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Gamification approaches to enhance critical thinking skills in elementary education: A literature review (2020-2025)

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Abstract
In the transformation, entering the era of society 5.0, learners are required to proficient the 6C skills, where critical thinking ability becomes one of the essential competencies that need to be developed from elementary school levels. However, research on the integration of gamification approaches to enhance critical thinking at the elementary level remains limited, so a literature review is necessary to identify trends, challenges, and future development opportunities. The purpose of this research is to explore how using gamification can enhance critical thinking abilities in elementary schools between 2020 and 2025 using the Systematic Literature Review (SLR) method. It was established through an analysis of 22 research papers that the gamification strategy significantly enhances the critical thinking abilities of primary school pupils. Additionally, gamification helps to enhance critical thinking abilities in addition to strengthens students' cognitive, affective, and social aspects by increasing motivation, creativity, and more meaningful engagement in learning.
Keywords: Critical thinking; gamification; elementary education

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INTRODUCTION

Education has become a platform for all individuals, without exception, to develop their abilities or potential so that they can compete in the global world as an investment in developing their abilities (Iskandar, 2021).Twenty-first-century education demands that students possess skills that focus not only on knowledge but also on critical thinking, communication, collaboration, creativity, citizenship, and character, known as the 6Cs (Trilling & Fadel, 2009). The existence of these 6Cs is urgent to prepare students to face future challenges and to realize a learning environment that has a positive influence on students. Inganah et al. (2023) also explained that integrating 6C competencies into education is believed to improve students' skills and prepare graduates to face global and social developments as well as the demands of society. One of the six competencies that students must possess, which will have a substantial impact on future work-based learning, is critical thinking skills (Raj et al., 2022).

Important thinking abilities must be among the various skills that students learn and grow, particularly in their early school years (Maylia et al., 2024). Critical thinking abilities can lead to a number of benefits, including lifetime learning abilities in an open, logical, reflective, critical,

and active learning mentality (Made et al., 2022). In essence, critical thinking skills need to be trained and developed from an early age by using a variety of learning strategies or approaches to create a learning environment that is conducive to collaboration, active idea generation, courage to express opinions, and willingness to accept diverse ideas (Rahmawati et al., 2023). According to (Sarwanto et al., 2021) The reality on the ground is that many students have not yet mastered or even acquired this skill, even though critical thinking skills are urgently needed in the global world. Based on this, teachers play an important role in creating a learning environment that fosters critical thinking skills through innovative strategies, one of which is the gamification approach.

According to research Saleem et al. (2021), gamification is an innovation for students to acquire knowledge that emphasizes entertaining, interactive, and useful learning. According to Kirana et al. (2022) gamification-based learning media help concretely presenting abstract materials support learning by concretely presenting abstract material. The presentation of material is appropriate for elementary school students, but more innovative in its appearance. In line with the opinion of Sailer and Homner (2020), gamification-based learning can improve stable and significant cognitive learning outcomes. Ortiz-Rojas et al. (2025) explains that gamification elements such as scoreboards can influence student motivation and improve learning performance. More deeply, the gamification approach has become one of the strategic innovations in 21st-century education because it can balance entertainment and learning aspects and encourage students to learn more enthusiastically and meaningfully. On the other hand, research on critical thinking in elementary schools is also growing, as this skill is an asset for every individual. The aim is for students to become accustomed to thinking critically as preparation for facing increasingly complex global challenges (Anggraeni et al., 2022). There are currently very few studies on the incorporation of gamification at the elementary school level, though, as the majority of these studies are yet independent. Therefore, it is important to conduct a literature review that specifically highlights how the gamification approach can contribute to or be proven effective in improving critical thinking skills, especially at the elementary school level.

According to the information provided, this research aims to investigate on the above description, the purpose of this study is to examine the implementation of the gamification approach for enhance abilities in critical thinking elementary schools between 2020 and 2025. This study is expected to contribute and provide references for educators in developing more innovative, interactive, and contextually relevant learning strategies for students.

