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# Gamification-Based Science Learning with a Deep Learning Approach in Elementary Schools

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**Abstract:** Elementary school education often faces the challenge of low student engagement, motivation, and enthusiasm due to monotonous teaching methods. This article aims to examine the role and integration of gamification and deep learning approaches in elementary school education. The study employs a qualitative approach through a literature review of 25 journals (2017–2026). The findings indicate that the combination of gamification and deep learning has a significant positive impact on the learning process. Gamification enhances students' intrinsic motivation and engagement through points, levels, badges, and leaderboards; deep learning fosters contextual understanding, enabling students to connect new knowledge with real-world experiences and develop critical thinking skills. Digital media (Kahoot!, Quiziz, PowerPoint, educational videos) support the integration of both in the classroom [SHORT: the list of media is condensed into a short phrase]. The studies reviewed show that 85% of students are ready for digital learning, 86% accept gamification, and 97% want meaningful and reflective learning. However, implementation faces challenges: limited teacher competencies in designing innovative digital media, as well as uneven distribution of facilities and infrastructure. Practical recommendations: enhanced teacher training, quasi-experimental research to measure the impact on Higher-Order Thinking Skills (HOTS) and long-term retention, and investment in digital infrastructure for equitable access in elementary schools.

**Keywords:** Gamification, Deep Learning, Elementary School, Learning Motivation, Digital Media

## Introduction

Education is not simply the transfer of knowledge from teacher to student, but a journey to shape the whole person. Education can be a space where intellect, character, and skills grow (Rusmanto & Hanif, 2024). Education can also serve as a bridge between knowledge and real life, so that students not only "know" but also "can" apply the education provided. This education ranges from non-formal to formal education. Elementary school education is a form of formal education where children begin to be trained to understand basic scientific concepts, moral values, and social skills, which will be essential for subsequent levels of education.

Elementary school education is crucial because it is during this period that children begin to develop their intellectual abilities, character, and skills. During the learning process, teachers are not only required to deliver material but also to create learning experiences that encourage active student engagement. However, in reality, learning in elementary schools tends to use methods that focus solely on memorization and teacher explanations. This situation can impact student learning, such as a lack of interest in the learning process, impacting student engagement, and making it difficult to understand the material properly. Research on game-based solutions in education has grown rapidly in recent years. This indicates that gamification enhances student engagement, motivation, and learning outcomes through digital learning approaches. Gamification is a valuable approach that incorporates game elements into non-game contexts to boost engagement, motivation, and behavioral changes among users during the learning process. The integration of gamification with smart learning technologies also enables the creation of more personalized and adaptive learning experiences (Swacha, 2021; Khakpour & Colomo-Palacios, 2021).

Gamification, the application of game elements in non-game areas, for example, in education, has been proven to create a more engaging, enjoyable, and interactive learning environment. This allows students to become active and participate in the learning process, which can increase their motivation (Riatmaja et al., 2025). In line with this, educational innovation in elementary schools is also beginning to be directed towards the implementation of modern approaches such as deep learning, which emphasizes meaningful, conscious, and enjoyable learning.

Deep learning in modern education today is not limited to artificial intelligence (AI) technology but encompasses deeper learning techniques to understand and then apply knowledge. The integration of artificial intelligence and gamification allows learning systems to tailor challenges, feedback, and learning activities to each student's individual characteristics, thereby enhancing the effectiveness of learning (Swacha & Gracel 2023). Deep learning goes beyond rote learning but refers to learning that encourages students to delve deeper into a subject. In deep learning, students are encouraged to understand the context, critically analyze information, and create innovative solutions based on a strong conceptual understanding. Therefore, this deep learning approach is oriented towards active, collaborative, and sustainable learning (Santiani, 2025). According to Fatmawati (2025), deep learning in the context of 21st-century education is an approach that focuses on in-depth conceptual understanding, such as the application of knowledge in real-world contexts and higher-order thinking skills. This approach aims to prepare students to have relevant skills in facing complex and dynamic global challenges. Using digital technology facilitates this approach to increase student engagement in the learning process and utilizes existing infant practices. Developing adaptive thinking skills through deep learning is key to facing an uncertain future and is an important provision for the younger generation.

