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Meta-analysis of research related to gamification with emphasis on its long-term effects on the academic performance of elementary students

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ABSTRACT

Background and Objectives: In recent years, gamification has emerged as a prominent strategy for redesigning learning experiences and enhancing students' motivation and engagement, gaining a significant position in the literature on school-based education. Despite the growth of empirical studies, a considerable portion of the existing evidence has focused on short-term outcomes, and a conclusive synthesis of the long-term effects of gamification on academic performance, particularly in elementary education, is still lacking. Given that the early school years are critical for the development of learning habits and stable motivational patterns, evaluating the long-term impacts of gamification from the perspective of curriculum planning and educational policy is of particular importance. Accordingly, the present study aimed to conduct a meta-analysis of quantitative studies on gamification, with an emphasis on its long-term effects on the academic performance of elementary school students, to determine the combined effect size and the consistency of longitudinal study results in this domain.

Materials and Methods: This study was conducted using a meta-analytic approach. The research population included all published domestic and international quantitative studies over the past 24 years that reported the long-term effects of gamification on the academic performance of elementary school students. Literature search and retrieval were conducted using keywords related to gamification, academic performance, longitudinal studies, and elementary education, and the retrieved studies were screened based on inclusion and exclusion criteria. Key inclusion criteria comprised a focus on elementary school students, use of quasi-experimental longitudinal designs, provision of quantitative data convertible to effect sizes, and reporting of outcomes over a long-term period. Following evaluation and coding of data using the data extraction forms, a total of 21 quasi-experimental and longitudinal studies were included in the analysis. Data analyses were performed using Comprehensive Meta-Analysis (CMA) software, focusing on effect sizes and heterogeneity indices across studies.

Findings: The fixed-effect model indicated that gamification exerts a positive and statistically significant long-term impact on students' academic performance, yielding a pooled effect size of 0.472, which falls within the moderate range. The heterogeneity indices suggested no statistically meaningful between-study variability ($Q = 19.14$, $\chi^2 = 36.415$, $I^2 = 0\%$), indicating overall consistency across the included studies. Nevertheless, interpretation of the long-term effect should remain sensitive to contextual conditions and implementation quality, as substantive variations in real-world impact may not be fully captured by heterogeneity statistics. Within this framework, students' developmental and individual characteristics, classroom and school contexts, and the intensity and quality of gamified technology design and use may moderate the magnitude and durability of academic outcomes. Moreover, intervention duration and the timing of follow-up assessments are key factors that likely shape whether gamification effects are sustained or attenuate over time in longitudinal research.

Conclusions: Based on the synthesized evidence, gamification can positively and significantly improve the long-term academic performance of elementary school students. This finding extends gamification beyond a short-term motivational intervention, positioning it as a reliable strategy for designing sustainable learning experiences, provided that game elements align with educational objectives and curriculum logic. Practically, it is recommended that the development and implementation of gamified approaches in elementary schools be supported, with emphasis on design quality, developmental appropriateness, and continuity of implementation. Furthermore, future research that reports detailed intervention components, follow-up duration, and implementation quality can enable more nuanced analyses and clarify the mechanisms underlying the long-term effectiveness of gamification.

NUMBER OF REFERENCES
45

NUMBER OF FIGURES
2

NUMBER OF TABLES
6

مقاله پژوهشی

فراتحلیل پژوهش‌های مرتبط با بازی گونه ســـازی با تاکید بر اثرات دراز مدت آنها بر عملکرد تحصـــیلی دانش آموزان ابتدایی

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چکیده

پیشینه و اهداف: بازی‌وارسازی در سال‌های اخیر به‌عنوان راهبردی برای بازطراحی تجربه یادگیری و تقویت انگیزش و مشارکت دانش‌آموزان، جایگاه برجسته‌ای در ادبیات آموزش مدرسه‌ای یافته است. با وجود گسترش مطالعات تجربی، بخش قابل توجهی از شـــواهد موجود به پیامدهای کوتاه‌مدت معطوف بوده و درباره پایداری اثرات بازی‌وارســـازی بر عملکرد تحصـیلی، به‌ویژه در دوره ابتدایی، هنوز جمع‌بندی قاطع و مبتنی بر شواهد تلفیقی در دسترس نیست. از آنجا که سال‌های ابتدایی مدرسه زمان شکل‌گیری عادات یادگیری و الگوهای انگیزشی پایدار است، ارزیابی اثرات بلندمدت بازی‌وارسازی از منظر برنامه‌درسی و سیاست‌گذاری آموزشی اهمیت ویژه دارد. بر این اساس، پژوهش حاضر با هدف فراتحلیل مطالعات کمی مرتبط با بازی‌وارسازی و با تأکید بر اثرات بلندمدت آن بر عملکرد تحصیلی دانش‌آموزان دوره ابتدایی انجام شد تا اندازه اثر ترکیبی و میزان همسویی نتایج مطالعات طولی در این حوزه تعیین شود.

روش‌ها: این پژوهش با رویکرد فراتحلیل انجام شـــد. جامعه پژوهش شـــامل کلیه مطالعات کمی داخلی و خارجی منتشرشده طی ۲۴ سال گذشته بود که اثرات بلندمدت بازی‌وارسازی بر عملکرد تحصیلی دانش‌آموزان دوره ابتدایی را گزارش کرده بودند. جست‌وجو و بازیابی منابع بر اساس کلیدواژه‌های مرتبط با بازی‌وارسازی، عملکرد تحصیلی، مطالعه طولی و دوره ابتدایی انجام گرفت و مطالعات بازیابی‌شـــده بر پایه معیارهای ورود و خروج غربالگری شـــدند. معیارهای اصلی ورود شامل تمرکز بر دانش‌آموزان ابتدایی، استفاده از طرح‌های شبه‌آزمایشی با رویکرد طولی، ارائه داده‌های کمی قابل تبدیل به اندازه اثر و گزارش ســـنجش پیامدها در افق زمانی بلندمدت بود. پس از ارزیابی و کدگذاری داده‌ها با فرمهای اســـتخراج داده، در نهایت ۲۱ مطالعه شـبه‌آزمایشـی و بلندمدت وارد تحلیل شـد. تحلیل‌ها با نرم‌افزار CMA و با تمرکز بر اندازه اثر و شاخص‌های ناهمگنی بین مطالعات انجام گرفت.

یافته‌ها: مدل اثر ثابت نشان داد بازی‌وارسازی در بلندمدت اثر مثبت و معناداری بر عملکرد تحصیلی دانش‌آموزان دارد و اندازه اثر ترکیبی برابر با ۰.۴۷۲ به‌دست آمد که در دامنه متوسط تفسیر می‌شود. شاخص‌های ناهمگنی نیز بیانگر عدم ناهمگونی معنادار بین مطالعات بود (Q = 19.14، کای‌دو = ۳۶.۴۱۵، I^2 = 0%) و از همســـویی کلی نتایج در مجموعه مطالعات منتخب حکایت داشت. با وجود هم‌سویی شاخص‌های ناهمگنی، تفسیر اثر بلندمدت بازی‌وارسازی باید با توجه به شـــرایط زمینه‌ای و کیفیت اجرا انجام شـــود؛ زیرا تفاوت‌های واقعیِ اثر ممکن اســـت در آمار ناهمگنی به‌طور کامل منعکس نشـده باشـد. در این چارچوب، ویژگی‌های رشـدی و فردی دانش‌آموزان، بافت کلاس و مدرسـه، و نیز شـدت و کیفیت طراحی و اســـتفاده از فناوری‌های بازی‌واره می‌توانند دامنه و پایداری اثرات تحصـــیلی را تعدیل کنند. همچنین مدت مداخله و زمان‌بندی ســـنجش پیگیری از عوامل کلیدی‌اند که احتمالاً بر اســـتمرار یا فرســـایش اثرات در مطالعات طولی اثر می‌گذارند.