METHODS

This study uses a Systematic Literature Review (SLR) approach consisting of three processes, namely collecting, assessing, and interpreting research evidence. The data sources obtained were journal reviews as references, namely databases from Google Scholar, Crossref, and Semantic Scholar on PoP from 2020 to 2025 in September, totaling 2,513 articles. After exclusion, 22 articles were obtained for analysis. The software used was Publish or Perish to obtain complete data and VOSviewer for visualization. The model used was PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses). The collected articles will then undergo an assessment or screening process using the inclusion and exclusion table in Table 1.

Tabel 1. Inclusion and exclusion criteria

Inclusion	Exclusion
Journal Article	Books, magazines, dissertations
The article was published between 2020 and 2025	The article was published before 2020
Google Scholar, Crossref, and Semantic Scholar	Besides Google Scholar, Crossref and Semantic Scholar
Elementary School	High School and University

The PRISMA model flowchart is presented in Figure 1.

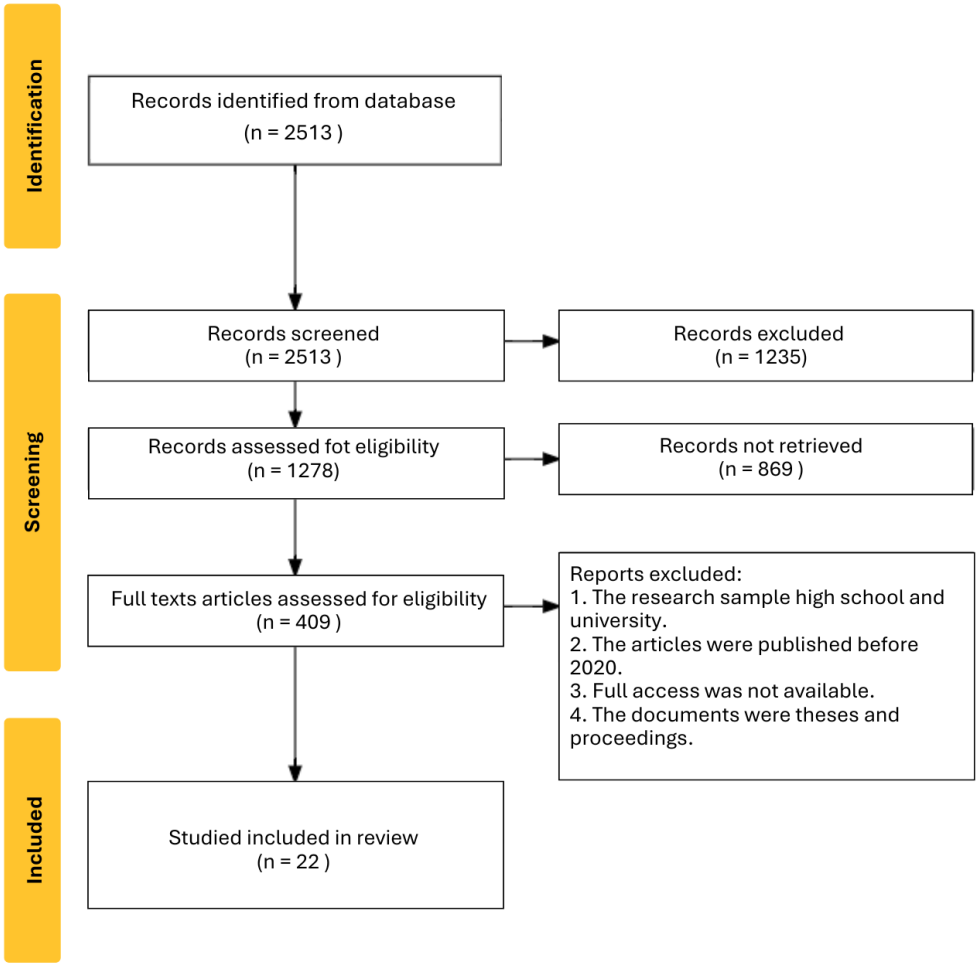

Figure 1. PRISMA flow diagram

RESULTS AND DISCUSSION

Results

The gamification approach to learning in improving critical thinking skills has been a focus in recent years, with 22 articles discussed, consisting of 9 articles in national journals and 13 international articles from various countries. For more information on the distribution of article publication years, see Figure 2.