Given these conditions, engaging learning is necessary and actively engages students. One method that can be used is gamification. Based on research by Riatmaja et al. (2025), the application of gamification to the learning process has a significant impact on

increasing student learning motivation. However, a critical research gap remains unaddressed in elementary school education literature. While existing studies focus heavily on general student motivation (Purba et al., 2024; Riatmaja et al., 2025) or identify baseline factors causing low motivation in specific subjects (Rambe & Nukman, 2025), there is an urgent lack of a comprehensive pedagogical framework that integrates gamified tools directly with structured Deep Learning approaches to overcome the widespread limitations of conventional lecture methods (Melianti et al., 2023). Current gamification practices often operate superficially, focusing on superficial game points rather than scaffolding deep cognitive engagement. Previous research has predominantly been descriptive in nature or has employed cross-sectional survey designs without testing the effectiveness of specific gamification mechanisms (e.g., tiered missions, formative feedback, and progress tracking) that can be combined with deep learning phases for elementary school students (for example, in grades 4–6) within the context of public or urban schools in Indonesia. Consequently, there has been no experimental or quasi-experimental research on enhancing higher-order thinking skills (HOTS), fostering sustained motivation, and developing social-emotional skills through the pedagogical application of gamification compared to conventional teaching methods.

To fill this gap, the novelty of this study lies in establishing a conceptual and empirical synthesis that bridges digital gamification frameworks (such as Wordwall or E-LKPD) (Aini et al., 2025; Rahmasari, 2025) with technology-supported Deep Learning principles tailored specifically to the unique cognitive and socio-emotional needs of elementary school students (Lampropoulos et al., 2026; Wijaya et al., 2026). By anchoring gamified mechanics into the three core pillars of Deep Learning *meaningful, mindful, and joyful learning* (Adnyana, 2024; Santiani, 2025) this research demonstrates a scalable pathway to satisfy learners' psychological needs for autonomy and mastery, thereby driving higher-order thinking skills (HOTS) and sustained academic motivation (Gyedu et al., 2026).

## Method

This article was written using a qualitative approach with a literature review method employing a qualitative-descriptive approach, focusing on the analysis of learning strategies to enhance student creativity (Harjun et al., 2026). The selection of this method is based on the research objective, which focuses on building an in-depth conceptual synthesis based on findings from various existing studies, rather than on direct data collection in the field. A literature review itself is a form of research that emphasizes the systematic process of identifying, evaluating, and synthesizing relevant scientific literature to address the research problem that has been formulated (Pragholapati et al., 2024). This method was also deemed the most appropriate to address the gap identified in the introduction, namely the lack of a pedagogical framework that comprehensively integrates gamification mechanisms with the principles of deep learning in a structured manner within the context of elementary education in Indonesia.

The data sources for this study were obtained through a systematic literature review of academic databases, primarily Google Scholar, supplemented by several other reputable

journal databases. This research used 25 journals published over a 10-year period (2017-2026). The search process utilized a combination of keywords that were carefully selected to identify studies relevant to the focus of this research. The keywords used included: "gamification in learning," "deep learning in elementary school," "gamification and higher-order thinking skills (HOTS)," "student learning motivation," "digital media in elementary school learning," and "integration of gamification and deep learning." The selection of these keyword combinations was deliberate to ensure that the search yielded not only studies discussing the superficial application of gamification, but also studies that link game elements to deeper learning outcomes, both cognitively and socio-emotionally, in line with the conceptual framework of meaningful, mindful, and joyful learning outlined in the introduction.

Following the initial search and screening process, the selected literature was analyzed in two sequential stages. In the first stage, each article was thoroughly read to identify the main arguments, methodological approaches used, key findings, and limitations recognized by each researcher. In the second stage, a thematic synthesis was conducted by grouping all findings into three main themes that directly address the problem formulation and compare those presented in the introduction. These three themes include: first, the role and impact of gamification on student motivation and active engagement in the learning process in elementary schools; second, the conceptual foundation and practical implementation of the deep learning approach, specifically the three main pillars of meaningful, attentive, and enjoyable learning; and third, the integration of various digital media such as Kahoot!, Quiziz, PowerPoint, and learning videos as instruments that bridge gamification with deep learning in real-world classroom practice. The synthesis of these three themes then forms the basis for the Results and Discussion section, while also contributing to the formation of a pedagogical framework that is the novelty of this research.