نتیجه‌گیری: بر مبنای شـــواهد تلفیقی، بازی‌وارســـازی می‌تواند در بلندمدت نیز عملکرد تحصـــیلی دانش‌آموزان دوره ابتدایی را به‌طور مثبت و معنادار بهبود دهد. این نتیجه بازی‌وارســـازی را از ســـطح یک مداخله انگیزشـــی کوتاه‌اثر فراتر می‌برد و آن را به‌عنوان راهبردی قابل اتکا در طراحی تجربه‌های یادگیری پایدار مطرح می‌کند؛ مشـروط بر آنکه عناصـر بازی در خدمت اهداف آموزشـی و منطق برنامه‌درسـی قرار گیرند. از منظر کاربردی، توصـیه می‌شـود توسـعه و اسـتقرار رویکردهای بازی‌واره در مدارس ابتدایی با تأکید بر کیفیت طراحی، تناســب رشـدی، و اســتمرار اجرای مداخله حمایت

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شـــود. همچنین پژوهش‌های آینده با گزارش دقیق‌تر اجزای مداخله، مدت پیگیری، و کیفیت اجرا می‌توانند امکان تحلیل‌های تفکیکی و شفاف‌سازی سازوکارهای اثرگذاری بلندمدت بازی‌وارسازی را فراهم کنند.

Introduction

In recent decades, educational systems across the globe have been confronted with a growing set of complex and interrelated challenges. Among the most prominent of these are the declining levels of students' active participation in the learning process, the erosion of intrinsic motivation to engage with academic tasks, and the persistent weaknesses observed in learners' basic academic performance [1]. These issues have become especially pressing in a world that is rapidly changing due to technological advancements, shifting societal demands, and increasingly diverse learning populations. As a result, traditional pedagogical approaches, which often emphasize rote memorization and passive knowledge transfer, have been criticized for their inability to address the evolving needs of contemporary learners [2].

In response to these concerns, educational researchers and practitioners have begun to explore modern, student-centered, and more engaging approaches to teaching and learning. One of the most promising of these approaches is gamification, which has attracted significant scholarly attention over the past decade. Gamification (rooted in principles of game design) refers to the deliberate incorporation of motivational and interactive elements into non-game environments such as the classroom, to enhance students' engagement and persistence [3]. In the field of education, this means constructing learning environments in which students perceive themselves to be on a path marked by progress, meaningful challenges, and rewarding achievements [3,4].

When applied to educational practice, gamification often involves the integration of specific components such as scoring systems, badges, immediate feedback mechanisms, and structured opportunities for collaboration or competition among learners. Together, these elements attempt to shift the learning experience away from a passive reception of information toward a more active, immersive, and meaningful process of knowledge construction [5]. Put differently, gamification seeks to enrich educational environments by drawing inspiration from the inherently attractive and motivating features of games. By doing so, it not only injects excitement and novelty into learning activities but also strengthens learners' intrinsic desire to engage, persist, and ultimately succeed in their academic endeavors. It is important to note that gamification is different from game-based learning; in game-based learning, complete games are used as educational tools, whereas gamification merely adds some elements of games (such as scoring or competition) to the real educational environment [6]. This approach has been applied across a wide range of subjects—from mathematics and science to language education—and in both digital (e.g., online classes with game-like platforms) and non-digital forms (e.g., paper-based scoring systems in the classroom) [7]. The main goal of using game elements in education is to increase students' motivation and participation in learning activities by creating incentives and rewards for their efforts. In fact, gamification is a structured process aimed at reinforcing learning behaviors and improving academic outcomes by creating game-like experiences in educational settings [8]. For instance, Kirikova et al showed that adding rewards and recognition of achievements in class can stimulate students' active participation and make learning more attractive [9]. Thus,

gamification is an attempt to utilize the intrinsic appeal of games to create meaning in learning and enhance students' interaction with educational content [10].

A meta-analysis of studies related to gamification indicates that this approach can play a significant role in enhancing students' academic performance, particularly at the elementary level [11]. The reviewed findings reveal that gamification has been associated with increased active participation, improved intrinsic motivation, and the enhancement of learning processes [12,13,14]. Furthermore, the meta-analyses conducted by Seiler and Homner [13] and Zhao et al. [15] demonstrated that gamification exerts a positive (though moderate) effect on both cognitive and motivational outcomes, thereby contributing to the consolidation and reinforcement of learning [15]. In this regard, Huang et al [16] emphasized the importance of tools such as leaderboards, which were found to significantly improve learning performance. In addition, Harris and Park reported that gamification can foster improvements in memory, concentration, and attention, thereby laying the foundation for more sustainable academic achievement among students. Longitudinal investigations have further supported these findings: Barta et al. [17], in a three-year study, and Nehring et al. [18], during an 11-week intervention, both documented continuous improvements in student performance within gamified learning contexts [9,10,2,11,12,13,14,19]. Overall, the available evidence suggests that gamification not only produces short-term positive effects on learning but also contributes, in the long run, to knowledge retention, the cultivation of sustained motivation, and the continuous improvement of elementary students' academic performance [16, 20].

However, this issue is particularly important in elementary education because children may initially respond enthusiastically to game elements but may become accustomed to or bored with them after a while. A recent systematic review conducted by Rodriguez et al. [21], specifically in the context of elementary schools, also emphasizes this point [22]. They, by reviewing 31 recent studies at the elementary level, found that although most gamification experiences at this level led to improved participation, motivation, and self-efficacy among students, there was no conclusive evidence of improvement in learning outcomes and academic performance in these studies [23]. In other words, in elementary schools, the effects of gamification on student collaboration have sometimes been negative, and the learning outcomes resulting from it have been reported as contradictory or inconclusive. These findings are a warning that although gamification may boost the excitement and enthusiasm for learning in the short term, to assess its true value, one must examine whether this approach also leads to sustainable improvement in academic performance. Overall, the lack of certainty about the continuation of the positive effects of gamification in the long term (especially for young students) indicates a necessity that the present research aims to address [24,25,26].

Therefore, the main research question of the present study is: Does augmented reality and gamification have a long-term effect on the academic performance of elementary school students? What are the effect sizes of this technology on students' academic performance in the long term? What variables have contributed to the heterogeneity of the observed effect sizes on students' academic performance over the long term

Review of the Related Literature

As mentioned, numerous studies have examined the effects of gamification on

students' motivation, engagement, and academic performance, reporting positive outcomes [9,10,2,11,28,28,29,30,31,32,33]. Some of these studies are discussed in detail below. Lin et al. [34] conducted a long-term study comparing computer-based and game-based formative assessments. The results showed that game-based assessments increased students' average scores, improved academic performance, and enhanced learning motivation over time. Nabizadeh et al [35] carried out a ten-year study on students' behavior in a gamified course. Findings indicated that students with higher interaction with game content demonstrated more stable academic performance and maintained motivation consistently throughout the period. Recabarren et al [36] examined the effects of gamification on gamer and non-gamer students. Results showed that gamer students exhibited higher motivation and academic performance, and gamified learning increased their engagement and participation in the learning process. Pesek et al [37] investigated the "Troubadour" gamified e-learning platform for music education. The study found that students using the platform achieved higher test performance and experienced better user engagement compared to traditional methods.

