



Effectiveness of digital game-based learning in elementary education: A systematic literature review

Fauzia Hasanah ¹, Sandi Budi Iriawan  ^{1*}, Effy Mulyasari ¹,
Zsalzsa Puspa Alivia ¹

¹ Universitas Pendidikan Indonesia, Bandung, Indonesia, 40154

Article info	Abstract
Keywords: academic achievement, affective outcomes, digital game-based learning, elementary education, pedagogical alignment	This study aims to systematically synthesize empirical evidence on the effectiveness of Digital Game-Based Learning (DGBL) in elementary education, focusing on both academic achievement and affective learning outcomes. A systematic literature review was conducted following the PRISMA protocol to ensure methodological rigor and transparency. Peer-reviewed empirical articles published between 2021 and 2025 were retrieved from the Scopus database using pre-defined inclusion and exclusion criteria. The selection process involved identification, screening, eligibility assessment, and final inclusion stages, resulting in 20 eligible studies. Data were analyzed using thematic synthesis to identify recurring pedagogical patterns and trends in outcomes across studies. The validity of the review process was ensured through clearly defined selection criteria, consistent screening procedures, and cross-checking of extracted data. The findings reveal that effective DGBL implementation is strongly associated with pedagogical alignment, particularly the integration of explicit learning objectives into game mechanics, immediate and adaptive feedback, student-centered learning approaches, progressive scaffolding, and functional gamification elements. These features consistently contributed to improvements in students' academic achievement, conceptual understanding, and learning retention. In the affective domain, learning motivation and student engagement emerged as the most prominently enhanced outcomes, followed by positive shifts in learning attitudes and self-efficacy. The most stable and consistent effects were observed in language-related subjects, upper elementary grades (Grades 4–6), and formal classroom settings. Overall, the findings indicate that DGBL's effectiveness depends more on instructional and pedagogical design than on technological complexity, highlighting the importance of pedagogically grounded game-based learning in elementary education.

* Corresponding Author.

E-mail address: iriawan.sandi@yahoo.co.id (Sandi Budi Iriawan)

DOI: <http://dx.doi.org/10.33578/jpkip.v15i4.1036-1052>

Received 16 March 2026; Received in revised form 2 June 2026; Accepted 6 July 2026

Available online 30 August 2026

e-ISSN 2598-5949 | p-ISSN 2303-1514 © The Authors.

1. Introduction

The rapid advancement of educational technologies has fundamentally transformed teaching and learning practices across global education systems, particularly in basic education contexts. Digital technologies have increasingly been positioned not only as instructional tools but also as pedagogical environments that reshape how learners interact with content, peers, and teachers (Facer & Selwyn, 2021; Voogt et al., 2013). Within this transformation, Digital Game-Based Learning (DGBL) has emerged as a prominent instructional approach due to its capacity to combine learning objectives with game mechanics that foster active engagement, experiential learning, and multimodal interaction among elementary students (Mayer, 2021; Plass et al., 2015).

Previous studies have demonstrated that DGBL can support conceptual understanding, learning motivation, and sustained engagement by embedding academic content within meaningful play activities (Bai et al., 2020; Sailer & Homner, 2020). Through features such as feedback, challenge progression, and learner autonomy, digital games are argued to align well with constructivist and student-centered learning principles commonly recommended for elementary education (Plass et al., 2015). Consequently, DGBL has been increasingly adopted in formal classroom settings across various subject domains.

Despite its growing popularity, empirical evidence regarding the effectiveness of DGBL remains inconsistent and highly context-dependent. While numerous studies report positive effects on academic achievement and affective learning outcomes, other research highlights mixed or limited impacts, particularly within non-cognitive domains such as motivation, engagement, and self-efficacy (Koivisto & Hamari, 2019; Plass et al., 2015). These discrepancies indicate that learning outcomes may be influenced not merely by the presence of digital games, but by how pedagogical design characteristics and contextual factors are integrated into their implementation.

This inconsistency reveals a critical research problem: the lack of a comprehensive and up-to-date synthesis that systematically examines which pedagogical design features of DGBL are most effective, which non-cognitive outcomes are consistently influenced, and how implementation contexts shape learning effectiveness at the elementary school level. Although prior reviews have addressed game-based learning broadly, many combine heterogeneous educational levels, technologies, or timeframes, limiting their applicability to current elementary education contexts.

As an alternative, a focused, methodologically rigorous synthesis of recent empirical studies is required. Therefore, this study adopts a Systematic Literature Review (SLR) guided by the PRISMA protocol to synthesize empirical evidence published between 2021 and 2025 on the effectiveness of Digital Game-Based Learning in elementary education. The selected approach allows for transparent study selection, systematic analysis, and thematic interpretation of findings across comparable contexts.

The research objectives are threefold: (1) to identify pedagogical design characteristics of DGBL that are most consistently associated with improved learning outcomes; (2) to analyze trends in non-cognitive learning outcomes affected by DGBL implementation; and (3) to examine how subject areas, grade levels, and learning environments influence reported effectiveness. The research findings are expected to provide theoretical and practical benefits by offering evidence-based guidance to educators, instructional designers, and policymakers in designing pedagogically aligned, contextually responsive digital game-based learning environments that support sustainable elementary education.

2. Theoretical Framework

Constructivist learning theory explains that learners actively construct knowledge through interaction, exploration, and problem-solving activities rather than passively receiving information. In the context of Digital Game-Based Learning (DGBL), game environments offer students meaningful learning experiences through active participation and discovery (Plass et al., 2015).

