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Literature Review: Innovation in Mathematics Learning through Gamification to Improve Elementary School Students' Learning Outcomes (2015-2025)

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Abstract
Mathematics learning in elementary schools is often considered difficult and uninteresting by students, resulting in low motivation and learning outcomes. To overcome this problem, gamification comes as one of the innovative approaches in learning by integrating game elements such as points, levels, challenges, and rewards into the learning process. This study aims to analyze the effectiveness of gamification in improving mathematics learning outcomes of elementary school students through the Systematic Literature Review (SLR) method. The literature analyzed was sourced from various scientific publications, including journals and conference proceedings published between 2015 and 2025, using databases such as Google Scholar, Crossref, Semantic Scholar, and OpenAlex. The study's findings indicate that the implementation of gamification, through platforms like Wordwall, Quizizz, Kahoot, and other educational games, has been proven to enhance conceptual understanding, learning motivation, and active student participation in mathematics education. However, the success of gamification implementation is influenced by infrastructure readiness, teachers' digital skills, and appropriate instructional design. Thus, gamification has great potential as a long-term learning strategy that can make math more fun and meaningful for elementary school students.

Keywords: gamification, mathematics learning, learning outcomes

INTRODUCTION

Innovation in mathematics education is becoming increasingly important with the advancement of technology and changing educational needs in the 21st century. Many students often find conventional mathematics teaching methods boring and difficult to understand, especially students in elementary school (Prasetya et al., 2024). As a result, there is a decline in student motivation and learning outcomes. Therefore, new approaches or methods in mathematics education that are more interactive and engaging are needed to help enhance students' interest, understanding, and learning outcomes.

One of the main focuses in the field of education is improving student learning outcomes (Novitasari et al., 2024). Various methods have been attempted to enhance the effectiveness of mathematics learning. An innovation that can be applied to assist in improving student learning outcomes, particularly in mathematics education, is gamification-based learning, which involves integrating game elements into the learning process. Karnilah et al. (2024); (Ernasari et al., 2025; Rozianita et al., 2024) revealed that the use of gamification in mathematics learning can create a more interactive and engaging learning environment, which encourages students to be more active in learning mathematical concepts. Additionally, Nurjannah et al. (2021) dan Kurniawan et al. (2025) added that the implementation of gamification has proven effective in enhancing motivation and student learning outcomes at the elementary school level.

Gamification, which combines game elements in learning, offers a more engaging approach for students to learn mathematics. By utilizing components such as levels, challenges, points, and rewards, gamification can create a more dynamic and enjoyable learning experience. This method can help increase student motivation as they feel valued after completing tasks or achieving goals. Gamification also gives students the opportunity to actively participate in learning activities through simulations and missions related to the lesson. Through this approach, students not only gain knowledge about mathematical theory but also acquire practical experience that helps them understand abstract concepts in mathematics learning

(Sitepu et al., 2024).

Gamification-based learning has become a widely researched topic in the field of education. As shown in the research conducted by Srimuliyani (2023), gamification can help increase student motivation and engagement in mathematics learning. Additionally, several recent studies support the effectiveness of gamification in education. Furthermore, research by Twiningsih (2024) found that gamification can improve students' mathematics learning outcomes. Research by Maryana et al., (2024) also revealed that gamification contributes to increased student engagement and mathematics learning achievements. Furthermore, research by Huang et al., (2020) states that the implementation of gamification in mathematics learning can help improve student motivation and engagement, as well as enhance their learning outcomes.

Although many studies have demonstrated the effectiveness of gamification in mathematics learning, further analysis is needed regarding the implementation of this strategy in different contexts. Each school has unique characteristics that can influence the success of implementing innovative learning methods. Therefore, this study aims to analyze in depth the innovation of mathematics learning through gamification to improve the learning outcomes of elementary school students.

By examining various innovative approaches and existing research findings, this study is expected to provide new insights and information to educators in planning more

engaging and effective learning strategies. Additionally, this study is expected to serve as a reference and assist policymakers in developing a more adaptive and student-centered curriculum, thereby making mathematics learning more meaningful and positively impacting their academic achievements.