Keyhan [38] studied the effects of a computer-based jigsaw puzzle game on accuracy, speed, learning, and retention in mathematics among lower secondary students. Findings indicated significant improvements in academic performance, problem-solving speed, and learning retention. Van Roy and Zaman [39] assessed the motivational effects of gamification over a semester. Results demonstrated that students' controlled motivation persisted over time, suggesting that well-designed gamified elements can foster sustained engagement and active participation in learning. Nehring et al [40] examined gamification's impact on student performance in a quasi-experimental study. Results showed that gamification improved both motivation and academic performance, with students in the experimental group outperforming those in the control group. Barata et al [41] investigated individual differences in student responses to gamified education. Findings indicated that students with higher engagement in gamified activities showed greater motivation and learning outcomes, emphasizing that long-term effects depend on individual student characteristics.

Hakulinen et al [42] explored gamification effects on students with different achievement goal orientations. The study found that badges and game elements enhanced mastery-oriented motivation and reduced avoidance behaviors, though effects varied depending on students' goal orientations. Dodero et al [43] applied tangible co-design gamification in primary schools. Results showed students enjoyed gamified activities, increasing participation and motivation in voluntary tasks, highlighting the positive influence of gamified learning on active engagement. Barata et al [44] examined gamification's impact on participation and learning. Findings revealed that online gamified activities increased student engagement, reduced score gaps, and enhanced learning outcomes, confirming gamification as an effective instructional strategy.

Method

Design

This study was conducted as a quantitative meta-analysis to synthesize empirical evidence on the long-term effects of gamification on elementary students' academic performance. Meta-analysis was selected because it enables the systematic integration of findings from

independent controlled studies, producing a pooled estimate of sustained impact and clarifying whether observed benefits persist beyond short-term engagement gains. The scope of the review covered studies published between 2001 and 2025, reflecting both early foundational research and more recent technology-supported gamification interventions in primary education. A systematic search strategy was implemented across national and international sources. Iranian databases and repositories included Irandoc, Noormags, MagIran, SID, and Elmnet. International coverage was sought through major bibliographic and publisher platforms, with emphasis on Scopus and relevant full-text environments such as ScienceDirect/Elsevier and Wiley Online Library, where applicable. To minimize retrieval bias, the reference lists of eligible papers were also examined. Search terms were structured around three concept domains and combined using Boolean operators: gamification; long-term/follow-up/retention/sustained effects; and academic performance/achievement/grades/learning outcomes.

Materials

Eligibility criteria were defined a priori to ensure conceptual relevance and methodological comparability. Studies were included if they (1) examined gamification as a clearly identifiable educational intervention (e.g., structured use of points, levels, badges, leaderboards, feedback loops, or digital gamified environments integrated into instruction); (2) targeted elementary school students (typically ≤12 years); (3) used experimental or quasi-experimental designs with a control or comparison condition; (4) reported long-term or follow-up assessments of academic performance beyond the immediate post-intervention measurement; (5) implemented interventions lasting at least four weeks to support more credible inferences about sustained learning effects; (6) were published in English or Persian; and (7) provided sufficient quantitative information to compute standardized effect sizes (group sample sizes, means, and standard deviations). Studies were excluded if they were theoretical papers, commentaries, or reviews; focused on non-elementary populations; lacked explicit gamification components; did not include follow-up outcomes; had interventions shorter than four weeks; or failed to report adequate statistical data for effect size estimation. Study selection proceeded through sequential screening of titles/abstracts and full texts according to the predefined criteria. After eligibility assessment and methodological verification, 21 longitudinal experimental or quasi-experimental studies were retained for final synthesis. Data were extracted using a structured form adapted from Mesrabadi and Yadollahi [45], capturing bibliographic details, sample characteristics, features of the gamification intervention, duration and timing of follow-up, and outcome statistics. When studies reported multiple relevant outcomes, academic performance indicators most directly aligned with achievement at the follow-up point were prioritized to maintain conceptual coherence across the dataset.

Procedure

Effect sizes were calculated using the d family of standardized mean differences. For each eligible study, group-level sample size, mean, and standard deviation of academic performance at the follow-up assessment were extracted for intervention and comparison conditions. Meta-analytic computations were conducted using Comprehensive Meta-Analysis (CMA) software. Pooled effect size estimates with confidence intervals were generated, and

between-study heterogeneity was assessed using the Q statistic and the I^2 index. Given the study's explicit focus on long-term impact in a developmentally sensitive educational stage, this analytical framework was intended to provide a rigorous and policy-relevant estimate of the sustained academic value of gamification in elementary education.

Results and Findings

First, the present study examines the key characteristics of the 21 studies related to gamification, as summarized in Table 1. This analysis focuses on several critical dimensions, including the educational level of participants, the subject or discipline under investigation, the type and duration of gamified interventions, and the specific gamification elements implemented (e.g., scoring systems, badges, leaderboards, or collaborative tasks). By systematically reviewing these characteristics, the study aims to provide a comprehensive overview of the current research landscape, identify common patterns and trends, and highlight potential gaps in the existing literature. In particular, understanding these study features is essential for interpreting the effectiveness and generalizability of gamification interventions across different educational contexts. Moreover, examining the diversity in study designs, sample sizes, and methodological approaches enables researchers to assess the robustness of reported outcomes and to make informed recommendations for future research and practical implementation of gamification in education. Table 1 thus serves as a foundational reference, offering a structured summary of the 21 selected studies and facilitating a deeper understanding of how gamification has been applied, evaluated, and reported across various settings.

Table 1: Longitudinal Studies on Gamification and Academic Performance

No.	Researcher	Year	Article Title	Findings	Key Effect Info	Approach	Duration	Country
1	Hanus & Fox	2015	Assessing Gamification Effects in Classrooms	Gamified students showed lower intrinsic motivation and exam scores.	Motivation, Performance Exp: N=71, M=4.78 Ctrl: N=71, M=4.95 ...	Quasi-Experimental	4 months	USA
2	Barta et al.	2017	Differentiation in Gamified Learning	Students reacted differently but showed higher motivation.	Motivation Exp: N=46, M=77.80 Ctrl: N=46, M=75.67	Quasi-Experimental	36 months	Germany
3	Nehring et al.	2018	Improving Student Performance via Gamification	Gamification improved student motivation and performance.	Motivation Exp: N=64, M=78.58 Ctrl: N=55, M=77.80	Quasi-Experimental	3 months	Germany

