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Advancing learning through gamification in primary schools: a systematic literature review

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Abstrak

Gamifikasi berkontribusi positif terhadap peningkatan motivasi belajar, prestasi akademik, dan pengembangan keterampilan abad ke-21. Namun, literatur yang ada cenderung terfragmentasi berdasarkan disiplin ilmu, jenis permainan, atau aspek spesifik dari hasil pembelajaran. Penelitian ini bertujuan untuk secara sistematis mengkaji penerapan gamifikasi dalam pembelajaran di sekolah dasar dan dampaknya terhadap motivasi belajar, prestasi akademik, dan pengembangan keterampilan siswa. Melalui pendekatan Tinjauan Literatur Sistematis, artikel ini menganalisis 15 artikel penelitian empiris terpilih yang diperoleh dari database Scopus dan ScienceDirect. Hasil analisis menunjukkan bahwa gamifikasi, baik dalam bentuk digital maupun fisik, secara konsisten meningkatkan motivasi, hasil belajar, serta keterampilan sosial, motorik, dan kognitif siswa sekolah dasar. Faktor-faktor pendukung keberhasilan termasuk kesiapan guru, antusiasme siswa, dan ketersediaan infrastruktur, sedangkan hambatan utama termasuk keterbatasan teknologi, waktu, dan pelatihan. Studi ini juga menemukan bahwa gamifikasi memiliki potensi tinggi untuk diintegrasikan secara strategis ke dalam kurikulum sekolah dasar. Dengan demikian, gamifikasi dapat menjadi pendekatan pedagogis yang relevan, adaptif, dan transformatif dalam pendidikan dasar abad ke-21.

Kata Kunci: gamifikasi, sekolah dasar, pembelajaran, hasil belajar, kurikulum

Abstract

Gamification contributes positively to increased learning motivation, academic achievement, and 21st century skill development. However, the existing literature tends to be fragmented based on disciplines, types of games, or specific aspects of learning outcomes. This study aims to systematically examine the application of gamification in learning in elementary schools and its impact on students' learning motivation, academic achievement, and skill development. Through the Systematic Literature Review approach, this article analyzes 15 selected empirical research articles obtained from the Scopus and ScienceDirect databases. The results of the analysis show that gamification, both in digital and physical form, consistently improves the motivation, learning outcomes, as well as social, motor, and cognitive skills of elementary school students. Factors supporting success include teacher readiness, student enthusiasm, and infrastructure availability, while key barriers include technology limitations, time, and training. The study also found that gamification has high potential to be strategically integrated into the primary school curriculum. Thus, gamification can be a relevant, adaptive, and transformative pedagogical approach in 21st-century primary education.

***Keywords**: gamification, elementary school, learning, outcomes, curriculum*

Introduction

In recent years, primary education has faced increasingly complex demands to not only improve students' academic achievement (Panagouli et al., 2021), but also foster their motivation and active involvement in the learning process (Jia & Tu, 2024; Vidergor, 2021). Traditional learning approaches that are one-way and teacher-centered are considered less effective in answering the needs of the 21st century generation of students who are growing up in an interactive and dynamic digital environment (Ong & Annamalai, 2024). In response to this condition, gamification—the application of game elements in a non-game context—has emerged as a promising pedagogical approach (Saleem et al., 2022). In the context of basic education, gamification aims to transform learning activities into more interesting, meaningful, and student-centered (Čubela et al., 2023).

Various studies have shown that gamification contributes positively to increased learning motivation, academic achievement, as well as the development of 21st-century skills (Mårell-Olsson, 2021) such as problem-solving, collaboration, and critical thinking (Kassenkhan et al., 2025; Samala et al., 2023). At the elementary school level, gamification has been implemented in various forms, both digitally (e.g. Kahoot! (Rayan & Watted, 2024), Scratch-based games, and artificial intelligence-based role-playing), and non-digital (such as board games, manipulative games (Dewi & Verawati, 2022), and local traditional games such as *engklek* (Kamid et al., 2021)). These strategies are generally associated with subjects such as natural sciences, mathematics, and physical education (Dewi & Verawati, 2022; Ramli et al., 2022; Rayan & Watted, 2024), and are designed to support the achievement of students' cognitive, social, and emotional competencies.