METHOD

The research method used in this study is the Systematic Literature Review (SLR) method, which serves to assess the effectiveness of gamification in improving students' mathematics learning outcomes at the elementary school level. The SLR method was chosen because it provides a systematic and transparent approach to identifying, evaluating, and synthesizing research findings or studies relevant to the topic under investigation. By using this approach, the study can provide a comprehensive overview of trends, challenges, and the effectiveness of gamification implementation in mathematics education.

This study utilized the Publish or Perish (PoP) software to search for and identify relevant scientific articles from various academic databases, such as Google Scholar, Semantic Scholar, OpenAlex, and Crossref. Keywords such as gamification, mathematics learning, and learning outcomes were used to conduct the literature search. The publication year range used was from 2015 to 2025, with a focus on articles in English and Indonesian. In the selection process, this study followed the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines, which consist of four main stages: identification, screening, eligibility determination, and verification.

The collected articles were screened based on predetermined inclusion and exclusion criteria. The inclusion criteria were articles published between 2015 and 2025 and relevant to the topic of gamification in mathematics learning. Exclusion criteria include articles that do not directly discuss gamification, articles unrelated to education or mathematics, and articles not available in a comprehensible language, which will be eliminated. To provide a clearer overview of the article search process, the following diagram is presented.

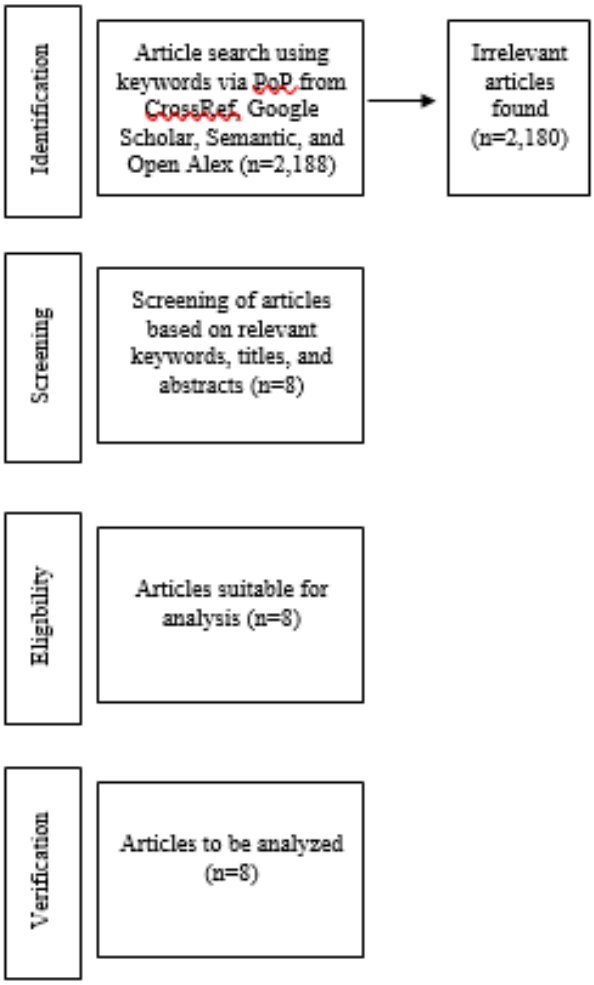

Fig. 1. Illustration of article search

RESULT AND DISCUSSION

Various new innovations in education have emerged as a result of technological advances to create more interactive learning. One example is gamification. This method is considered relevant for use in elementary schools because it aligns with students' preferences for playful activities and visually appealing content. In mathematics education, gamification can help transform learning activities that were previously perceived as complex and tedious into more enjoyable, challenging, and engaging experiences that encourage active student participation. Various studies conducted between 2015 and 2025 indicate improved learning outcomes through the use of gamification methods. Platforms such as Wordwall and Quizizz can help students enhance their conceptual understanding, classroom engagement, and motivation to learn.