No.	Researcher	Year	Article Title	Findings	Key Effect Info	Approach	Duration	Country
4	Putz et al.	2020	Gamification & Learning Enhancement	Gamification improved retention and learning outcomes.	Performance Exp: N=39, M=3.33 Ctrl: N=44, M=1.68	Quasi-Experimental	24 months	Austria
5	Lin et al.	2023	Game-Based vs Formative Assessment	Game-based testing showed higher average scores.	Performance Exp: N=51, M=59.90 Ctrl: N=59, M=71.49	Quasi-Experimental	4 months	China
6	Nabizadeh et al.	2021	Gamified Learning Over a Decade	High interaction predicted stable long-term scores.	Motivation Exp: N=99, M=3.22 Ctrl: N=35, M=2.20	Quasi-Experimental	120 months	Iran
7	Lusap & Opma	2014	Gamification in Technical Higher Ed	Improved participation and voluntary task engagement.	Motivation Exp: N=36, M=3.24 Ctrl: N=36, M=3.00	Quasi-Experimental	36 months	Netherlands
8	Recabarren et al.	2023	Gamers vs Non-Gamers in Classrooms	Gamified learning improved academic outcomes.	Motivation, Performance Exp: N=49 Ctrl: N=47	Quasi-Experimental	12 months	Chile
9	Dudero et al.	2014	Tangible Gamified Design in School	Students enjoyed using the designed gamified objects.	Motivation Exp: N=42, M=12.32 Ctrl: N=42, M=10.74	Quasi-Experimental	12 months	Italy
10	Pesk et al.	2020	TROUBADOUR: Gamified E-Learning Platform	Higher test performance; UX encouraged participation.	Performance Exp: N=19, M=68.9 Ctrl: N=19, M=60.60	Quasi-Experimental	12 months	USA
11	Van Roy & Zaman	2018	Gamification Needs in Education	Controlled motivation persisted across the semester.	Motivation Exp: N=40 Ctrl: N=40	Quasi-Experimental	4 months	Belgium
12	Barata et al.	2013	Boosting Participation with Gamification	Improved online activity and reduced score gaps.	Participation Exp: N=52, M=79.99 Ctrl: N=52, M=81.06	Quasi-Experimental	60 months	Portugal

No.	Researcher	Year	Article Title	Findings	Key Effect Info	Approach	Duration	Country
13	Hong & Masoud	2014	Gamification & Secondary Student Motivation	Gamified students had higher intrinsic motivation.	Motivation Exp: N=29, M=5.35 Ctrl: N=31, M=4.94	Quasi-Experimental	5 months	Taiwan
14	Hakolinen & Auvinen	2014	Gamification Effects by Goal Orientation	Badges linked with mastery and reduced avoidance.	Achievement Exp: N=26, M=1.77 Ctrl: N=26, M=0.98	Quasi-Experimental	5 months	Finland
15	Zhou et al.	2019	Long-Term Literacy Growth via Gamification	Improved reading habits, emotions, and skills.	Performance Exp: N=29, M=4.83 Ctrl: N=29, M=3.95	Quasi-Experimental	6 months	China
16	Khan et al.	2017	GBL & Gender Differences in Science	Girls outperformed boys in engagement and scores.	Performance Exp: N=31, M=7.16 Ctrl: N=41, M=4.79	Quasi-Experimental	6 months	Pakistan
17	Yildirim	2017	Gamified Practices & Student Progress	Gamified methods boosted progress and attitude.	Achievement Exp: N=49, M=24.23 Ctrl: N=48, M=21.04	Quasi-Experimental	6 months	Turkey
18	Ortiz Rojas et al.	2017	Gamification in Programming Education	Higher participation, but no significant gain in performance.	Performance Exp: N=50, M=9.64 Ctrl: N=50, M=4.74	Quasi-Experimental	5 months	Colombia
19	Wang et al.	2017	Gamification for Chinese Language Learning	Improved speaking belief, but no effect on other skills.	Performance Exp: N=30, M=3.65 Ctrl: N=30, M=3.46	Quasi-Experimental	6 months	China
20	Andrade et al.	2020	Gamified STEM App in Secondary Schools	Motivation unchanged; other factors improved.	Performance Exp: N=22, M=9.59 Ctrl: N=26, M=8.88	Quasi-Experimental	6 months	Brazil
21	Hamzeh et al.	2015	Gamification & Motivation in E-Learning	Gamified students were more motivated to use platforms.	Motivation	21	Hamzeh et al.	2015

From the information in Table 1, it can be seen that among the reviewed studies, no Iranian research with a long-term approach was retrieved, and 21 foreign studies (100%) were identified, all of which were quantitative and conducted with a quasi-experimental approach. Furthermore, according to Table 2, the status of these studies in terms of the long-term duration used in the reviewed research is presented in Table 1.

Table 2: Frequency of Long-Term Duration in Gamification Studies

Research Duration	Absolute Frequency	Relative Frequency
Less than 12 months	13	62%
12 to 36 months	6	29%
More than 36 months	2	9%
Total	21	100%

Table 2 shows that the majority of research durations fall within the period of less than 12 months, accounting for 62% of the studies; the 12 to 36 months period includes 6 studies, equal to 29%; and the least frequent duration is more than 36 months, with 2 studies, comprising 9% of all the studies reviewed. In addition, the frequency distribution of the studies based on their publication years is presented in Table 3.

Table 3: Frequency Distribution of Gamification Studies by Publication Year

Publication Year	Absolute Frequency	Relative Frequency
2000 to 2010	0	0%
2011 to 2020	18	67%
2021 to 2024	3	23%
Total	21	100%

According to Table 3, most of the reviewed studies were conducted between the years 2011 and 2020, with a frequency of 18 studies (86%), and 3 studies, equal to 14%, were conducted between 2021 and 2024. However, in the period from 2000 to 2010, no long-term study with a longitudinal gamification approach was retrieved.

Assessment of Publication Bias

At the beginning of the meta-analysis, the researcher examined the publication bias of gamification studies. In meta-analysis, evaluating publication bias is important because there is a possibility that certain studies or data have not been assessed due to non-publication or being overlooked, which might be disregarded by researchers. This issue may lead to errors and bias in the final results of the meta-analysis.

Therefore, identifying and correcting publication bias in the early stages of meta-analysis is essential to improve the accuracy and validity of the results. The funnel plot is a simple and standard method for detecting publication bias in meta-analyses. In this plot, the effect of the intervention on individual study estimates is displayed in relation to the sample size of each study. This chart can assist in making decisions related to publication bias and the credibility of meta-analysis results.

Fig. 1 displays the funnel plot of the gamification studies. In the presented funnel plot, the standard error is plotted on the vertical axis, and the standardized mean difference is plotted on the horizontal axis. The central line, which passes through the middle of the plot, represents the mean standardized effect size across all studies. The dashed lines indicate the 95% confidence intervals for the mean effect size. As can be observed, the data points are symmetrically distributed around the central line, with no significant deviation from it. This suggests that the likelihood of publication bias in this meta-analysis is low.