However, despite the growing interest in gamification, comprehensive and systematic studies of its specific application in primary education are still limited. The existing literature tends to be fragmented based on disciplines, types of games, or certain aspects of learning outcomes. It is still rare to find studies that comprehensively bridge the impact of gamification on motivation (Lin et al., 2023), academic achievement (Bozan & Taslidere, 2025), and skill development of elementary school students (Dewi & Verawati, 2022). In addition, the factors that support and hinder the implementation of gamification in educational practice have not been analyzed in a structured manner. Finally, the question of how gamification can be meaningfully integrated into the elementary school curriculum, rather than just as an additional activity, is still a gap that has not been explored in previous research.

Based on this background, this study aims to conduct a systematic literature review on empirical studies on the application of gamification in primary education. Specifically, this study will answer the following three research questions:

RQ1: How does gamification affect students' motivation to learn, academic achievement, and skill development in elementary school?
RQ2: What factors support or hinder the implementation of gamification in elementary school learning?
RQ3: How can gamification be meaningfully integrated into the elementary school curriculum?

Through this study, it is hoped that a complete and comprehensive understanding of the practice, effectiveness, and challenges of gamification implementation in the context of basic education will be obtained. The results of this study are also aimed at providing conceptual and practical contributions for teachers, curriculum developers, and policy makers in adopting gamification as an innovative and sustainable learning strategy.

Method

Literature Search

The literature search in this study was carried out systematically using two main databases, namely Scopus and ScienceDirect, during June 2025. The search strategy was designed to identify articles that discuss the application of gamification in science learning at the elementary school level, using a combination of keywords: ("elementary school" OR "primary school") AND (science learning OR "science" OR "natural science") AND (gamification OR game OR gaming"). These terms are searched in the title, abstract, and/or keyword section of the publication. The initial search results resulted in a total of 600 potentially relevant scientific articles for further analysis at the selection stage based on inclusion and exclusion criteria.

Study Selection Criteria

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The study selection process is carried out through several stages of screening based on the inclusion and exclusion criteria that have been set. The inclusion criteria include: (1) articles published in the period 2016 to 2025; (2) the article is the result of empirical research (not editorial, review, or opinion); (3) articles are included in the field of social sciences in accordance with the classification of databases; (4) the article is written in English; and (5) the article is available in open access for full analysis. After the screening process of the initial 600 articles based on these criteria, 35 articles were obtained that met all the requirements. Furthermore, a thorough reading and review of the 35 articles was carried out. Based on the content analysis, 15 main articles were selected that explicitly or implicitly discuss gamification in the context of learning in elementary schools. A total of 20 other articles were excluded because they did not meet thematic criteria, such as: not explicitly or implicitly discussing gamification; not intended for primary school contexts; not focusing on the student learning process; or mention gamification but not as the main approach in learning design.