## Results and Discussion

According to Melianti et al. (2023), elementary school education is an important stage for children, because at this stage elementary school children not only develop physically but also experience personal-social development, academic development, and career development, so in this phase children will begin to be responsible and act according to their own wishes. In elementary school education, it does not only focus on delivering lesson materials, but also on character formation such as finding conscience and finding moral awareness based on life values. Therefore, the holistic development aspect which is the goal of elementary education will be difficult to achieve if the learning process is unable to arouse student motivation and involvement. In general, the problem of learning in elementary schools is the lack of student activity in learning which can be caused by a lack of student learning motivation. Student learning motivation is influenced by the learning methods used, learning methods that are less interesting tend to make students bored and lose their enthusiasm for learning. This is caused by monotonous learning methods and the lack of use of learning media. Although schools have adequate teaching aids, their use is less than optimal due to problems with maintenance and inappropriate use. This situation

encourages teachers to predominantly use lecture methods, which ultimately reduces students' enthusiasm for learning (Rambe & Nukman, 2025). Consistent with this issue, other research also confirms that improving teachers' pedagogical competence plays a crucial role in increasing student motivation and engagement.

According to Melati and Susanto (2023), teachers' pedagogical competence has a very positive and significant influence on elementary school students' learning motivation. The study's findings confirm that pedagogical competence and learning strategies can increase student engagement, making them more interested and persistent in the learning process. Therefore, while good pedagogical competence and learning strategies have the potential to increase student motivation and engagement, barriers to utilizing digital learning media can reduce the effectiveness of this interactive approach. The use of interactive and innovative learning media can increase student motivation, enhance student participation in learning, help students understand the material, and make learning effective and enjoyable. This aligns with gamification and deep learning in learning, which encourage active student engagement and emphasize meaningful understanding over mere memorization. However, its implementation has not been fully implemented due to challenges such as teachers' lack of skills in designing and utilizing digital-based learning media and the limited use of digital media or technology (Karna, Adrias, & Zulkarnaini, 2025).

Gamification is an innovative approach in education that utilizes game elements to increase student motivation, engagement, and achievement in teaching and learning activities. This approach can trigger positive emotions in students, including joy, involvement, and pride in achievement, which can boost intrinsic motivation. Moreover, gamification has also been shown to impact students' academic performance. Gamification has been shown to not only boost learning motivation but also have a direct impact on students' academic performance. A meta-analysis by Zeng et al. (2024) of 22 experimental studies from 2008–2023 found a moderate positive effect of using gamification on academic achievement. Similarly, a systematic review by Nurhayati & Fathurrohman (2025) confirmed that gamification is effective in encouraging motivation while also improving students' academic outcomes. Gamification creates feedback from students to teachers regarding the material presented, allowing learning to be two-way and increasing student engagement. With today's rapidly developing technology, the application of gamification in learning has become increasingly effective and engaging (Purba et al., 2024). Research by Riwayatiningsih et al. (2025) shows that the integration of gamification, multimodal learning, and Project-Based Learning (PBL) can increase student engagement in learning. In game-supported project-based activities, students are encouraged to think critically, collaborate, and produce meaningful work. This indicates that gamification not only boosts learning motivation but also supports the development of Higher Order Thinking Skills (HOTS), which is one of the goals of modern education. The use of gamified learning apps can promote a deep learning approach, as students become more motivated to actively and continuously explore the material (Aguiar et al., 2021).

Deep learning is a hands-on learning approach that focuses on students, not just theoretical understanding but also directs them toward understanding knowledge in real-life situations (Adnyana, 2024). In educational context, deep learning is a pedagogical approach that emphasizes a deep understanding of ideas, the ability to connect various ideas, and the transfer of knowledge to new situations. This concept differs from deep learning in artificial intelligence, which refers to computational techniques that use artificial neural networks to process data and make predictions, because in deep learning, learning is oriented towards three main dimensions: meaningful learning, mindful learning, and joyful learning. These three dimensions describe a learning process that is not only oriented towards superficial mastery of information (surface learning), but also towards the formation of deep understanding, cognitive and emotional engagement of students, and the creation of a positive and reflective learning atmosphere (Munfarikhatin & Natsir, 2025; Rahmawati, 2025). According to Adnyana, deep learning requires students not only to memorize information but also to connect new concepts with prior knowledge, analyze, evaluate, and apply them in real-life situations. Gamification supports this process through game elements such as tiered challenges, instant feedback, and contextual narratives that stimulate intrinsic motivation and curiosity (Rahmasari, 2025). Previous research has clarified and strengthened this relationship, demonstrating that the integration of deep learning and digital media supports a reflective and collaborative learning process. Research by Wijaya et al. (2026) explains that the implementation of deep learning and the assistance of digital media in mathematics learning can not only help improve teachers' abilities in designing innovative learning media, but also become an important foundation for the realization of a reflective, collaborative learning process that is oriented towards the formation of a Pancasila student profile. However, previous research has generally focused on teacher competence and student motivation rather than directly examining students' higher-order thinking skills (HOTS) in greater depth. With this, teachers can use digital media to help students' learning process in understanding the material and creating a pleasant learning atmosphere.