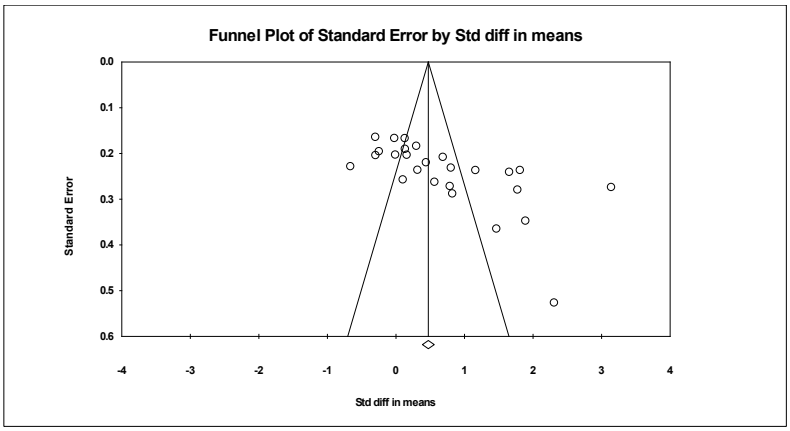

Fig. 1: Funnel Plot of Gamification Studies

Effect Size Calculation

Effect size is a statistical index that indicates the strength or importance of the relationship between two variables or the difference between two groups [27]. As a standardized metric, effect size allows us to compare the results of different studies with each other.

One of the most well-known and widely used effect sizes is Cohen's d, introduced by Jacob Cohen in 1988. This index is calculated based on the difference between the means of two groups and their pooled standard deviation, and it is commonly used to compare group differences in experimental and clinical studies. To calculate the effect sizes of the gamification studies, the CMA (Comprehensive Meta-Analysis) software was used, and the results are presented in Table 4.

According to Table 4, studies in which the mean differences were statistically significant and had a considerable effect size—such as Barata et al. [41], Putz et al. [22], and Lin et al. [34]—demonstrated large or medium effect sizes. In contrast, studies where the mean differences were not statistically significant—such as Hanus and Fox [21], and others—showed small or very small effect sizes.

According to Table 5, the fixed effect size of the studies is 0.472, which indicates a medium and statistically significant effect size. This effect size shows that the mean difference favors the first group and is statistically significant, as the p-value is less than 0.05. Additionally, the upper and lower bounds of the 95% confidence interval are 0.199 and 0.397, respectively, indicating a reliable and precise estimate of the effect size. The Z-value also indicates a substantial standard deviation, confirming that the observed difference is statistically significant.

Fig. 2 presents the effect size (standardized mean difference) and the 95% confidence interval for each of the studies. The horizontal axis represents the effect size, while each horizontal line shows the 95% confidence interval for a study. The vertical lines on both sides of the graph represent points A and B. The dots and squares represent the estimated effect sizes of each study, and the size of the squares reflects the weight of each study in the overall meta-analysis.

According to this plot, the studies with negative effect sizes (located to the left of the zero axis) include Hanus and Fox [21]. These studies indicate a preference for Group A over Group B (i.e., the control group over the experimental group), but this preference is not statistically significant, as the confidence intervals include zero. On the other hand, the studies with positive effect sizes (located to the right of the zero axis) include Barata et al. [41], Putz et al. [22], Lin et al. [34], Nabizadeh et al. [35], Recabarren et al. [36], Dudero et al. [15],

Table 4: Effect Sizes of Research Variables at the 95% Confidence Level

Model	Study name	Statistics for each study						
		Std diff in means	Standard error	Variance	Lower limit	Upper limit	Z-Value	p-Value
	Hanus & Fox (2015) _1	-0.291	0.165	0.027	-0.615	0.033	-1.758	0.079
	Hanus & Fox (2015) _2	0.138	0.168	0.028	-0.191	0.468	0.823	0.410
	Hanus & Fox (2015) _3	-0.013	0.168	0.028	-0.342	0.316	-0.079	0.937
	Barata et. al (2017)	1.662	0.242	0.058	1.188	2.136	6.873	0.000
	Nehring et. al (2018)	0.307	0.185	0.034	-0.056	0.669	1.658	0.097
	Putz et. al (2020)	1.170	0.238	0.057	0.704	1.636	4.917	0.000
	Lin et. al (2023)	0.142	0.191	0.037	-0.234	0.517	0.739	0.460
	Nabizadeh et. al (2021)	3.150	0.275	0.076	2.610	3.689	11.448	0.000
	Iosup & Epema (2014)	0.324	0.237	0.056	-0.141	0.789	1.367	0.171
	Recabarren et. al (2023) _1	0.168	0.205	0.042	-0.233	0.568	0.819	0.413
	Recabarren et. al (2023)_2	-0.289	0.205	0.042	-0.691	0.113	-1.409	0.159
	Recabarren et. al (2023)_3	0.000	0.204	0.042	-0.400	0.400	0.000	1.000
	Dodero et. al (2014)	0.448	0.221	0.049	0.015	0.881	2.028	0.043
	Pesek et. al (2020)	1.475	0.366	0.134	0.758	2.193	4.032	0.000
	VanRoy & Zaman (2018)_1	0.812	0.233	0.054	0.356	1.268	3.489	0.000
	VanRoy & Zaman (2018)_2	-0.655	0.230	0.053	-1.105	-0.205	-2.853	0.004
	Barata et. al (2013)	-0.238	0.197	0.039	-0.624	0.148	-1.210	0.226
	Hong & Masood (2014)	0.573	0.264	0.069	0.056	1.089	2.173	0.030
	Hakulinen & Auvinen (2014)	0.833	0.289	0.084	0.266	1.399	2.879	0.004
	Zhu et al. (2019)	0.796	0.273	0.074	0.261	1.331	2.918	0.004
	Khan et al. (2017)	1.783	0.281	0.079	1.233	2.333	6.354	0.000
	Yildirim (2017)	0.695	0.209	0.044	0.285	1.105	3.323	0.001
	OrtizRojas et al (2017)	1.819	0.238	0.057	1.353	2.285	7.650	0.000
	Wang et al. (2017)	0.110	0.258	0.067	-0.396	0.617	0.427	0.669
	Andrade (2020)	1.899	0.349	0.121	1.216	2.582	5.449	0.000
	Hamzah et al. (2015)	2.317	0.528	0.278	1.283	3.351	4.390	0.000
Fixed		0.472	0.044	0.002	0.386	0.559	10.693	0.000

Meta Analysis

Table 5: Combined Effect Size of Gamification Studies

Model	Study name	Statistics for each study						
		Std diff in means	Standard error	Variance	Lower limit	Upper limit	Z-Value	p-Value
Fixed		0.472	0.044	0.002	0.386	0.559	10.693	0.000

Meta Analysis

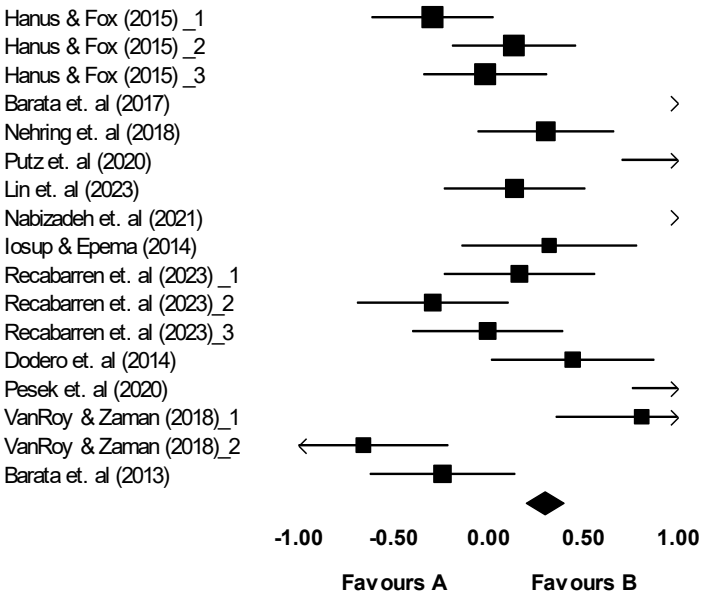

Fig. 2: Forest Plot of Confidence Intervals (Accumulation Chart) for Gamification Studies

Pesk et al. [17], Van Roy and Zaman [39], and Barata et al. [44]. These studies show a preference for Group B over Group A, and this preference is statistically significant, since the confidence intervals do not include zero.