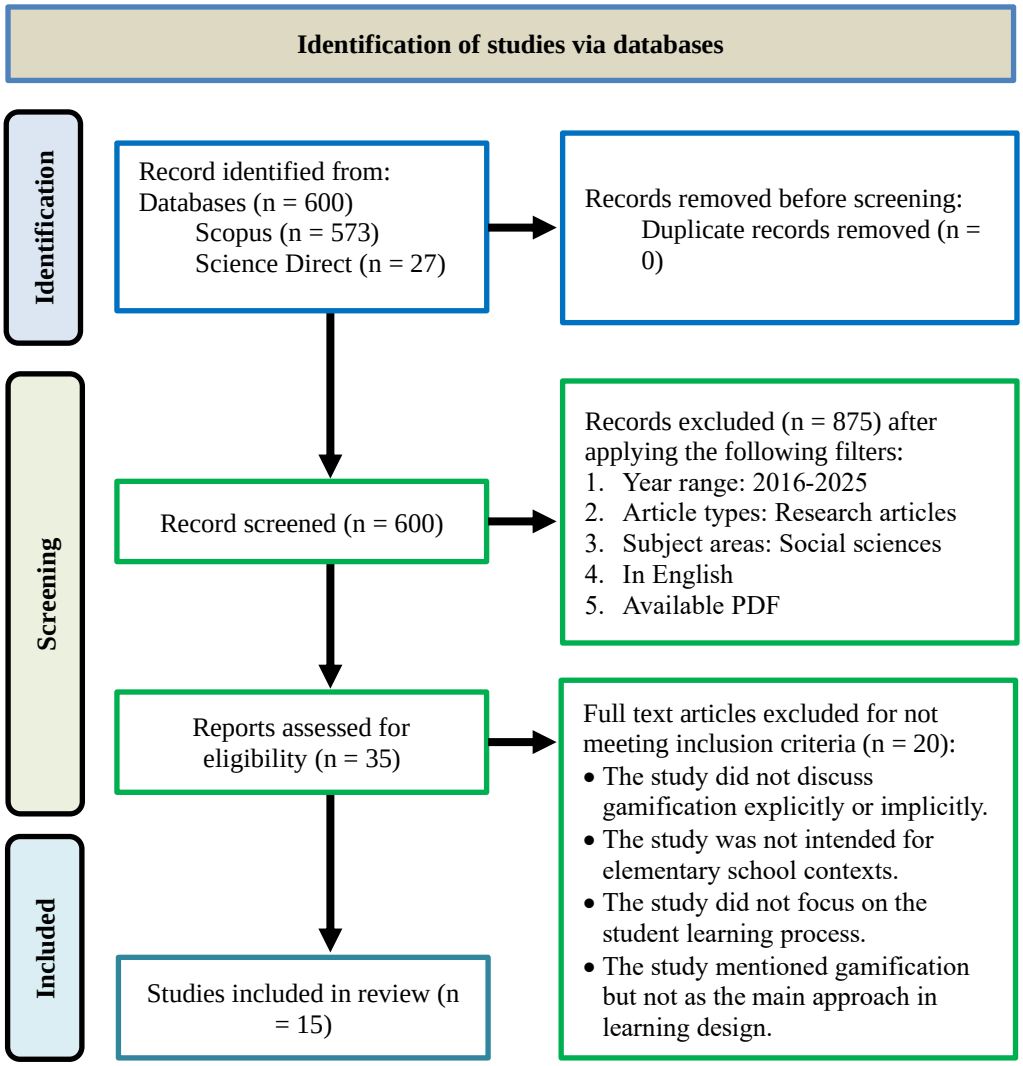

Figure 1. The inclusion and exclusion processes of primary studies

Quality Assessment

Standard quality assessment criteria (Kmet et al., 2004) were used to assess the 15 selected articles. Of the 14 quality indicators, the author uses only 5 indicators which include assessment of question/objective, study design, subject characteristics, results, and conclusions. The article quality assessment process is carried out using a three-level scoring system, where a score of 2 is given if the information or data is

presented in full, a score of 1 if the information is only partially available, and a score of 0 if the information is not available at all or does not meet the set criteria. This assessment is carried out independently by two authors, and the score results of each assessor are summed up, then the percentage is calculated against the maximum total score. To determine the feasibility of the article, a threshold value of 55% was used, which was set as a relatively liberal cut-off point to remain inclusive of various types of studies. Based on calculations made using Microsoft Excel, the quality value of articles that passed the selection ranged from 70% to 100%, with an overall average value of 88.33%, which indicates that the articles have adequate methodological quality for further analysis.

Coding Study Characteristics

Studies that have been declared eligible are coded by title, author, year, research objective, research method, type of gamification, research subject and main results (see Table 1). In general, the research objectives in these articles focus on evaluating the effectiveness of gamification in improving learning motivation, concept understanding, academic outcomes, and students' skills. Some studies also highlight aspects of 21st century skill development, such as collaboration, critical thinking, and problem-solving. In terms of research methods, most articles use experimental or quasi-experimental quantitative approaches, with a pretest-posttest design and control groups. Several other articles use qualitative or mixed methods approaches to gain a deeper understanding of students' processes and experiences during gamification-based learning.