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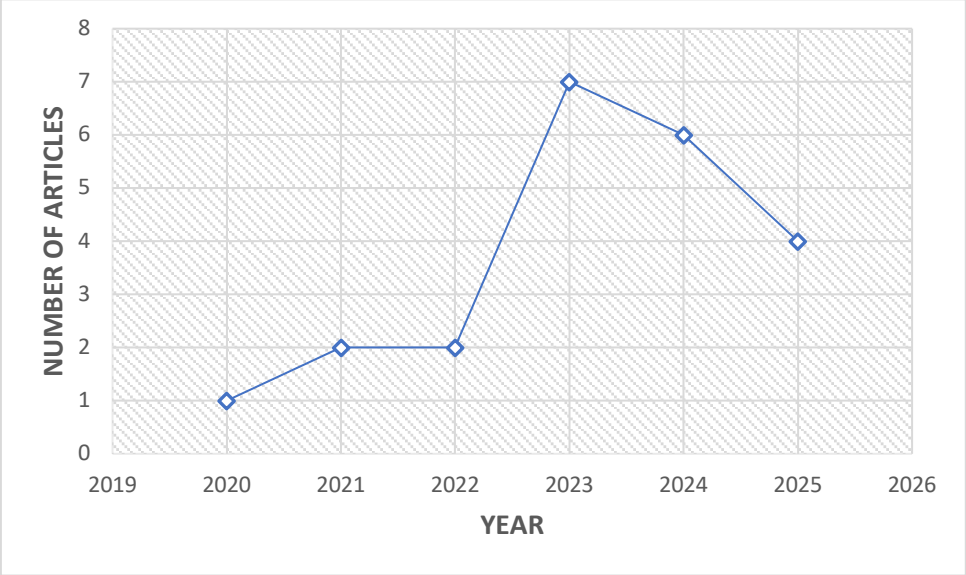

Figure 2. Representation of article publication year

Based on Figure 2, the distribution of article publication between 2020 to 2025 has decreased in the last year. The dominant country in terms of publications is Indonesia, with 14 articles compared to other countries such as India, Spain, and so on. Scientific publications from 2020 to 2025 by country are presented in Figure 3.

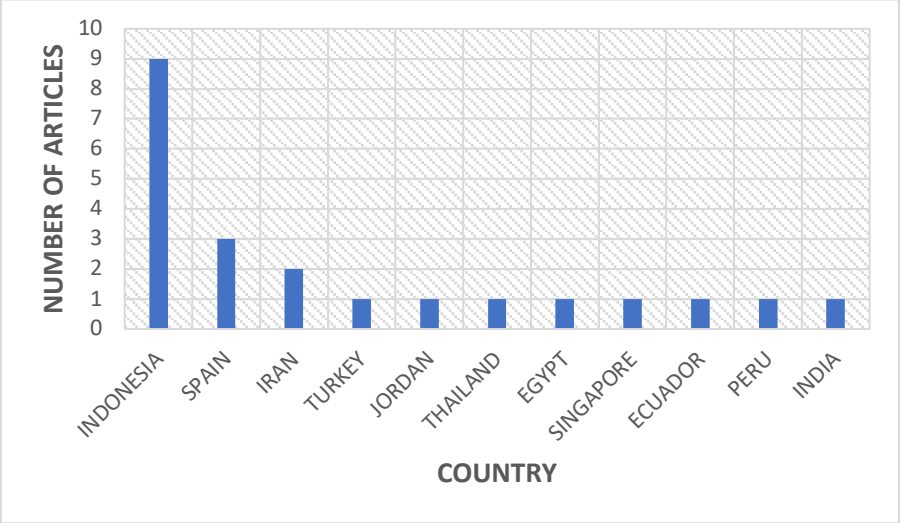

Figure 3. Scientific publications from 2020 to 2025 by country of origin

Based on Figure 4, the most common type of empirical research is quantitative research, namely experimental research, followed by qualitative research with 16 studies. This is presented in Figure 4.