Practically speaking, the combination of gamification and deep learning appears to produce positive results, namely increased student motivation and acceptance of digital learning. Deep learning-based gamification has a positive impact on learning. Elements such as points, levels, badges, and leaderboards make learning more fun and competitive, thereby increasing student motivation. Aini et al. (2025) noted that 85% of students were ready to implement digital learning and 86% accepted the implementation of gamification. Although the results of these studies show positive outcomes, most of the research relies on self-reported data; therefore, it cannot yet demonstrate cognitive development or long-term learning memory. This finding strongly mirrors global trends where educational gamification is no longer seen as a mere gaming tool, but as a crucial pedagogical instrument designed to fulfill students' intrinsic psychological needs for autonomy, structured mastery, and high-order learning retention (Gyedu et al., 2026; Lampropoulos et al., 2026).

The combination of gamification and deep learning also encourages critical thinking, collaboration, and a deeper understanding of concepts, rather than simply memorizing.

According to the findings of Aini et al. (2025), 97% of students expect meaningful and reflective learning; this expectation aligns with the three core principles of deep learning: meaningful, mindful, and joyful as outlined in the mandatory Merdeka Curriculum. Although this combination has produced positive and promising results, several operational constraints, such as limited internet access and teachers' lack of understanding of technology, still hinder the full utilization of this approach.

In integrating gamification and deep learning in elementary schools, teachers can utilize various available media. Gamification can be implemented using digital media such as Kahoot! and Quiziz. Kahoot and Quiziz are two interactive quiz platforms that incorporate gamification elements, through a quick point system awarded based on the speed and accuracy of answers. Teachers can also create contextual story problems that relate the material to real-life situations. After the quiz, teachers can encourage students to reflect on their answers and provide feedback to improve their understanding. Research by Lalu et al. (2025) demonstrates that using Kahoot can lead to behavioral changes in students. They not only become more motivated but also begin to show initiative in reading the material before the lesson begins.

In addition to using media to improve student comprehension, teachers can also utilize interactive media such as PowerPoint presentations or videos when delivering material. The use of visual media such as PowerPoint presentations, images, and engaging learning videos has been shown to increase student focus and motivation, while also making it easier for them to grasp abstract concepts because they can see tangible processes or shapes. Thus, visual media not only makes learning more enjoyable and less boring, but also helps deepen understanding and makes the material more memorable. (Junanah, Safitri, & Farhurahman, 2025). Therefore, this study contributes to a systematic pedagogical framework that integrates gamification with deep learning. It aims to address the limitations of conventional, teacher-centered learning by enhancing student motivation without compromising deep learning.

## Conclusion

Based on the results of the literature review, the application of gamification through a deep learning approach can provide interactive and engaging learning experiences and help students gain a deeper understanding of the material. This approach also helps students engage in meaningful learning, enhances their critical thinking skills, and enables them to grasp concepts more easily—not merely through rote memorization. This approach is based on the three principles of deep learning: meaningful, mindful, and joyful. This integration has the potential to improve students' Higher-Order Thinking Skills (HOTS), although long-term empirical evidence still needs to be studied. However, it also requires the support of teachers' pedagogical competencies in designing learning methods and evaluating learning by adapting to students' needs. In addition, teachers can utilize learning resources from technology and various interactive tools, as well as digital media such as Kahoot!, Quizizz, PowerPoint, and educational videos. This approach can create effective, enjoyable, and collaborative learning experiences, while also boosting students' motivation

to learn. The implementation of gamification and deep learning in the classroom still faces challenges, such as limited digital resources and teachers who have not yet mastered the design of gamified learning; consequently, there is a need for teacher training on gamification methods and tools to support the students' learning process. This study is based on a literature review; most of the studies examined were self-report and descriptive in nature, so evidence of long-term cognitive impacts remains limited. Quasi-experimental studies are needed to measure the impact on higher-order thinking skills (HOTS) and long-term retention, along with investment in digital infrastructure to ensure equitable access in elementary schools.

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