This improvement is not merely quantitative in terms of test scores but also qualitative in terms of student engagement and confidence in mathematics. To provide a clearer and more systematic overview, the results of the journal analysis from 2015 to 2025 are presented in the form of an analysis table. This table shows the gamification models used, the grade levels studied, and their impact on student learning outcomes. With this table, readers can easily see the patterns of gamification effectiveness while understand the contribution of each study in providing evidence that gamification can help improve student learning outcomes in elementary schools, particularly in mathematics learning.

Table 1. Article Analysis Table

No	Author & Year	Title	Gamification Model	Research Results
1	Nurmala et al. (2025)	Application of Interactive Digital Game-Based Learning to Improve Student Motivation and Learning Outcomes in Mathematics at MIS Darussalam Sungai Salak Riau	Interactive digital games	Students' scores on the final test of cycle II increased significantly compared to their initial scores. More than 80% of students met the Minimum Competency Criteria (KKM). Based on these results, mathematics learning using the gamification method has proven successful in improving student learning outcomes. Engaging and educational digital games can make learning enjoyable, challenging, and interactive.
2	Ningrum et al. (2023)	Application of Wordwall Gamification to Improve Student Learning Outcomes in Mathematics on the Topic of Time Units for Grade II at SDN Kaliasin VII/286 Surabaya	Wordwall "Snowball Throwing"	The pre-test results showed a completion rate of 31.58% with an average of 56.21. After applying gamification in Cycle I, the completion rate increased to 63.16% with an average of 74.63. After improvements were made, the completion rate in Cycle II reached 95% with an average of 87.8. It can be concluded that the use of Wordwall in mathematics learning can help improve student learning outcomes. Additionally, student activity also increased, as seen from their participation in the Wordwall game, enabling teachers to more easily convey the material and motivate students during the learning process.
3	Eriska et al. (2023)	The Application of the Project-Based Learning Model Assisted by Education Digital Games to Improve Student Learning Outcomes in Mathematics in Grade IV at SDN Majalengka Wetan VII	Digital educational games	The results of the study indicate a significant improvement in students' mathematics learning outcomes, where in the pre-cycle, the average score for the was 66.12 with a learning completion rate of 34.37%. In Cycle I, there was an improvement, with the average score increasing to 77.25 and the learning achievement rate reaching 59.38%. In Cycle II, the average score further improved to 84.97, with the learning achievement rate reaching 87.5%. Based on the research results, it can be concluded that learning with the assistance of educational games can help improve student learning outcomes. The use of technology in the form of digital educational games provides a more engaging and enjoyable learning experience for students, which ultimately helps improve their understanding and motivation to learn.
4	Sholikhatun (2023)	Application of the Dolphin Math Game-Based Learning Model to Improve Mathematics Learning Outcomes	Interactive digital game "Dolphin Math"	Based on the research conducted, it was found that there was an improvement in students' learning outcomes. The average initial test score of 43.25 increased to 57.50 in the first session. In the second session, the average score increased to 86. Based on these results, the Dolphin Math game-based learning model was able to improve students' mathematics learning outcomes and can be used in limited face-to-face learning.

5	Dermawan & Ramadhan (2024)	Mathematics Learning Through the Quizizz Game Medium to Improve Student Learning Outcomes	Quizziz	There was an improvement in student learning outcomes, where the average score of students increased from 63 in Cycle I to 78 in Cycle II. This method can be one of the options for teachers to support the achievement of learning objectives, especially in improving student learning outcomes.
6	Muzayanati & Puspitasari (2022)	The Effectiveness of the Kahoot Game Application in Improving Student Motivation and Learning Outcomes in Mathematics at Elementary School	Kahoot	The improvement in learning outcomes in this study was demonstrated through the administration of pre-tests and posttests, which were then analyzed using a paired sample test and yielded a significance level of <0.05. This indicates that the use of Kahoot has a positive effect on student learning outcomes in mathematics education. Additionally, the results of the questionnaire also show that students feel engaged and motivated when using Kahoot.
7	Astuti et al. (2024)	Experimentation of the "Math Brain" Educational Game on Students' Mathematics Learning Outcomes	The educational game "Math Brain"	Compared to students who did not use Math Brain, students who used this educational game had a more interactive and enjoyable learning experience that significantly improved student learning outcomes. This study shows that educational games can be an effective option for improving students' mathematics learning outcomes in elementary schools. It also provides new insights into the use of technology in education.
8	Azzahra et al. (2025)	Implementation of Proprofs as a GameBased Learning Medium to Improve Mathematics Learning Outcomes of Fifth-Grade MI Students	The educational game "Proprofs"	The research findings indicate a positive impact of using Proprofs as a gamified mathematics learning medium in improving students' mathematics learning outcomes. Students can more easily understand abstract concepts such as number operations, fractions, and mixed numbers using the ProProfs medium, which features games, challenges, and immediate feedback.