Cognitive Load Theory elucidates that the instructional materials should be designed to optimize learners' cognitive processing by reducing unnecessary cognitive load and supporting schema construction (Mayer, 2021). Features commonly found in DGBL, such as adaptive feedback, progressive challenges, and scaffolding, may facilitate effective learning by managing cognitive demands. Self-determination theory posits that motivation is enhanced when learners experience autonomy, competence, and relatedness (Ryan & Deci, 2020). DGBL environments often support these psychological needs through learner control, achievement systems, feedback mechanisms, and collaborative activities, thereby increasing motivation and engagement.

Based on these theoretical perspectives, this review assumes that pedagogically aligned DGBL design characteristics influence cognitive and affective learning outcomes, while implementation contexts may strengthen or constrain these effects.

3. Method

3.1 Research design

This study employs a Systematic Literature Review (SLR) as the research design to synthesize empirical evidence on the effectiveness of Digital Game-Based Learning (DGBL) in elementary education. This review is positioned as a scientific assessment of instructional effectiveness rather than a narrative literature review. The SLR approach was selected to ensure a transparent, replicable, and rigorous synthesis of findings across multiple empirical studies. The review followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) protocol, which comprises four main stages: identification, screening, eligibility, and inclusion.

3.2 Time and research setting

The review was conducted between November and December 2025. The research setting was a database-based review environment, with Scopus used as the primary data source. Scopus was selected for its broad coverage of peer-reviewed international journals and its relevance to educational technology research.

3.3 Search strategy and data source

Data were collected from the Scopus database using a systematic search strategy. Scopus was selected because it is one of the largest international indexing databases and provides broad coverage of peer-reviewed educational technology research. The search was conducted in December 2025 and focused on the TITLE-ABS-KEY field to identify studies on Digital Game-Based Learning (DGBL) in elementary education. The keywords “digital game-based learning” and “elementary school” were selected based on the review's focus and their frequent use in previous studies. Additional filtering procedures were applied to include only peer-reviewed journal articles written in English, reporting empirical research findings, and published between 2021 and 2025. The retrieved records were subsequently exported and screened according to the predefined inclusion and exclusion criteria.

3.4 Inclusion and exclusion criteria

The inclusion criteria were established to ensure that only relevant, credible, and methodologically sound studies were included in the analysis (Akpahou et al., 2024). Eligible studies were peer-reviewed journal articles written in English, available in both Open Access and non-Open Access formats, and explicitly examining the effectiveness of Digital Game-Based Learning in elementary school contexts. Only studies presenting empirical data with clearly described research methodologies were included to ensure the robustness and accountability of the synthesis.

Conversely, exclusion criteria were applied to maintain analytical focus and quality. Conference proceedings, book chapters, review articles, and short surveys were excluded due to their limited methodological depth or lack of primary empirical data. In addition, non-English publications, non-peer-reviewed articles, studies unrelated to elementary-level DGBL, and purely descriptive narratives without empirical evidence were excluded. These criteria ensured that the review was based on valid, relevant, and methodologically reliable evidence. Table 1 summarizes the inclusion and exclusion criteria applied in this review.

Table 1. Inclusion and exclusion criteria

Inclusion Criteria
1. Articles in scientific journals
2. Written in English
3. Peer-reviewed articles
4. Articles available in both full Open Access (OA) and non-Open Access formats
5. Articles that explicitly discuss the Effectiveness of Digital Game-Based Learning in Elementary Schools
6. Articles that contain empirical data and a clear methodology
Exclusion Criteria
1. Documents in the form of conference papers, book chapters, review articles, and short surveys
2. Articles in non-English languages
3. Articles that have not undergone peer review
4. Articles that are outside the scope of the topic
5. Articles that are descriptive, narrative, or not data-based

3.5 Study selection procedure

The study selection process followed the four stages of the PRISMA protocol: identification, screening, eligibility, and inclusion. The initial search conducted in the Scopus database yielded 120 records. After limiting the publication period to 2021–2025, 53 records remained. Subsequently, document type filtering was applied, resulting in the exclusion of 12 conference

papers, 2 review articles, and 1 book chapter. This process produced 38 journal articles for further screening.