Based on the type of gamification, three main categories were found: (1) digital gamification, such as the use of Kahoot!, coding games, and interactive video games; (2) physical/non-digital, such as traditional games, educational board games, and manipulative games; and (3) a combination of the two. This shows that gamification in the context of elementary schools is not limited to digital platforms but also makes use of local resources and contextual physical play. The research subjects are generally elementary school students in grades 3 to 6, with an age range of 7–12 years. Some studies have also specifically targeted gifted students or students with multicultural backgrounds.

In terms of main outcomes, the majority of articles show that gamification has a positive impact on increasing learning motivation, academic achievement, and the development of students' social, motor, and cognitive skills. These results are consistent in both digital and physical gamification. Some studies have even noted significant improvements in aspects of critical thinking and problem-solving skills when students engage in digital game design or project-based coding.

Data Analysis

The author manually analyzed and synthesized 15 articles using the thematic analysis method (Nowell et al., 2017). Themes are determined based on research questions. Based on RQ1, the theme set is the influence of gamification on learning motivation, academic achievement, and skill development of students in elementary school. Based on RQ2, the theme covers factors that support or hinder the implementation of gamification in learning in primary schools. Furthermore, based on RQ3, the theme set is the meaningful integration of gamification into the elementary school curriculum.

Results

Impact of Gamification

Overall, research shows that gamification has a significant impact on increasing the motivation of elementary school students (see Table 2). For example, research on the game Chemical Battleship and the use of digital platforms such as Kahoot! significantly increases students' interest in learning materials. In particular, the use of ICT-based digital gamification has also been proven to be able to create a fun and challenging learning atmosphere so that students are more motivated. Meanwhile, traditional games such as engklek (Engklek Game) show that social interaction in physical games also has a positive impact on student motivation.

Most of the articles indicate that the implementation of gamification positively affects students' academic achievement. In science learning, for example, board and didactic games have been proven to be able to significantly improve student learning outcomes. The effectiveness of digital games is also proven in increasing mathematical achievement and understanding of bioengineering concepts through interactive videogames. In addition, the integration of 5E learning models enriched with

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coding and digital game design specifically enhances the academic abilities of talented students.

Table 1. Characteristics of Selected Studies

No	Article Title (Author, Year)	Research Objectives	Research Methods	Types of Gamification	Research Subject
1	Chemical Battleship: Discovering and Learning the Periodic Table Playing a Didactic and Strategic Board Game (Montejo Bernardo & Fernández González, 2021)	Examining the effectiveness of board games in helping students understand periodic tables and basic chemistry concepts.	Quasi-experimental studies, pretest-posttest	Physical (Board game)	Elementary school students aged 8–11 years old
2	Development of Natural Science through the Gamification and ICT in Primary Education (Bilbao-Aiastu & Miranda-Urquij, 2022)	Examining the impact of ICT-based gamification integration in science learning.	Quasi-experimental studies	Digital (ICT-based games)	Elementary school students aged 9–12 years old
3	Digital Game-based Learning and Learning Analytics in Mathematics (Ramli et al., 2022)	Testing the impact of digital games on the mathematics achievement of elementary school students.	Experiment, mixed method	Digital (Videogame)	Elementary students in grades 4–6
4	Effect of the 5E model enriched with coding and digital game design activities on gifted students' academic achievement and problem-solving skills (Bozan & Taslidere, 2025)	Testing the effectiveness of a combination of 5E models, coding, and digital game design on the academic achievement and problem-solving abilities of gifted students.	Experiments with control groups	Digital (Coding & Game Design)	Gifted students in grades 4–6
5	Effects of Game-Based Instruction on the Results of Primary School Children Taking a Natural Science Course (Chen et al., 2019)	Examining the impact of game-based instruction on student achievement in science subjects.	Experiment (pretest-posttest control group)	Blended (Digital-physical combination)	Elementary students in grades 3–5
6	Engklek Game in Mathematics: How difference and relationship student attitude towards science process skills? (Kamid et al., 2021)	Measuring the impact of traditional engklek games on students' attitudes in science process skills in mathematics.	Quasi-experimental studies	Physical (Traditional Game)	Grades 4–5 elementary school
7	Enhancing Children's Interest and Knowledge in Bioengineering through an Interactive Videogame (Strawhacker et al., 2018)	Testing the effectiveness of interactive videogames to increase students' interest and knowledge in bioengineering.	Experiment (pretest-posttest)	Digital (Interactive videogame)	Grades 4–6 Elementary School
8	Enhancing Education in Elementary Schools through Gamified Learning: Exploring the Impact of Kahoot! (Rayan & Watted, 2024)	Examining the impact of using the Kahoot! in science learning in elementary school.	Experiment, survey	Digital (Gamified learning platform)	Elementary students in grades 3–6
9	Evaluating the Effectiveness of Gaming Practices in Enhancing Computer Science Terminology Learning among	Examining the effectiveness of game-based learning in improving students'	Experiment	Digital (Game-based learning apps)	Grades 4–6 Elementary School