In addition, the studies whose confidence intervals include zero (located around the zero axis) include Nehring et al. [40], Lusap and Opma, and Van Roy and Zaman [39]. These studies indicate that there is no clear preference between Group A and Group B, and the differences are not statistically significant. Overall, based on the forest plot, many studies show significant differences in favor of Group B, while a few studies show insignificant differences or differences in favor of Group A.

Assessment of Study Heterogeneity

In the final section of the meta-analysis, study heterogeneity was assessed using the Q-test for between-study variability [28]. The Q-test indicates whether there is a statistically significant heterogeneity among the studies. The results of the analysis of all the reviewed studies, which included 17 variables across 12 studies, are presented in Table 6.

Table 6: Q-Test Results at 95% Confidence Level

Q Statistic	Number of Variables	df	Chi-square (X^2)	Result
278.918	17	16	26.629	Heterogeneity Exists

The results in Table 6 show that the total Q-value is 278.918, which is much higher than the critical value of 26.296 for 16 degrees of freedom at the 0.05 significance level. This result indicates the existence of considerable heterogeneity among the studies under review.

Alongside the Q-test in assessing the heterogeneity of gamification studies, the I^2 index was also calculated and found to be 94.29%. This value indicates that about 94.29% of the observed variation in study results is due to heterogeneity among the studies and not due to random differences; this demonstrates substantial heterogeneity among the studies.

Accordingly, various variables may play a key role in this heterogeneity in the effect of gamification on the academic performance of students in longitudinal studies. To this end, the variables influencing the heterogeneity in the effect of gamification on students' academic

performance in longitudinal studies can be outlined as follows:

- Changes in student characteristics: Over time, students develop and evolve in terms of cognitive skills, learning abilities, interests, and motivations. These changes can affect the effectiveness of educational games throughout the study period and over time. Students' learning needs and goals change during their educational course and as time progresses. Educational games should adapt to these changes and address the new needs and goals to maintain their effectiveness.
- Changes in the educational environment: Curricula evolve based on new educational needs and approaches. Educational games must align with these curriculum changes and be designed and implemented accordingly to remain effective.
- Changes in intervening variables: Shifts in the socio-economic status of students and their families can occur over time. These changes can influence access to educational resources, family and school support, and ultimately the effectiveness of educational games throughout the study period. Additionally, changes in the attitudes and beliefs of teachers, parents, and the community regarding educational games can vary over time. These changes may impact the acceptance and implementation of this educational method in schools and ultimately affect its effectiveness during the study period.
- Emergence of long-term effects: Longitudinal and extended studies provide an opportunity to observe the long-term effects of gamification on students' academic performance. These long-term effects may not be visible in short-term studies and may emerge over time as the study progresses.
- Variation in individual responses: Different students respond differently to educational games, and the effects of this method can vary among them. Longitudinal and extended studies, by examining the effects of gamification on a wide range of students over time, can contribute to a better understanding of the diversity in individual responses and the factors influencing them.

In fact, the factor of time and the duration of the study play a complex and multifaceted role in the heterogeneity observed in the effects of gamification on students' academic performance in longitudinal studies. A deeper understanding of these effects requires a more detailed examination of changes in student characteristics, the educational environment, intervening variables, and the emergence of long-term effects of gamification over time.

Discussion

The present study aimed to conduct a meta-analysis of research related to gamification, with an emphasis on its long-term effects on the academic performance of elementary school students. Based on the findings, several of the reviewed studies showed notable effect sizes, including those by Barata et al. [41], Putz et al. [22], Lin et al. [34], Nabizadeh et al. [35], Recabarren et al. [36], Dudero et al. [15], Pesk et al. [17], Van Roy & Zaman [39], and Barata et al. [44], where the effect sizes were large or medium.

Alongside this, the overall fixed effect size across all studies was found to be 0.298, which indicates a small to medium effect size. This means that variables such as learning performance, achievement motivation, learning motivation, academic performance, and achievement drive have been most impacted by gamification in the long term.

This result aligns with the studies of Lopez and Tucker [8], which have shown that the success of digital games in long-term education contributes to improved motivation, engagement, and social impact, allowing students to enhance their learning and experience joy and depth in the process. It also aligns with the longitudinal study by Harris and Park [20], which showed that gamification leads to improvements in memory, focus, and attention over the long run. Furthermore, the results are consistent with the longitudinal studies by Buckley and Doyle and Barata et al. on the improvement of student performance.

To explain this finding, it should be said that large and significant effect sizes can indicate meaningful impacts that may reflect the sustainability of results in experimental and longitudinal research. In particular, the enjoyment of digital games in education helps enhance students' motivation, engagement, and deep learning; such that game elements in instructional design can create engaging experiences for players and associate learning with positive emotions and enjoyment.

In contrast, studies where the difference in means was not statistically significant, such as Hanus and Fox [21] had small or very small effect sizes. This means that achievement and learning motivation may decline in the long term. This result also aligns with the longitudinal studies of Hanus and Fox, who found that students in the gamified condition demonstrated lower motivation and lower final exam scores compared to the non-gamified class.

Additionally, the study by Hanus and Fox [21]. showed that gamification did not affect performance, dropout rates, or pass rates compared to the control group.

This suggests that the effects of gamification may vary in the short term and long term. Longitudinal studies that cover different time frames may produce different outcomes. Differences in the duration of intervention can result in variations in the magnitude and sustainability of gamification effects. Longitudinal studies should aim to measure effects across different time intervals to accurately assess changes over time.

Multiple variables may play a key role in this heterogeneity in the long-term impact of gamification on students' academic performance. The effectiveness of educational games over time may be influenced by changes in student characteristics, the educational environment, and intervening factors. Students grow over time in terms of cognitive skills, interests, and motivation, and their learning needs and goals evolve. The educational environment also transforms through changes in the curriculum and new instructional approaches. Additionally, socioeconomic status and the attitudes of teachers and parents can influence access to and acceptance of educational games. Longitudinal studies reveal the long-term effects of gamification on student academic performance and help in better understanding the diversity in individual responses.

This finding is in line with the studies of Hanus and Fox [21]. All these studies highlight the challenges and limitations of long-term gamification in educational environments. Hanus and Fox showed that gamification could lead to reduced motivation and lower scores, emphasizing the need to adapt educational games to changing student characteristics and environments. Hanus and Fox [21]. showed that gamification had no impact on performance, dropout rate, or success rate in distance learning, possibly due to changes in intervening variables and the educational context.