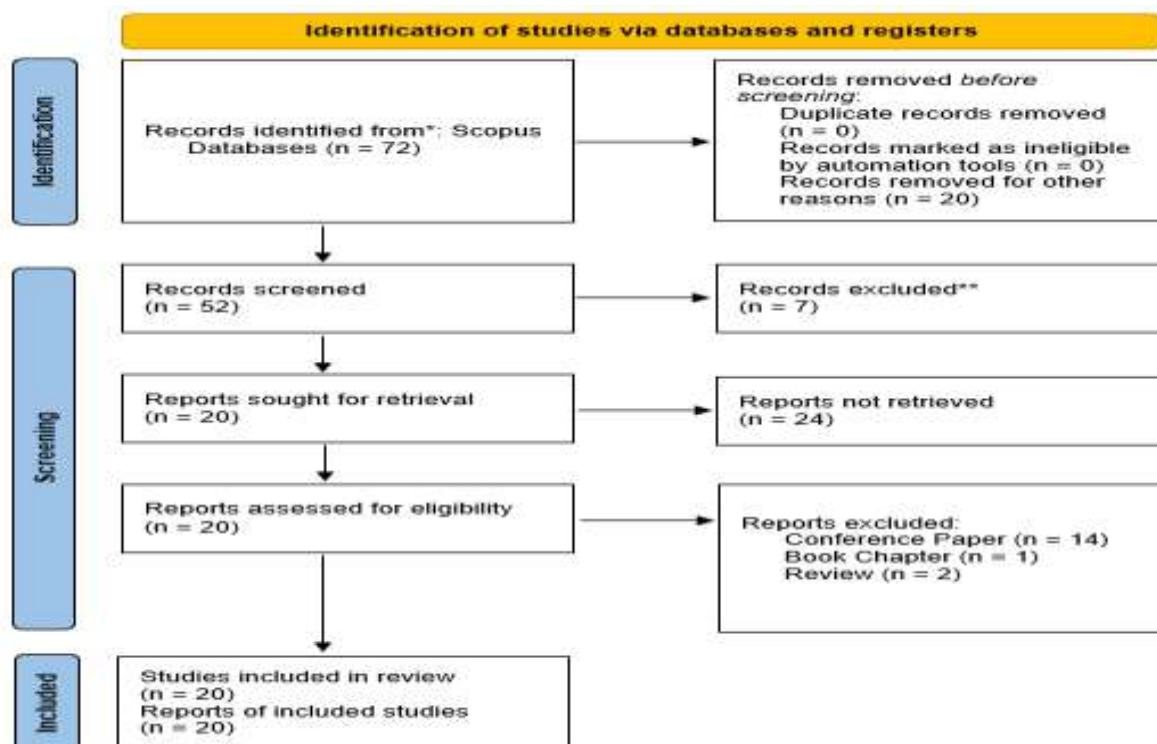


Figure 1. PRISMA flowchart

The titles, abstracts, and keywords of the remaining articles are screened according to the predefined inclusion and exclusion criteria. Three articles are excluded because they are not directly related to the effectiveness of Digital Game-Based Learning in elementary education contexts. The remaining studies undergo full-text assessment for eligibility. Following the eligibility review, 20 articles meet all criteria and are included in the final synthesis. The complete study selection process is presented in the PRISMA flow diagram shown in Figure 1.

To enhance the reliability of the selection process, the screening and eligibility assessments were conducted independently by two reviewers. The reviewers examined the titles, abstracts, and full texts of the retrieved articles according to the predefined inclusion and exclusion criteria. Any discrepancies in study selection were discussed until a consensus was reached, ensuring the consistency and validity of the final set of included studies.

3.6 Data extraction and analysis

Data extraction was conducted using a structured extraction form developed to align with the objectives of this review. Information extracted from each study includes author(s), publication year, country, subject area, grade level, sample characteristics, research design, type of Digital Game-Based Learning (DGBL), data collection instruments, learning outcomes, and reported limitations. The extracted data were organized into summary tables to facilitate cross-study comparison and support the thematic synthesis process.

The extracted data were analyzed using thematic synthesis, involving iterative coding and cross-study comparison to address the three research questions related to pedagogical design features, non-cognitive learning outcomes, and contextual implementation factors.

3.7 Quality assessment

To ensure methodological rigor, all eligible articles were evaluated using predefined quality criteria focusing on research purpose clarity, methodological transparency, contextual definition, and outcome reporting. Each quality criterion was scored using a binary system: one (1 point) if the criterion was fulfilled and 0 if it was not. Therefore, the maximum quality score for each study was 8 points. Based on the total score, studies were classified into three categories: high quality (7–8 points), moderate quality (5–6 points), and low quality (0–4 points). Only studies categorized as high or moderate quality were retained for the final synthesis. Table 2 summarises the quality assessment criteria used in this review.

Table 2. Quality criteria

Quality Criteria	
1.	Is the purpose of the study related to the effectiveness of Digital Game-Based Learning, gamification, or Augmented Reality clearly stated?
2.	Is the research method described in sufficient detail and adequately justified to address the research questions?
3.	Does the study specify the type of Digital Game-Based Learning technology, gamification mechanism, or Augmented Reality platform used in the educational context?
4.	Are the educational contexts or domains (e.g., grade level, subject area, learning environment) clearly defined?
5.	Are the outcomes or findings regarding the effectiveness of DGBL, gamification, or AR in learning reported comprehensively?
6.	Does the study discuss any ethical, technical, implementation, or pedagogical challenges encountered during the application of these technologies?
7.	Is the study based on empirical data, case studies, experiments, or validated theoretical frameworks?
8.	Are the practical or policy implications of using DGBL, gamification, or AR in education explicitly discussed by the authors?

To facilitate the interpretation of quality assessment results, studies are categorized by total quality score. The quality classification criteria applied in this review are presented in Table 3.

Table 3. Quality classification criteria

Total Scores	Quality Categories
7–8	High Quality
5–6	Moderate Quality
0–4	Low Quality

The quality assessment results for the 20 included studies are presented in Table 4. The assessment is conducted based on the eight predefined quality criteria to evaluate the methodological rigor and reporting quality of each study.

Table 4. Quality assessment results of included studies

No	Studies	Scores	Categories
1	Hsieh & Hwang (2025)	8	High
2	Hong et al. (2025)	8	High

No	Studies	Scores	Categories
3	Kim et al. (2025)	7	High
4	Darnawati et al. (2025)	7	High
5	Tsuei & Lu (2025)	8	High
6	Wu et al. (2025)	7	High
7	Syawaluddin & Aeni (2025)	7	High
8	Ženatý et al. (2024)	7	High
9	Mar'atussolichah et al. (2024)	6	Moderate
10	Liao et al. (2024)	8	High
11	Rayan & Watted (2024)	6	Moderate
12	Bento Miguens et al. (2024)	7	High
13	Bang et al. (2023)	8	High
14	Yeh & Ting (2023)	7	High
15	Yu & Tsuei (2023)	8	High
16	Yang & Kuo (2022)	8	High
17	Mystakidis et al. (2022)	7	High
18	Vidergor (2021)	8	High
19	Komalawardhana et al. (2021)	7	High
20	Bouzid et al. (2021)	6	Moderate
Mean Score		7.25	High

As shown in Table 4, the majority of the included studies are classified as high quality. 17 studies achieve high-quality status, while three studies are categorized as moderate quality. No study is classified as low quality. These results indicate that the evidence synthesized in this review is derived from studies with generally strong methodological quality and adequate reporting standards.