Based on the journal analysis conducted, it can be concluded that gamification has evolved into a relevant pedagogical strategy for improving student learning outcomes at the elementary school level, not merely as an alternative approach to mathematics education (Oliveira et al., 2024). In addition to creating a more enjoyable learning environment, this implementation can enhance students' motivation to complete academic tasks. These findings support the argument that gamification can bridge the gap between conventional approaches that have long dominated mathematics classrooms and the learning styles of the digital-native generation (Permana, 2022).

Furthermore, for gamification-based learning to be effective, instructional design, the selection of appropriate platforms, and the teacher's role as an adaptive facilitator must be implemented in tandem. Teachers can create a healthy and competitive learning environment by incorporating challenges, instant feedback, and an organized reward system. In this context, the success of gamification does not solely depend on the use of digital applications but also on the teacher's ability to create meaningful learning experiences (Mårell-Olsson, 2022; Celasun, 2025).

Although gamification has been proven to help improve learning outcomes, the fact is that implementing gamification is not always easy, as it comes with various challenges and obstacles. Inadequate infrastructure and teachers' digital skills are the main obstacles. Especially in 3T areas—frontier, outermost, and disadvantaged— not all elementary schools have access to digital devices and stable internet connections. Additionally, many educators lack the necessary knowledge to design gamification-based learning. Therefore, the findings of this study indicate that professional training is crucial for teachers, and educational policies must support the integration of technology into the basic curriculum (Triwahyuni et al., 2025)

From a psychopedagogical perspective, gamification has proven effective in strengthening students' affective and cognitive aspects (Sun & Sailer, 2024);(Kurniawan et al., 2025). Game elements such as points, levels, and badges can increase students' interest in learning and boost their confidence in solving math

problems. This aligns with the concept of learning motivation, which emphasizes how important a sense of success and recognition can be in encouraging students to actively engage in the learning process (Disriani & Habibi, 2023; Muzaimah & Akbar, 2024). Therefore, gamification not only influences students' learning outcomes but also helps them develop a more positive attitude toward mathematics as a whole.

Based on the analysis conducted, gamification holds significant potential as a longterm educational innovation in elementary schools, particularly in mathematics education. However, to assess its success, gamification must be implemented contextually and sustainably. This also requires integration with supportive educational policies. Teacher training and the development of gamification media are important steps to maximize this potential. To support the transformation of inclusive and adaptive elementary education in line with contemporary developments, further research is needed on the long-term effectiveness of gamification.

CONCLUSION

Based on the results of a literature review of several journals conducted between 2021 and 2025, it can be concluded that gamification innovation in mathematics learning has the potential to help improve student learning outcomes in elementary school consistently. In addition to increasing student motivation and engagement, gamification can help make mathematics learning more enjoyable and meaningful. This method has proven to be effective and successful in creating an interactive and competitive learning environment. Mathematics learning using gamification can also encourage students to actively participate in learning activities. However, game design, appropriate integration of material, and the role of teachers in helping students learn greatly influence the effectiveness of gamification. Therefore, to achieve maximum learning outcomes, gamification in mathematics learning must be strategically designed and tailored to the characteristics of elementary school students.

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