	Primary School Students (Alipova et al., 2024)	computer terminology mastery.			
10	Machine learning role-playing game: Instructional design of AI education for age-appropriate in K-12 (Kajiwara et al., 2023)	Developing machine learning-based role-playing games for AI education in K-12.	Development design experiments	Digital (Role-playing game)	Elementary & Junior High School Students (K-12)
11	The Educational Effectiveness of Didactical Games in Project-based Science Learning among 5th Grade Students (Hugerat et al., 2020)	Measuring the effectiveness of didactic games in improving student learning outcomes in project-based science learning.	Experiments with control groups	Physical (Didactic games)	Grade 5 elementary school students
12	The Effect of Manipulative Games to Improve Fundamental Motor Skills in Elementary School Students (Dewi & Verawati, 2022)	Examining the impact of manipulative games on basic motor skills of elementary school students.	Experiments (one-group pretest-posttest)	Physical (Manipulative games)	Elementary school students aged 7–10 years old
13	Aesthetic Experience and Imagination in Early Elementary School Science – a growth of 'Science–Art–Language–Game' (Caiman & Jakobson, 2022)	Investigating the integration of art, language, and games in science learning in early elementary grades.	Qualitative case studies	Physical & imaginative (Art-based & Game-based learning)	Grade 1-2 lementary school students
14	A Study on the Influence of Recreational Activities Intervening in Natural Science Courses on Learning Motivation and Learning Outcomes—The Case of Tabletop Games (Lin et al., 2023)	Examining the effect of tabletop games on students' learning motivation in science lessons.	Quasi-experimental studies	Physical (Tabletop games)	Grade 5 elementary school students
15	Playground as Meaning-Making Space: Multimodal making and re-making of meaning in the (virtual) playground (Potter & Cowan, 2020)	Examining the role of playgrounds (physical and virtual) in the formation of social meaning in elementary school students.	Qualitative case studies	Blended (Physical & virtual playground)	Elementary students in grades 3–5

The implementation of gamification also contributes to the improvement of various student skills, both motor skills, problem solving, critical thinking, and social and emotional skills. Manipulative games such as in the Manipulative Games study are very effective in improving students' motor skills. In addition, research involving coding-based digital game design (5E Model & Digital Game Design) has been shown to be effective in improving critical thinking and problem-solving skills. Socially and emotionally, group-based games such as Machine Learning Role-Playing Games also show increased interaction and collaboration between students.

Table 2. The Impact of Gamification

Theme Synthesis	Key Results
The Impact of Gamification on Students' Learning Motivation	– Significantly increase student motivation and engagement – Foster students' interest in learning materials – Make the learning process fun and interactive (Bilbao-Aiastu & Miranda-Urquij, 2022; Kamid et al., 2021; Lin et al., 2023; Montejo Bernardo & Fernández González, 2021; Ramli et al., 2022; Rayan & Watted, 2024; Strawhacker et al., 2018)
The Influence of Gamification on	– Improve students' understanding and academic achievement in science, mathematics, bioengineering, and basic computer concepts (coding)

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Academic Achievement	– Effective in improving the problem-solving and critical thinking skills of gifted students (Alipova et al., 2024; Bozan & Taslidere, 2025; Chen et al., 2019; Hugerat et al., 2020; Montejo Bernardo & Fernández González, 2021; Ramli et al., 2022; Strawhacker et al., 2018)
Gamification in Student Skill Development	– Effectively develop students' basic motor skills through physical activity – Improve social skills and collaboration through interaction in group play – Improve critical thinking, problem-solving, and creativity skills through digital game design and coding (Bilbao-Aiastu & Miranda-Urquij, 2022; Bozan & Taslidere, 2025; Dewi & Verawati, 2022; Hugerat et al., 2020; Kajiwara et al., 2023; Potter & Cowan, 2020)