3.8 Ethical considerations

This study did not involve direct interaction with human participants. All data were obtained from publicly available and peer-reviewed sources. No personal or identifiable data was collected. Therefore, issues related to participant anonymity and data confidentiality were inherently addressed, and all data were used solely for academic research purposes.

4. Results

A total of 20 studies met the inclusion criteria and were included in the final synthesis. The included studies varied in terms of country, subject area, grade level, research design, sample characteristics, and Digital Game-Based Learning (DGBL) implementation. To provide an overview of the studies analyzed in this review, the characteristics of the included studies are summarised in Table 5.

As shown in Table 5, the included studies are conducted across diverse educational contexts, with language learning, mathematics, and science emerging as the most frequently investigated subject areas. Most studies employ experimental or quasi-experimental designs and report positive effects of DGBL on both cognitive and non-cognitive learning outcomes, including achievement, motivation, engagement, self-efficacy, and collaboration. This section

presents the findings of the systematic literature review based solely on the analysis of the 20 selected empirical studies published between 2021 and 2025. The findings are organized according to the three research questions.

Table 5. Characteristics of included studies

No	Studies	Areas of Subjects	Research Designs	Main Findings
1	Bouزيد et al. (2021)	Mathematics	Experimental	DGBL improved students' mathematics learning experiences and engagement
2	Komalawardhana et al. (2021)	Science	Experimental	DGBL supported collaboration and learning achievement
3	Vidergor (2021)	STEM	Quasi-experimental	DGBL enhanced creativity, motivation, and self-efficacy
4	Yang & Kuo (2022)	Language Learning	Experimental	DGBL improved learning outcomes and engagement
5	Mystakidis et al. (2022)	STEM	Experimental	Game-based environments promoted active learning
6	Bang et al. (2023)	Mathematics	Experimental	Adaptive game-based learning improved mathematics achievement
7	Yeh & Ting (2023)	Language Learning	Quasi-experimental	DGBL increased motivation and language performance
8	Yu & Tsuei (2023)	Language Learning	Experimental	DGBL supported learning achievement and engagement
9	Bento Miguens et al. (2024)	Mathematics	Mixed Methods	Educational robotics enhanced motivation and computational thinking
10	Liao et al. (2024)	Language Learning	Experimental	DGBL improved learning outcomes and self-efficacy
11	Mar'atussolichah et al. (2024)	Elementary Education	Quasi-experimental	DGBL positively influenced motivation and learning outcomes
12	Rayan & Watted (2024)	Language Learning	Experimental	Collaborative game-based learning strengthened engagement
13	Ženatý et al. (2024)	Mathematics	Experimental	DGBL supported collaboration and engagement
14	Syawaluddin Aeni (2025)	English Vocabulary Learning	Quasi-Experimental	Digital traditional games improved vocabulary mastery, engagement, and learning motivation
15	Darnawati et al. (2025)	History Learning	Development Research	Educational games improved learning motivation and participation
16	Hong et al. (2025)	Language Learning	Experimental	DGBL improved conceptual understanding
17	Hsieh & Hwang (2025)	Language Learning	Experimental	DGBL increased learning achievement and engagement
18	Kim et al. (2025)	Language Learning	Experimental	DGBL improved English language proficiency and enhanced students' learning engagement
19	Tsuei & Lu (2025)	Language Learning	Experimental	DGBL supported motivation and language achievement
20	Wu et al., (2025)	Elementary Education	Experimental	DGBL promoted collaboration, self-regulation, and learning outcomes

4.1 Findings related to rq1: pedagogical design characteristics of DGBL

The analysis underscores that the effectiveness of Digital Game-Based Learning (DGBL) in elementary education is consistently associated with specific pedagogical design characteristics rather than the mere inclusion of game elements. Five dominant pedagogical features were identified across the reviewed studies.

First, all reviewed studies included in this synthesis reported the explicit integration of learning objectives into game mechanics, such as missions, levels, and challenges aligned with targeted competencies. Second, immediate and adaptive feedback was reported in 18 studies, typically implemented through scores, visual progress indicators, or corrective hints. Third, student-centered learning approaches were identified in 17 studies, where learners were given autonomy to explore, make decisions, and actively engage with learning tasks. Fourth, progressive scaffolding through increasing levels of difficulty was evident in 16 studies, enabling gradual conceptual development. Lastly, functional gamification elements, such as points, badges, and virtual rewards, were reported in 15 studies and were effective when used to reinforce learning rather than as extrinsic incentives alone. A summary of these pedagogical design characteristics, their frequency, and reported impacts is presented in Table 6.

