lower Limit	Upper Limit		Q	df	p
Learning Delivery Modality	1.20	-0.32	2.71		5.78	2	0.056
Traditional face-to-face (in-person)	1.17	0.64	1.70	0.38			
Online/blended learning	0.97	0.56	1.37	0.49			
Not specified	2.15	0.97	3.33	0.13			
Intervention/ Gamified Apps	1.10	-0.42	2.62		3.09	2	0.213
Kahoot	1.64	0.98	2.30	0.24			
Quizizz	0.85	0.84	0.87	0.50			
Others	1.07	0.49	1.66	0.27			

Note. The magnitude of the effect sizes was classified as large (g= 0.80 and above), medium (g= 0.50 to 0.79), small (g= 0.20 to 0.49), and no effect (g < 0.19) (Cohen, 1988)

Discussion

RQ1 - Overall Effects of Gamification on Learning Achievement

The random effect model was used in this study. The effect size of g = 1.30 is a large effect (Goulet-Pelletier & Cousineau, 2018). It shows that gamification has a large positive effect on student learning achievement. It is much higher compared to the previous meta-analyses on gamification, with effect sizes of g = 0.49 (Sailer & Homner, 2020) and g = 0.464 on learning outcomes (Huang et al/., 2020), g = 0.862 on achievement (Dikmen, 2021), and g = 0.557 on academic performance (Mula-Falcón et al., 2022). As stated in the study of Dikmen (2021), it would be a big deal if a small change with an impact size of 0.1 could help students do better in school. Despite the funnel plot in this study showing asymmetry with five outliers, testing using the Begg-Mazumdar (p= 0.729) and Rosenthal fail-safe number (FSN) confirmed no publication bias in the data.

RQ2 - Effects of Moderator Variables

A high heterogeneity statistic value (I^2 = 92.06%) indicates variability in the study's effect sizes. It may be associated with bias impact and use a statistical approach and subgroup analysis (Augusteijn, et. al., 2017). In this

meta-analysis, researchers used the random effects model and found no publication bias. A subgroup or moderator analysis was performed to measure the effects of moderators. Findings showed that, compared to the traditional approach, the effects of gamification ($p > 0.05$) on student learning achievement were unaffected by the region in Asia, school level, academic discipline, learning modality, and type of gamified app. It suggests that gamification is effective no matter where they are in Asia, their school level, their subject, the type of learning modality, or what kind of gamified app they use.

The data indicates no significant differences in subgroup analysis based on moderator variables but notable trends in the overall effect sizes of gamification on student learning achievement across different variables. The study found that gamification significantly enhances student learning achievement across various regions ($g= 1.29$), school levels ($g= 1.30$), academic disciplines ($g= 1.02$), learning modality ($g= 1.20$), and gamification app type ($g= 1.0$), indicating its strong effectiveness. This information is crucial for educators interested in implementing gamification strategies in education. In the future, researchers could combine this method with others to help students improve their attitude toward the subject, motivation, interest, and ability to learn in class. A study (Alebous, 2021) showed that gamification strategies could be used to explain complicated ideas and that students are more interested in a gaming environment. Because it is based on competition and virtual games, gamification is an essential tool that students can use to improve their ability to solve problems and make decisions, as well as their imagination and ability to pay attention (Alebous, 2021).

Asian Regions

The meta-analysis reveals that Southeast Asia has more research ($n=9$) than West Asia ($n= 4$), with only one study published in East and South Asia. Factors influencing this result include regional research activity, academic institutions' prioritization of gamification in education, cultural preferences, availability of data, and productivity in international collaborations. Southeast Asia has the most significant potential for gamification benefits due to its high smartphone adoption rate and youth-oriented online gaming culture (So & Seo, 2018). However, the study's location in Asia did not significantly impact the effect of gamification on learning achievement.

School Levels

The result of the current study demonstrates that student levels are not a significant moderator of the impact of gamification on academic achievement. The results of the literature's meta-analysis studies are consistent (Dikmen, 2021). In this situation, gamification applies to all student levels and is not just for a specific age group.