The results of the study show that digital and physical gamification each have their own advantages. Digital gamification (e.g. with Kahoot! and interactive videogames) tends to be effective in increasing individual student engagement as well as enabling the use of learning analytics to monitor student achievement in real-time (Digital Game-based Learning). Meanwhile, physical gamification such as board games and manipulatives is very effective in creating a socially and physically interactive learning environment, thus helping students to understand abstract concepts through real activities (Chemical Battleship, Manipulative Games, Didactical Games). Research on tabletop games also confirms the effectiveness of physical games in increasing motivation and learning outcomes simultaneously (Tabletop Games).

Supporting and Inhibiting Factors

Some of the main supporting factors in the implementation of gamification include teacher competence, school support, and the availability of adequate technology. For example, research on ICT-based learning and Kahoot! emphasizing the importance of the availability of technology and adequate training for teachers to achieve maximum results. However, there are also significant inhibiting factors such as limited time in integrating gamification into the existing curriculum, as well as the lack of readiness of teachers in managing digital technology (Digital Game-based Learning, Kahoot!). This obstacle shows the need for continuous teacher training so that the implementation of gamification can run effectively in the classroom.

Table 3. Supporting and Inhibiting Factors

Category	Supporting Factors	Inhibiting Factors
Teacher	- Competence and readiness of teachers in the use of technology and coding - Teachers who have an interest in innovative methods (Bilbao-Aiastu & Miranda-Urquij, 2022; Bozan & Taslidere, 2025; Chen et al., 2019)	- Lack of specific training for teachers in the use of new technologies - The complexity of learning content involving high technology (Bilbao-Aiastu & Miranda-Urquij, 2022; Bozan & Taslidere, 2025; Kajiwara et al., 2023)
Student	- High student motivation and enthusiasm for game-based learning - Social interaction between students in game activities (Chen et al., 2019; Hugerat et al., 2020; Lin et al., 2023; Montejo Bernardo & Fernández González, 2021)	- Difficulty in managing class dynamics during the implementation of interactive games (Lin et al., 2023; Montejo Bernardo & Fernández González, 2021)
Technology	- Adequate technology support (device and internet connection) - Ease of access to digital applications/platforms (e.g. Kahoot!) (Bilbao-Aiastu & Miranda-Urquij, 2022; Rayan & Watted, 2024; Strawhacker et al., 2018)	- Limitations of technological devices (computers, tablets, internet) - Technical challenges and internet connection disruptions (Alipova et al., 2024; Ramli et al., 2022; Rayan & Watted, 2024; Strawhacker et al., 2018)

Time	- Flexibility of implementation that can be adapted to regular lesson schedules (such as simple traditional games) (Dewi & Verawati, 2022; Kamid et al., 2021)	- Limited time for gamification preparation and implementation - Integration challenges with already hectic learning schedules (Chen et al., 2019; Montejo Bernardo & Fernández González, 2021)
Facilities and Environment	- The existence of a learning environment that supports physical and interactive activities (classrooms, open areas) - Availability of physical game support tools (Dewi & Verawati, 2022; Hugerat et al., 2020; Potter & Cowan, 2020)	- Need for adequate space or special facilities for physical play - Preparation of physical tools that is quite time-consuming (Dewi & Verawati, 2022; Kamid et al., 2021; Potter & Cowan, 2020)

The Potential for Gamification Integration with Existing Curriculum

The articles analyzed show that gamification can be effectively integrated into existing curricula, both in science learning, mathematics, and other subjects such as bioengineering and computer science. Research on Didactical Games in Project-based Science confirms that gamification is well suited for integration in project-based learning because it simultaneously improves student motivation and learning outcomes. This approach also supports the achievement of curriculum learning objectives effectively and efficiently.