Table 6. Pedagogical design characteristics of digital game-based learning

DGBL Pedagogical Design Aspects	Study Frequencies	Dominant Implementation Forms	Impacts on Learning Outcomes
Explicit learning objectives	20	Competency-based missions/levels	Positive improvement in cognitive learning outcomes
Immediate and adaptive feedback	18	Scores, auto-hints, progress visuals	Understanding of concepts & retention increases
Student-centered learning	17	Player control, independent exploration	Engagement and motivation increase
Staged scaffolding	16	Progressive levels, multilevel challenges	Managed cognitive load
Functional gamification elements	15	Points, badges, virtual rewards	Intrinsic motivation & learning persistence
Collaboration (optional)	6	Multiplayer/group work	Social skills and conceptual discussion

The number of studies reported in Table 7 represents the frequency with which each pedagogical design characteristic occurs across the 20 included articles. Since individual studies may incorporate multiple pedagogical features within a single Digital Game-Based Learning intervention, the reported frequencies overlap and do not constitute mutually exclusive categories. All included studies are fully documented in the paper inventory and are systematically coded during the thematic synthesis process.

4.2 Findings related to rq2: non-cognitive learning outcomes

The review indicates that DGBL has a substantial impact on non-cognitive learning outcomes among elementary students. Learning motivation emerged as the most frequently reported outcome, appearing in 18 of the 20 studies. Student engagement, encompassing behavioral, emotional, and cognitive engagement, was reported in 16 studies and revealed consistent improvement compared to conventional instruction.

In addition, positive changes in learning attitudes were reported in 14 studies, particularly in subjects previously perceived as difficult. Self-efficacy was reported in 10 studies, generally showing positive but more moderate effects. Social collaboration and self-regulated learning were less frequently reported but still demonstrated positive tendencies when DGBL was designed collaboratively and supported with appropriate scaffolding. The distribution of non-cognitive outcomes, indicators, and trends is summarised in Table 7.

Table 7. Non-cognitive learning outcomes of digital game-based learning

Non-Cognitive Domains	Study Frequencies	Commonly Used Indicators	Trends of Findings
Learning Motivation	18	Intrinsic motivation, interest in learning, persistence	Dominance increases significantly
Student engagement	16	Focus, active participation, and enthusiasm	Improve consistently
Learning attitude	14	Positive perception, enjoyment of learning	Tends to increase
Self-efficacy	10	Confidence in completing tasks	The majority increased
Social collaboration	7	Cooperation, communication	Improves on collaborative gaming
Self-regulation	6	Independence, learning control	Limited increase

The number of studies reported in Table 7 indicates the frequency of non-cognitive learning outcomes reported across the 20 included articles. Because individual studies often examine more than one affective or non-cognitive outcome, the frequencies overlap and should not be interpreted as mutually exclusive counts. All counted studies are documented in the paper inventory and are coded systematically according to the explicit outcome measures reported in each study.

4.3 Findings related to rq3: implementation contexts

The findings demonstrate that the effectiveness of DGBL varies according to implementation contexts. Subject areas, language learning, particularly English, reveal the most stable and positive effects, reported in eight studies. Mathematics (seven studies) and science (four studies) demonstrated positive cognitive outcomes when games supported problem-solving and conceptual simulation, though with greater variation.

In terms of grade levels, DGBL was most frequently implemented in upper elementary grades (Grades 4–6), with 14 studies reporting more consistent and significant outcomes than those conducted in lower grades. Regarding learning environments, formal classroom settings yielded the most stable results, while home-based or online implementations indicated greater variability. These contextual variations are summarised in Table 8.

Table 8. Implementation Contexts of DGBL Effectiveness

Aspects	Dominant Categories	Study Frequencies	Trends of Findings
Subjects	Language (e.g., English, reading)	8	Strong impact on motivation and learning outcomes
	Mathematics	7	Cognitive impact significant, moderate variation
	Science	4	Effective for concepts & simulations
	Others	1	Limited impact

Aspects	Dominant Categories	Study Frequencies	Trends of Findings
Class level	Lower elementary (Grades 1–3)	6	Motivation increases, cognitive outcomes vary
	Upper elementary (Grades 4–6)	14	Most consistent impact
Learning environment	Formal classes	13	Most stable outcomes
	Blended learning	5	Effective when structured
	Daring/in home	2	High variation, depending on external support

5. Discussion

5.1 Discussion of rq1: pedagogical alignment as the core of dgbl effectiveness

The findings for RQ1 clearly demonstrate that the effectiveness of Digital Game-Based Learning (DGBL) in elementary education is fundamentally driven by pedagogical alignment rather than technological sophistication. This result supports earlier theoretical arguments that learning through games becomes meaningful only when instructional objectives are explicitly embedded within game mechanics (Mayer, 2021; Plass et al., 2015).

The universal presence of explicit learning objectives across all reviewed studies indicates that games function most effectively as learning environments when gameplay activities directly represent academic competencies. This finding underscores the concept of ‘meaningful play’, where learning outcomes emerge from intentional interactions between learners and well-designed rule-based systems (Plass et al., 2015). Without such alignment, digital games risk becoming motivational tools with limited instructional value.

The prevalence of immediate and adaptive feedback further aligns with Cognitive Load Theory, which emphasizes the importance of timely information to reduce extraneous cognitive load and support schema construction (Mayer, 2021). In elementary education, where learners are still developing foundational cognitive structures, feedback mechanisms embedded in DGBL help learners correct misconceptions early and maintain learning momentum. This explains why studies incorporating adaptive feedback reported more consistent improvements in conceptual understanding and learning retention.

In addition, the dominance of student-centered learning approaches and progressive scaffolding reflects constructivist learning principles. Allowing learners to explore, make decisions, and progress through gradually increasing challenges enables knowledge construction through active engagement rather than passive reception (Sailer & Homner, 2020). The findings, therefore, confirm that DGBL is most effective when it aligns with developmentally appropriate instructional strategies for elementary learners.