Several reasons may explain why gamification may have reduced effects over time. First, the initial motivation driven by the

novelty and appeal of these technologies may wane as students become accustomed to them, reducing their effectiveness. Second, the repetitive and monotonous nature of content may lower student interest and engagement. Third, shifts in the educational environment and evolving student needs and learning goals may render such technologies less effective over time.

Additionally, intervening factors such as students' socio-economic status and the attitudes and beliefs of teachers and parents can affect access to and acceptance of these technologies. Lastly, individual differences among students and their varying responses to these methods may contribute to a general decline in the long-term effectiveness of gamification and augmented reality.

Based on the findings and analyses, it appears that gamification can significantly influence students' academic performance. However, these effects vary over time and depend on various contextual factors. In general, the effect size of gamification has been positive and notable, especially when these technologies are implemented over extended periods. Research has shown that gamification can effectively enhance students' motivation, engagement, and deep learning, which aligns with the findings of longitudinal studies that emphasize the sustainability and positive impacts of such approaches.

Conversely, some studies have shown that the positive effects of gamification may diminish over time, possibly due to factors such as repetitive content, reduced novelty and appeal, and habituation. Ultimately, multiple variables can affect the heterogeneity of gamification's effect sizes and its influence on students' academic outcomes. These variables include students' individual characteristics, the educational environment, duration of the intervention, frequency and intensity of technology use, and environmental and psychological changes.

Therefore, the use of these technologies in education should be approached with care and tailored to the evolving needs of students and the learning context to achieve long-term and sustainable positive effects.

Conclusions

The findings of this meta-analysis indicate that gamification has a generally positive, small-to-medium long-term effect on the academic performance of elementary school students, with an overall fixed effect size of 0.298. Several studies demonstrated medium to large effects, particularly in areas such as learning performance, achievement motivation, learning motivation, and deep engagement. These results align with longitudinal evidence showing that digital games and game elements can sustain learners' motivation, improve cognitive processes such as memory and attention, and enhance academic performance over extended periods. However, the analysis also revealed that not all studies report favorable long-term outcomes. Some investigations, particularly those by Hanus and Fox [21], indicate that the effectiveness of gamification may diminish over time, potentially due to declining novelty, repetitive instructional content, and changes in learner characteristics or contextual conditions.

Despite these insights, the present meta-analysis faces several limitations. First, the studies reviewed vary considerably in terms of duration, intervention design, educational settings, and participant characteristics, which contributes to heterogeneity in the findings. Second, differences in measurement tools and outcome variables across studies may limit comparability. Third, relatively few longitudinal studies with extended follow-up periods exist in

the field, which restricts the depth of conclusions regarding long-term sustainability. Additionally, contextual moderators such as socio-economic status, teacher attitudes, and instructional design quality were not consistently reported, limiting the ability to conduct moderator analyses. The results of this research have important practical implications for instructional designers, teachers, and policymakers. Gamification can be an effective approach for enhancing learner motivation and performance when implemented strategically and aligned with students' developmental and contextual needs. Sustaining its effectiveness requires integrating diverse game elements, avoiding monotonous content, and continuously adapting activities to maintain novelty and relevance. Educators should also consider environmental and psychological variables—such as learner readiness, classroom climate, and support from teachers and parents—that shape the success of long-term gamified learning.

Future research should address the existing gaps by conducting longitudinal studies with standardized measures, consistent time intervals, and robust experimental designs. Scholars should examine the role of moderating factors such as intervention duration, intensity of game use, learner characteristics, and changes in educational environments. Moreover, comparative studies between gamification and emerging technologies—such as augmented reality or adaptive learning systems—may provide deeper insights into how different digital tools support sustained student engagement and performance. Finally, future research should explore qualitative dimensions of learner experiences to better understand the psychological mechanisms underlying long-term changes in motivation and achievement.

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Conflicts of Interest

The authors have no conflicts of interest.

Authors' Contribution

Javad Kayhan contributed to the conceptualization and design of the study, supervision of the research process, data analysis, drafting the initial manuscript, and critical revision of the manuscript. Golestan Sheikhloo was responsible for data collection. Both authors contributed to the interpretation of findings, reviewed and approved the final version of the manuscript, and agreed to be accountable for all aspects of the work.

References

[1] Deterding S, Dixon D, Khaled R, Nacke L. From game design elements to gamefulness: Defining "gamification". In: Proceedings of the 15th International Academic MindTrek Conference: Envisioning Future Media Environments. ACM; 2011. p. 9–15. doi.org/10.1145/2181037.2181040

[2] Li M, Ma S, Shi Y. Examining the effectiveness of gamification as a tool promoting teaching and learning in educational settings: a meta-analysis. Front Psychol. 2023;14:1253549. doi.org/10.3389/fpsyg.2023.1253549

[3] Wijaya TT, Cao Y, Bernard M, Rahmadi IF, Lavicza Z, Surjono HD. Factors influencing microgame adoption among secondary school mathematics teachers supported by structural equation modelling-based research. Front Psychol. 2022;13:952549. doi.org/10.3389/fpsyg.2022.952549

[4] Kapp KM. The gamification of learning and instruction: game-based methods and strategies for training and education. Pfeiffer; 2012. doi.org/10.1145/2207270.2211316

[5] Sailer M, Homner L. The gamification of learning: a meta-analysis. Educational Psychology Review. 2020;32(1):77–112. doi.org/10.1007/s10648-019-09498-w

[6] Bai S, Hew KF, Huang B. Does gamification improve student learning outcome? Evidence from a meta-analysis and synthesis of qualitative data in educational contexts. Educational Research Review. 2020;30:100322.

[7] Romero-Rodríguez JM, Martínez-Menéndez A, Alonso-García S, Victoria-Maldonado JJ. The reality of the gamification methodology in Primary Education: A systematic review. Int J Educ Res. 2024;128:102481.

[8] Lopez CE, Tucker CS. The effects of player type on performance: a gamification case study. Computers in Human Behavior. 2019;91:333–45.

[9] Diaz AF, Estoque-Loñez H. A meta-analysis on the effectiveness of gamification on student learning achievement. International Journal of Education in Mathematics, Science and Technology. 2024;12(5):1236–53.

[10] Martínez-Hita M, Miralles-Martínez P, Gómez CJ. Gamificar la enseñanza de la historia: Percepciones del alumnado. REDIE: Revista Electrónica de Investigación Educativa. 2024;26:e03.