Table 4. The Potential of Gamification Integration into the Curriculum

Types of Gamification	Examples of Strategies or Activities	Subjects	Potential Integration into the Curriculum
Fisik (Board Game/ Tabletop) (Hugerat et al., 2020; Lin et al., 2023; Montejo Bernardo & Fernández González, 2021)	Games like Chemical Battleship to understand the periodic table or water cycle	Natural Sciences	It is well integrated in basic competencies related to the classification of materials, energy, and ecosystems.
Digital (Game-based Apps) (Rayan & Watted, 2024; Strawhacker et al., 2018)	Kahoot!, interactive quizzes, or science video games	Natural Sciences	It can be used as a formative and remedial evaluation tool in understanding the concepts of energy, force, and living beings.
Physical (Traditional Game) (Kamid et al., 2021)	*Engklek* for strengthening the concept of patterns, numbers, or coordinates	Mathematics	Supporting thematic and numeracy learning in contextual and local cultural approaches.
Digital (Videogame + Analytics) (Ramli et al., 2022)	Interactive games for practice questions and performance tracking	Mathematics	Suitable as enrichment or remedial based on numeracy competence.
Digital (Coding & Game Design) (Bozan & Taslidere, 2025; Kajiwara et al., 2023)	Scratch, micro:bit, AI-based role-playing	Information Technology/ Introduction to Informatics	Can be integrated into local content or ICT/coding introduction curriculum.
Physical (Manipulative Game) (Dewi & Verawati, 2022)	Catch, kick, throw ball games to develop motor skills	Physical Education	In line with the basic competency standards of basic movement and motor coordination.
Physical and Digital (Collaborative) (Hugerat et al., 2020; Potter & Cowan, 2020)	Group games that practice cooperation, responsibility, and honesty	Character Education	It can be integrated in the Pancasila Student profile strengthening project.
Physical-Digital Combination (Caiman & Jakobson, 2022; Tsai, 2023)	Science project games with character, story, and mission designs (e.g. creating energy sensors)	Integrative Thematic (Multidisciplinary Approach)	It is suitable for project-based learning and STEAM.

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Discussion

The application of gamification in elementary school learning shows a significant contribution to improving the quality of the teaching and learning process. Based on the results of the synthesis of 15 selected articles, gamification has been proven to be able to increase learning motivation, academic achievement, and the development of various student skills. In terms of motivation, digital games such as Kahoot!, interactive videogames, and traditional games such as *engklek*, have proven to be effective in creating a fun, interactive learning atmosphere, and encouraging active student participation. The learning environment colored by game elements has been proven to foster enthusiasm for learning and strengthen student involvement in the material taught (Rojabi et al., 2022).

In addition, gamification also has a positive impact on students' academic achievement in various subjects such as Natural Sciences, mathematics, and bioengineering. The use of games such as Chemical Battleship, didactical games, and digital-based game-based learning significantly improves students' conceptual understanding, memory, and academic achievement. In fact, in the context of gifted students, the combination of the 5E learning model with coding and game design activities showed a significant improvement in critical thinking skills and problem-solving skills (Rienovita et al., 2024). In addition, gamification also supports the development of non-academic skills (Liu et al., 2023), such as motor skills through manipulative games, as well as social and collaborative skills through team-based games and physical activities that involve interaction between students.

However, the success of gamification implementation is inseparable from various supporting and inhibiting factors. In terms of support, teachers' readiness and competence in applying technology and innovative methods are key aspects that determine the effectiveness of gamification (Mariana Lolowang et al., 2025). Students' enthusiasm for game-based learning also encourages the creation of a conducive learning atmosphere (Nadeem et al., 2023). In addition, the availability of technological infrastructure such as computer devices, internet connections, and flexible learning spaces greatly supports the implementation of gamification, both in digital and physical form. On the other hand, there are several challenges that can hinder the success of gamification. Among them are the limitations of teacher training in the use of learning technology, the limited technology devices in some schools, and the limited learning time that makes it difficult to integrate game activities in the dense curriculum. In addition, some forms of non-digital gamification also require physical space and props that are not always available in schools (Lampropoulos et al., 2022).