5.3 Discussion of rq2: the role of affective outcomes in learning enhancement

The findings related to RQ2 reveal that motivation and engagement are the most consistently enhanced non-cognitive outcomes of DGBL implementation. This pattern strongly supports Self-Determination theory, which posits that intrinsic motivation is fostered when learning environments satisfy learners’ needs for autonomy, competence, and relatedness (Ryan & Deci, 2020).

Digital games naturally support autonomy by allowing students to control their pace and learning pathways, while progressive challenges and feedback foster a sense of competence. Social and collaborative game elements further address the need for relatedness, particularly in

multiplayer or group-based designs. These mechanisms explain why motivational gains were reported across diverse subject areas and learning environments.

Importantly, the findings underscore that the affective outcomes often serve as mediating variables rather than end goals. Increased motivation and engagement create favorable learning conditions that subsequently support cognitive achievement, a relationship previously highlighted in game-based learning research (Koivisto & Hamari, 2019). This mediation effect may explain why studies that reported strong motivational outcomes also tend to report improvements in academic achievement and retention.

However, the relatively limited attention to self-efficacy and self-regulated learning highlights an essential research gap. While several studies reported positive effects on self-efficacy, the results were less consistent, particularly when game designs were overly competitive or lacked sufficient scaffolding. This finding underscores that not all motivational designs equally support learners' confidence, reinforcing the need for balanced game mechanics that combine challenge with instructional support (Plass et al., 2015).



Figure 2. Conceptual Framework of Effective Digital Game-Based Learning in Elementary Education

5.4 Discussion of rq3: contextual sensitivity of dgbl implementation

The findings for RQ3 confirm that DGBL's effectiveness is highly context-dependent. The stronger effects observed in language-learning contexts can be explained by the compatibility between game mechanics and language-learning processes, such as repetition, contextual practice, and immediate feedback (Bai et al., 2020). These characteristics are more easily represented in game environments than abstract procedural knowledge.

The more consistent outcomes reported in upper elementary grades (Grades 4–6) further support developmental learning theories. Older elementary students typically possess higher levels of reading comprehension, metacognitive awareness, and digital literacy, enabling them to navigate complex game systems more effectively (Mayer, 2021). In contrast, younger learners may require additional teacher guidance and simplified interfaces to achieve comparable learning gains.

The findings, furthermore, highlight the importance of learning environments. Formal classroom settings provide pedagogical structure, teacher facilitation, and real-time scaffolding, which enhance the instructional value of DGBL. Conversely, home-based or online implementations rely heavily on external support, such as parental involvement and access to technology, leading to greater variability in outcomes. This observation underscores previous concerns regarding equity and instructional consistency in technology-enhanced learning (Facer & Selwyn, 2021).

This review contributes to the growing body of literature on Digital Game-Based Learning by providing a focused synthesis of empirical studies conducted specifically in elementary education settings. Unlike previous reviews that examined game-based learning across multiple educational levels or combined various technology-enhanced learning approaches, this review integrates pedagogical design characteristics, non-cognitive learning outcomes, and implementation contexts within a single analytical framework. Consequently, the findings offer a more comprehensive understanding of the conditions under which DGBL can be implemented effectively in elementary classrooms.

Based on the synthesis of the included studies, a conceptual framework is proposed to illustrate the relationships among pedagogical design characteristics, non-cognitive outcomes, cognitive learning outcomes, and implementation contexts in Digital Game-Based Learning environments. The framework is presented in Figure 2.

As illustrated in Figure 2, pedagogical design characteristics represent the primary drivers of DGBL effectiveness. These characteristics influence cognitive learning outcomes both directly and indirectly through non-cognitive outcomes such as motivation, engagement, and self-efficacy. The framework also highlights the moderating role of implementation contexts, including subject area, grade level, and learning environment, which may strengthen the effectiveness of DGBL interventions.

6. Conclusion and implications

This systematic literature review synthesizes empirical evidence from 20 Scopus-indexed studies published between 2021 and 2025 to examine the effectiveness of Digital Game-Based Learning (DGBL) in elementary education. The conclusions are drawn as generalizations that directly address the research problems and research objectives.

First, the review confirms that DGBL's effectiveness in elementary education is primarily determined by pedagogical design characteristics rather than technological sophistication. DGBL implementations that explicitly integrate learning objectives into game mechanics, provide immediate and adaptive feedback, apply progressive scaffolding, promote student-centered learning, and utilize functional gamification elements consistently result in improved academic achievement, conceptual understanding, and learning retention among elementary students. This finding answers the first research problem by demonstrating that instructional alignment is the core factor underpinning successful DGBL implementation.

Second, the review concludes that DGBL exerts its strongest and most consistent influence on non-cognitive learning outcomes, particularly learning motivation and student engagement. Positive changes in learning attitudes and self-efficacy were also reported, though with less consistent results. These findings address the second research problem by indicating that affective outcomes play a crucial mediating role in enhancing cognitive learning outcomes within game-based learning environments.

Third, the findings demonstrate that DGBL's effectiveness is context-dependent. More stable and significant learning outcomes were reported in language-related subjects, upper elementary grades (Grades 4–6), and formal classroom environments. In contrast, implementations in lower grades or home-based learning contexts indicate greater variability. This conclusion addresses the third research problem by confirming that subject area, developmental level, and learning environment significantly influence the reported effectiveness of DGBL.