Academic Disciplines

Most gamification studies have been conducted in English ($n = 10$). Other fields, like math, science, and information technology, have produced one or two qualified studies. The data indicates that gamification studies in English are more prominent than other disciplines due to possible increased research interest in gamification's application in English classes, the availability of resources and tools for gamification in English, and diverse and

interactive method preferences. Moreover, English and math/science have large effect sizes (g = 1.56 and g = 0.85), while information and technology have a smaller effect size (g = 0.68). Gamification in English may be more effective than information technology due to its language orientation (Thurairasu, 2022). Compared to formal disciplines like math or science, English language classes have more studies for experimental and conventional teaching methods, making it easier for researchers to investigate and try gamification. Nevertheless, gamification does not significantly affect learning achievement across academic subjects ($p > 0.05$), contradicting the meta-analyses of Huang et al. (2020) and Dikmen (2021). More quasi-experimental studies, particularly in math and science, are recommended.

Learning Modalities

Gamification is increasingly popular in e-learning environments, but most studies focus on in-class settings (n = 7; g = 1.17) rather than online or blended environments (n = 5; g = 0.97). A few studies that examined gamification in an online environment used a single-group pretest and posttest. Consequently, they were excluded from the meta-analysis. Furthermore, the results could be more conclusive since the learning modality in the three studies needed to be specified (g = 2.15). One mode is better, but these three modalities had no significant differences. Jiang et al. (2021) highlighted the advantages and unique features of in-person, online, and blended modes. Their paper mentioned that a particular study compared face-to-face, online, and hybrid modalities in a course on child development for undergraduates. Online courses might be as successful as traditional ones at delivering satisfactory results. However, the blended learning mode combines the advantages of in-person and online instruction. Promising results regarding improving students' academic achievement through blended learning were found. According to this latest study, blended and offline learning were effective educational methods for students' critical thinking skill development (Huang et al., 2020). The availability and accessibility of technology determine the effectiveness of gamification, thus making in-class settings quite different from online or blended environments in terms of technological infrastructures, including internet connections, at school. Research into in-class gamification may improve the learning experience because students receive instant feedback, have real-time interactions, and become more socially engaged.

RQ3 - Effective Gaming Apps

The results showed that Kahoot is the most popular gamified platform for any learning method and has the biggest effect size. It aligns with the findings of Yu (2021) that Kahoot applications have gained more popularity in education than any other gaming apps, regardless of educational level. Kahoot's popularity stems from its user-friendly design, which allows teachers and students to create, join, and participate in quizzes quickly; interactive quiz features allowing users to create multiple choice, true/false, and poll quizzes, promoting competitiveness and engagement; dynamic and interactive learning experience incorporating social and competitive elements, including leaderboards and a point system; adaptability, making it helpful for the teachers to prepare quizzes based on their learning goals; cross-platform compatibility, which enables the participants to participate in quizzes on their preferred devices like smartphones, tablets, and computers; and community feature, whereby educators can share their quizzes with others, which promotes the sharing of educational content in community forums and may

encourage socialization of educators (Licorish et al., 2018; Muhridza et al., 2018; Wang Tahir, 2020; YU, 2021).

Conclusion

This meta-analysis of 15 eligible studies between 2018 and 2022 showed that gamification greatly affected how well students learned. As moderator variables, it was seen that Asian regions, school level, academic discipline, learning mode, and type of gamified app were not statistically significant. The results suggest that gamification could be used in all academic courses at all levels of education in any part of Asia that was part of the study. Kahoot is the gamified platform with the biggest effect size that could be used in well-designed in-person, online, or blended learning classes. It can be incorporated into any instructional strategy since students have individual needs and learn differently.

The data obtained from this meta-analysis can guide educators and policymakers in implementing improvement initiatives, especially in educational experiences, through the enormous application of gamification across various learning environments. The practical implications are to advocate for the use of gamification in learning, recognize the role of teachers in facilitating gamified learning environments, emphasize how gamified platforms such as Kahoot work effectively, acknowledge the needs of the students, promote more research on how one can apply it, and develop collaborative learning environments.

Recommendations

Future research in gamification should focus on its long-term impact on student learning, its adaptability across various learning environments (in-person, online, blended, or hybrid), the role of teachers in gamified learning, and its integration in various school settings. This should give new insights to understand better the best practices and guidelines for maximizing the potential of gamification in education.

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