The results of the synthesis also show that gamification has high potential to be integrated directly into the primary school curriculum, not just as an additional activity, but as part of a learning strategy that supports the achievement of basic competencies (Lamrani & Abdelwahed, 2020). Based on the analysis of the subjects and the form of gamification used, it was found that this approach can be widely applied in various fields of study, such as Natural Sciences, Mathematics, Information Technology, Physical Education, and Character Education. In science learning, both physical games such as Chemical Battleship and tabletop games, as well as digital games such as Kahoot! and interactive videogames, which can be used to teach abstract concepts such as energy systems, classification of matter, and the natural cycle. Gamification allows students to actively build understanding through concrete and interactive learning experiences, in line with the project-based learning and problem-based learning approaches (Huang et al., 2023). In the subject of Mathematics, traditional games have been proven to be able to strengthen students' understanding of the concepts of numbers, patterns, and coordinates through a contextual approach that is in accordance with the local culture. Meanwhile, analytics-based digital games can be used to enrich numeracy learning while monitoring student learning performance in real-time. Both approaches have the potential to support the implementation of differentiated learning, especially for students with diverse learning needs (Estaiteyeh & and DeCoito, 2024; Trinter et al., 2015).

Gamification is also very relevant to be integrated in Information Technology subjects or introduction to informatics, especially through Scratch and micro:bit-based coding activities that

encourage students to design their own educational games (Bozan & Taslidere, 2025). This approach not only improves students' computing skills, but also strengthens critical thinking, logic, and creativity skills, all of which are part of core competencies in 21st-century education. In addition, physical gamification such as manipulative games and group games in the playground also supports the Physical Education curriculum and strengthens students' character. Through gamifying physical activities, students learn cooperation, sportsmanship, self-control, and responsibility. This aspect is in line with strengthening the values in the Pancasila Student Profile and project-based learning in the integrative thematic curriculum.

Thus, the integration of gamification into the elementary curriculum is very possible to be done strategically and flexibly (Grabner-Hagen & Kingsley, 2023). The compatibility between the characteristics of the game and the learning objectives is key in determining the effectiveness of this integration. In addition to supporting academic competency achievement, gamification also serves as a bridge between cognitive, affective, and psychomotor learning, making it a comprehensive approach to basic learning (Hui & Mahmud, 2023). Therefore, policy development and learning planning should consider gamification as one of the integral components in curriculum design and future learning strategies.

Taking these findings into account, it can be concluded that gamification has great potential to be strategically integrated into primary school curricula. However, for its implementation to run optimally, a systematic approach is needed, such as continuous teacher training, flexible learning planning, and the provision of supporting facilities. Blended gamification strategies, which are a combination of physical and digital games, can also be an effective alternative, especially in schools that have limitations in technology infrastructure. Ultimately, gamification is not only a fun learning method, but also an important means of shaping active, creative, and critically thinking students in the face of the challenges of 21st century education.

Conclusion

This systematic literature review provides a comprehensive overview of the application of gamification in primary school education, highlighting its impact on the learning process, challenges faced, and its potential integration into the curriculum. Based on an analysis of 15 selected empirical research articles, gamification—whether in digital, physical, or a combination of both—has consistently shown a positive impact on students' learning motivation, academic achievement, and skill development. The play-based learning approach not only increases student engagement, but also supports cognitive development, critical thinking skills, social interaction, and motor skills of elementary school-age children.

The study also identified several important supporting factors in the implementation of gamification, such as teacher readiness, student enthusiasm, availability of technological infrastructure, and a supportive learning environment. On the other hand, there are several challenges that still need to be overcome, including limited access to digital devices, lack of teacher training in educational technology, limited time in lesson schedules, and the need for space and supporting tools. Nonetheless, the potential for integrating gamification into the curriculum is enormous, especially when aligned with project-based learning, 21st century skills reinforcement, and differentiated learning approaches.

Thus, gamification is not just an alternative instructional approach, but a valuable pedagogical strategy in enriching the learning experience of elementary school students (Ruiz-Bañuls et al., 2021). For effective and sustainable implementation, strategic planning, infrastructure support, and teacher capacity building are needed (Oliveira et al., 2021). Advanced research is strongly encouraged to explore the long-term impacts of gamification, its application in various cultural contexts, as well as broadly adaptable integration models in formal education systems (Moseikina et al., 2022).

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