Overall, this study underscores that Digital Game-Based Learning constitutes an effective instructional approach in elementary education when it is pedagogically grounded, developmentally appropriate, and contextually responsive. The findings suggest that DGBL should be conceptualized as a structured pedagogical strategy rather than as a motivational or technological novelty. These conclusions provide evidence-based guidance for educators, instructional designers, and policymakers seeking to design sustainable and effective game-based learning environments in elementary education.

Despite providing a comprehensive synthesis of recent studies on Digital Game-Based Learning in elementary education, this review has several limitations. First, the review was limited to studies indexed in Scopus, potentially excluding relevant studies from other databases. Second, only English-language journal articles published between 2021 and 2025 were included, potentially limiting the representation of research conducted in other languages and contexts. Third, the included studies varied considerably in terms of subject area, research design, sample characteristics, and outcome measures, making direct comparison across studies challenging. Lastly, this review employed thematic synthesis rather than meta-analysis; therefore, the findings should be interpreted as patterns and trends rather than pooled statistical estimates.

Future research should expand the evidence base by incorporating multiple databases, broader publication sources, and multilingual literature. Meta-analytic studies are recommended to quantify the magnitude of DGBL effects across different learning outcomes and educational contexts. Furthermore, additional research is needed in lower elementary grades, underrepresented subject areas, and diverse cultural settings to better understand the conditions under which DGBL can be implemented most effectively. Longitudinal studies examining the sustained impact of DGBL on both cognitive and non-cognitive outcomes would also contribute to a more comprehensive understanding of its long-term educational value.

Declaration and Statement

CRedit Authorship Contribution Statement

Fauzia Hasanah: Conceptualization, Methodology, Formal Analysis, Data Curation, Writing – Original Draft. Sandi Budi Iriawan: Supervision, Methodology, Validation, Writing – Review & Editing. Effy Mulyasari: Supervision, Validation, Writing – Review & Editing. Zsazsa Puspa Alivia: Literature Review Support, Data Validation, Writing – Review & Editing.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have influenced the work reported in this paper.

Funding Statement

This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

Data Availability Statement

The data supporting the findings of this study were obtained from published articles indexed in Scopus. Most studies included in the review are reported and summarised within the manuscript. No additional datasets were generated during the current study.

Ethical Declaration

Ethical approval was not required for this study because it employed a Systematic Literature Review methodology using publicly available published studies. No direct human participants were involved in the research process.

Informed Consent Statement

Not applicable, as this study did not involve human participants.

Acknowledgement

The authors did not provide acknowledgement information.

Declaration of Generative AI and AI-Assisted Technologies

Portions of this manuscript were drafted/edited/enhanced using ChatGPT-4.0. The authors used this tool for improving grammar and clarity/drafting an initial version of the Introduction section. All content generated by the AI was thoroughly reviewed, edited, and validated by the authors, who take full responsibility for the final content.

References

- Akpahou, R., Mensah, L. D., Quansah, D. A., & Kemausuor, F. (2024). Energy planning and modeling tools for sustainable development: A systematic literature review. *Energy Reports*, 11, 830–845. <https://doi.org/10.1016/j.egy.2023.11.043>
- Bai, S., Hew, K. F., & Huang, B. (2020). Does gamification improve student learning outcome? Evidence from a meta-analysis and synthesis of qualitative data in educational contexts. *Educational Research Review*, 30, 100322. <https://doi.org/10.1016/j.edurev.2020.100322>
- Bang, H. J., Li, L., & Flynn, K. (2023). Efficacy of an Adaptive Game-Based Math Learning App to Support Personalized Learning and Improve Early Elementary School Students' Learning. *Early Childhood Education Journal*, 51(4), 717–732. <https://doi.org/10.1007/s10643-022-01332-3>
- Bento Miguens, A. L., Nunes Piedade, J. M., dos Santos, R. J. B., & Oliva, T. L. (2024). Meaningful learning in mathematics: a study on motivation for learning and development of computational thinking using educational robotics. *Educational Media International*, 61(1–2), 4–15. <https://doi.org/10.1080/09523987.2024.2357472>
- Bouزيد, T., Kaddari, F., Darhmaoui, H., & Bouزيد, E. G. (2021). Enhancing Math-class Experience throughout Digital Game-based Learning, the case of Moroccan Elementary Public