[11] Price A, Beckey A, Collins D. Developing a love for playing games: A clarification of why digital video games approach is not gamification. Physical Education and Sport Pedagogy. 2022;1–15. doi:10.1080/17408989.2022.2125946

[12] García E, Fernández G. Intervención educativa mediante una propuesta de gamificación para mejorar la adhesión a la dieta mediterránea en estudiantes gallegos de Primaria. Retos. 2022;44:128–35. doi:10.47197/RETOS.V44I0.90142

[13] Anim NAHM, Suffarruddin SH, Najib NM, Sabarudin NA. Ensuring the sustainability of sadaqah-based crowdfunding platforms: the role of gamification and user experience. J Muamalat Islam Finan Res. 2023;20:35–48. doi:10.33102/jmifr.475

[14] Noshini Sh, Abdollahi M, Shirazi MR. Investigating the effect of virtual reality-based educational games on English language learning among students. Journal of Research in Foreign Language Teaching and Learning. 2019;7(15):13–28. [In Persian]

[15] Mazaheri S, Shahrokhi Z. Augmented reality-based educational games in learning educational concepts among primary school students. Journal of Research in Educational Systems. 2019;13(4):1–14. [In Persian]

[16] Buckley P, Noonan S, Geary C, Mackessy T, Nagle E. An empirical study of gamification frameworks. J Organ End User Comput. 2019;31(1):1–17. doi:10.4018/JOEUC.2019010102

[17] Chen CH, Huang CY, Chou YY. Integrating augmented reality into blended learning for elementary science course. In: Proceedings of the 5th International Conference on Information and Education Technology. 2017. p. 68–72. doi.org/10.1145/3029387.302941

[18] Dichev C, Dicheva D. Gamifying education: what is known, what is believed, and what remains uncertain. International Journal of Educational Technology in Higher Education. 2017;14(1):9. doi.org/10.1186/s41239-017-0042-5

[19] Kim J, Castelli DM. Effects of gamification on behavioral change in education: a meta-analysis. Int J Environ Res Public Health. 2021;18(7):3550. doi.org/10.3390/ijerph18073550

[20] Harris A, Park Y. The effect of augmented reality on student engagement: An analysis of the experiential aspects of augmented reality. J Educ Technol Dev Exch. 2017;10(1):1–14. doi.org/10.3390/info11040209

[21] Hanus MD, Fox J. Assessing the effects of gamification in the classroom: A longitudinal study on intrinsic motivation, social comparison, satisfaction, effort, and academic performance. Computers & Education. 2015;80:152–61. doi.org/10.1016/j.compedu.2014.08.019

[22] Hamari J, Koivisto J, Sarsa H. Does gamification work? – A literature review of empirical studies on gamification. In: Proceedings of the 47th Hawaii International Conference on System Sciences (HICSS). IEEE; 2014. p. 3025–34. doi.org/10.1109/HICSS.2014.377

[22] Putz LM, Hofbauer F, Treiblmaier H. Can gamification help to improve education? Findings from a longitudinal study. Computers in Human Behavior. 2020;110:106392. doi.org/10.1016/j.chb.2020.106392

[23] Jamiat N, Othman NFN. Effects of Augmented Reality Mobile Apps on Early Childhood Education Students' Achievement. In: Proceedings of the 3rd International Conference on Digital Technology in Education. 2019. p. 30–3. https://doi.org/10.1145/3369199.3369203

[24] Enzai NIM, Ahmad N, Ghani MAHA, Rais SS, Mohamed S. Development of augmented reality (AR) for innovative teaching and learning in engineering education. Asian Journal of University Education. 2021;16(4):99–108. doi:10.24191/ajue.v16i4.11954

[25] Chapell MS, Blanding ZB, Silverstein ME, Takahoshi M, Newman B, Gubi A, McCann N. Test anxiety and academic performance in undergraduate and graduate students. J Educ Psychol. 2005;97(2):268–74. doi:10.1037/0022-0663.97.2.268

[26] Bornstein M, Hedges LV, Higgins JP, Rothstein HR. Introduction to meta-analysis. Wiley; 2021. doi:10.1002/9780470743386

[27] Safari Y, Marzoughi R. An experimental study on the effect of metacognitive teaching method on academic performance and metacognitive awareness in middle school science

curriculum. Daneshvar Raftar Journal. 2009;16(39):45–54. [In Persian]

[29] Yaftian N, Abdi H. The effectiveness of gamification-based teaching on math anxiety and motivation among ninth-grade students. Scientific Journal of Research in School and Virtual Learning. 2021;9(1):27–36. [In Persian]

[30] Buttler D, Winne P. Feedback and Self-Regulated Learning: A Theoretical Synthesis. Review of Educational Research. 1995; 65:245–81. doi: 10.2307/1170684

[31] Chen CM, Tsai YN. Interactive augmented reality system for enhancing library instruction in elementary schools. Computers & Education. 2012;59(2):638–52. doi: 10.1016/j.compedu.2012.03.001

[32] Cechanowicz J, Gutwin C, Brownell B, Goodfellow L. Effects of gamification on participation and data quality in a real-world market research domain. In: Nacke LE, Harrigan K, Randall N, editors. Proceedings of the First International Conference on Gameful Design, Research, and Applications. New York: ACM; 2013. p. 58–65. doi:10.1145/2583008.2583016

[33] Elliot AJ, McGregor H. A 2 × 2 Achievement Goal Framework. J Pers Soc Psychol. 2001;80(3):501–19. doi:10.1037/0022-3514.80.3.501.

[34] Lin J-W, Tsai C-W, Hsu C-C. A comparison of computer-based and game-based formative assessments: a long-term experiment. Interact Learn Environ. 2023;31(2):938-954. doi:10.1080/10494820.2020.1815219.

[35] Nabizadeh AH, Jorge J, Gama S, Gonçalves D. How do students behave in a gamified course? A ten-year study. IEEE Access. 2021;9:81008-81031. doi:10.1109/ACCESS.2021.3083238.

[36] Recabarren M, Corvalán B, Villegas M. Exploring differences between gamer and non-gamer students in the effects of gamification on their motivation and learning. Interact Learn Environ. 2021;31(6):3529-3542. doi:10.1080/10494820.2021.1933543.

[37] Pesek M, Vučko Ž, Šavli P, Kavčič A, Marolt M. Troubadour: a gamified e-learning platform for ear training. IEEE Access. 2020;8:97090-97102. doi:10.1109/ACCESS.2020.2994389.

[38] Keyhan J. The effectiveness of a computer-based jigsaw puzzle game on accuracy, speed, learning, and learning retention in mathematics among lower secondary school students in Salmas County. New Educational Ideas. 2020;16(3):167-189. doi:10.22051/jontoe.2020.17731.1991.

[39] Van Roy R, Zaman B. Need-supporting gamification in education: an assessment of motivational effects over time. Comput Educ. 2018;127:283-297. doi:10.1016/j.compedu.2018.08.018.

[40] Nehring N, Baghaei N, Dacey S. Improving students' performance through gamification: a user study. In: Proceedings of the 10th International Conference on Computer Supported Education (CSEDU). Vol 2. 2018:213-218. doi:10.5220/0006687402130218.

[41] Barata G, Gama S, Jorge J, Gonçalves D. Studying student differentiation in gamified education: a long-term study. Comput Hum Behav. 2017;71:550-585. doi:10.1016/j.chb.2016.08.049.

[42] Hakulinen L, Auvinen T, Korhonen A. The effect of gamification on students with different achievement goal orientations. In: Proceedings of LaTiCE 2014.

[43] Dodero G, Gennari R, Melonio A, Torello A. Towards tangible gamified co-design at school: two studies in primary schools. In: Proceedings of the 2014 ACM Conference. 2014.

[44] Barata G, Gama S, Jorge J, Gonçalves D. Improving participation and learning with gamification. In: Proceedings of the 1st International Conference on Gameful Design, Research, and Applications (Gamification '13). 2013.

[45] Mesrabadi J, Nasrollahi Y. Meta-analysis: Concepts, Software, and Reporting. Tabriz: Shahid Madani University of Azerbaijan Press; 2016.

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