- Schools. *International Journal of Modern Education and Computer Science*, 13(5), 1–13. <https://doi.org/10.5815/ijmeecs.2021.05.01>
- Darnawati, Sutopo, H., Sahran, L. O., & Jamiludin. (2025). Exploring the Development of a Game-Based Education: History Learning for Elementary School Students. *International Journal of Digital Multimedia Broadcasting*, 2025(1). <https://doi.org/10.1155/ijdm/3600683>
- Facer, K., & Selwyn, N. (2021). Digital technology and the futures of education-towards “non-stupid” optimism. UNESCO. <https://unesdoc.unesco.org>
- Hong, J., Tai, T., & Liang, F. (2025). English vocabulary learning through gamification with Tic-Tac-Toe in Flippity-Connecto: The prediction of gameplay self-efficacy to anxiety, interest and flow experience. *British Journal of Educational Technology*, 56(6), 2387–2403. <https://doi.org/10.1111/bjet.13577>
- Hsieh, S., & Hwang, G. (2025). Concept Maps as a Content and Language Integrated Learning Facilitator in Digital Gaming Contexts: Triangulated Evidence From Students’ Learning Achievements, Perceptions and Behavioural Patterns. *Journal of Computer Assisted Learning*, 41(6). <https://doi.org/10.1111/jcal.70136>
- Kim, J. S., Kim, S. Y., Chung, S., Kim, S. M., & Han, D. H. (2025). Enhancing English Proficiency in Korean Schoolchildren with Problematic Behaviors: Efficacy of Digital Game-Based Learning. *Games for Health Journal*, 14(4), 295–304. <https://doi.org/10.1089/g4h.2024.0151>
- Koivisto, J., & Hamari, J. (2019). The rise of motivational information systems: A review of gamification research. *International Journal of Information Management*, 45, 191–210. <https://doi.org/10.1016/j.ijinfomgt.2018.10.013>
- Komalawardhana, N., Panjaburee, P., & Srisawasdi, N. (2021). A mobile game-based learning system with personalised conceptual level and mastery learning approach to promoting students’ learning perceptions and achievements. *International Journal of Mobile Learning and Organisation*, 15(1), 29. <https://doi.org/10.1504/IJMLO.2021.111596>
- Liao, C.-H. D., Wu, W.-C. V., Gunawan, V., & Chang, T.-C. (2024). Using an Augmented-Reality Game-Based Application to Enhance Language Learning and Motivation of Elementary School EFL Students: A Comparative Study in Rural and Urban Areas. *The Asia-Pacific Education Researcher*, 33(2), 307–319. <https://doi.org/10.1007/s40299-023-00729-x>
- Mar’atussolichah, M., Ibda, H., Al Hakim, M. F., Faizah, F., Aniqoh, A., & Mahsun, M. (2024). Benkangen game: Digital media in elementary school Indonesian language. *Journal of Education and Learning (EduLearn)*, 18(2), 480–488. <https://doi.org/10.11591/edulearn.v18i2.21091>
- Mayer, R. E. (2021). *Multimedia Learning*. Cambridge University Press.
- Mystakidis, S., Besharat, J., Papantzikos, G., Christopoulos, A., Stylios, C., Agorgianitis, S., & Tselentis, D. (2022). Design, Development, and Evaluation of a Virtual Reality Serious Game for School Fire Preparedness Training. *Education Sciences*, 12(4), 281. <https://doi.org/10.3390/educsci12040281>
- Plass, J. L., Homer, B. D., & Kinzer, C. K. (2015). Foundations of Game-Based Learning. *Educational Psychologist*, 50(4), 258–283. <https://doi.org/10.1080/00461520.2015.1122533>
- Rayan, B., & Watted, A. (2024). Enhancing Education in Elementary Schools through Gamified Learning: Exploring the Impact of Kahoot! on the Learning Process. *Education Sciences*, 14(3), 277. <https://doi.org/10.3390/educsci14030277>

- Ryan, R. M., & Deci, E. L. (2020). Intrinsic and extrinsic motivation from a self-determination theory perspective: Definitions, theory, practices, and future directions. *Contemporary Educational Psychology*, 61, 101860. <https://doi.org/10.1016/j.cedpsych.2020.101860>
- Sailer, M., & Homner, L. (2020). The Gamification of Learning: a Meta-analysis. *Educational Psychology Review*, 32(1), 77–112. <https://doi.org/10.1007/s10648-019-09498-w>
- Syawaluddin, A., & Aeni, N. (2025). Play and learn: digital traditional games for vocabulary mastery in young learners. *Discover Education*, 4(1), 103. <https://doi.org/10.1007/s44217-025-00485-8>
- Tsuei, M., & Lu, H.-C. (2025). Enhancing Children's Insurance-Related Knowledge and Learning Attitudes Through Digital Game-Based Learning. *International Journal of Serious Games*, 12(2), 77–90. <https://doi.org/10.17083/ijsg.v12i2.879>
- Vidergor, H. E. (2021). Effects of digital escape room on gameful experience, collaboration, and motivation of elementary school students. *Computers & Education*, 166, 104156. <https://doi.org/10.1016/j.compedu.2021.104156>
- Voogt, J., Knezek, G., Cox, M., Knezek, D., & Ten Brummelhuis, A. (2013). Under which conditions does ICT have a positive effect on teaching and learning? A Call to Action. *Journal of Computer Assisted Learning*, 29(1), 4–14. <https://doi.org/10.1111/j.1365-2729.2011.00453.x>
- Wu, P. H., Wu, W. T., & Ku, Y. J. (2025). A study on the integration of distanced simulated games with CLIL teaching method on elementary school students' English motivation, effectiveness, and altruistic behaviour. *International Journal of Mobile Learning and Organisation*, 19(4), 421–441. <https://doi.org/10.1504/IJMLO.2025.149023>
- Yang, J. C., & Kuo, W. (2022). A mobile game-based app to facilitate learners' motivation and achievement in learning Chinese reading activities: An individual differences perspective. *Journal of Computer Assisted Learning*, 38(5), 1448–1464. <https://doi.org/10.1111/jcal.12698>
- Yeh, Y., & Ting, Y. (2023). Comparisons of creativity performance and learning effects through digital game-based creativity learning between elementary school children in rural and urban areas. *British Journal of Educational Psychology*, 93(3), 790–805. <https://doi.org/10.1111/bjep.12594>
- Yu, Y.-T., & Tsuei, M. (2023). The effects of digital game-based learning on children's Chinese language learning, attention and self-efficacy. *Interactive Learning Environments*, 31(10), 6113–6132. <https://doi.org/10.1080/10494820.2022.2028855>
- Ženatý, E., Dosedla, M., Picka, K., & Šťastná, J. (2024). Didactic Game Based on the Unreal Engine and the Effectiveness of its Implementation in Mathematics Education. *TEM Journal*, 3092–3102. <https://doi.org/10.18421/TEM134-44>.