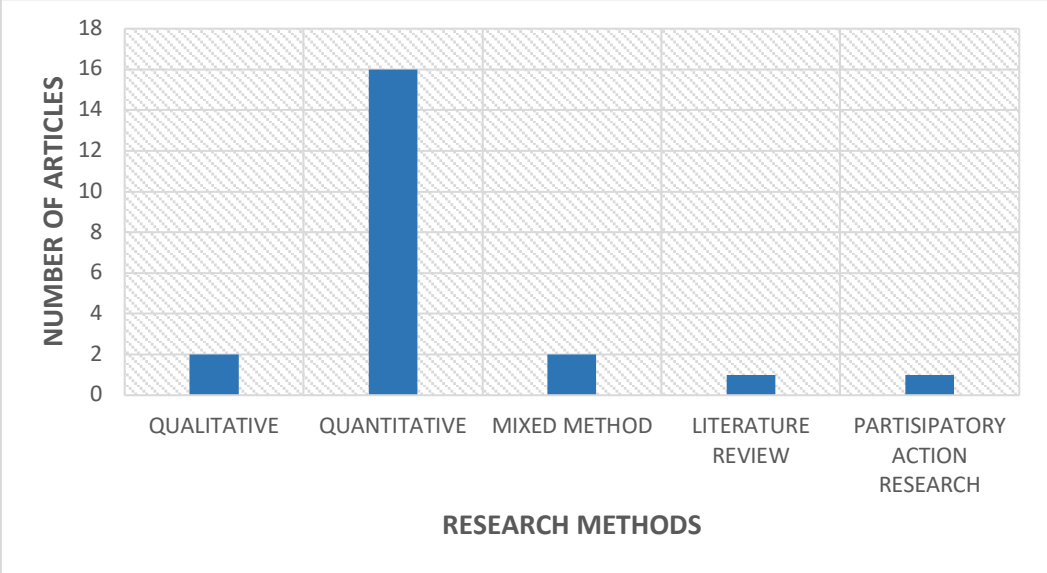

Figure 4. Scientific publications from 2020 to 2025 based on research methods

Through visualization using VOSviewer, it was found that the gamification approach in learning is related to critical thinking skills from 2020 to 2025. Furthermore, the results of data visualization with VOSviewer related to synchronization and keyword clusters can be seen in Figure 5.

Figure 5. VOSviewer visualization based on Title

Based on Figure 5, it shows a visualization of keywords that display the interrelationships between terms in research with gamification as the center. Terms such as critical thinking, motivation, and computational thinking are closely related to this main concept.

Discussion

Implementation of a Gamification Approach in Developing Basic Critical Thinking Skills

The data indicates that variations in the number of publications throughout that time period are the cause of the varying increases in publications. Direct research conducted in Ecuador by Chávez Suárez et al. (2024) emphasizes gamification as a pedagogical tool in elementary school mathematics learning, which encourages the improvement of critical thinking skills. Similar findings were also carried out in another country, Peru, by Chávez and Marreros (2023), who conducted research in elementary level with children aged 8 to 11 years. The results of applying gamification between the pre-test and post-test proved to have a significant effect on the development of critical thinking skills in elementary school students in all areas assessed. The areas assessed that are related to critical thinking skills include interpreting data, conducting analysis, assessing situations, drawing conclusions, presenting concepts, and managing their cognitive processes effectively. Supported Al-Barakat et al. (2025) states that the gamification approach implemented through technological integration significantly and positively contributes to improving critical thinking skills.

Hermita et al. (2022) indicates a significant effect on critical thinking skills using gamified learning implemented with Genially. The gamified learning media used is concrete but implemented in a more sophisticated and efficient manner, emphasizing enjoyable learning while still training students in problem-solving. Supported by opinion Wibisono et al. (2024) in the same country, Indonesia, it is argued that in the learning process, gamification is recommended as an approach in order to improve the quality of teaching, because it not only makes learning more enjoyable, but also focuses on the goal of improving critical thinking skills.

Gamification approach is also based on STEM (Science, Technology, Engineering, and Math). Asigigan and Samur (2021) explains that learning that emphasizes elements of the STEM gamification approach can help students improve their academic abilities alongside their critical thinking skills. Ortiz-Rojas et al. (2025) explaining gamification elements such as earning points through scoreboards can improve student learning performance. Similar research was also conducted by Fauziyati and Sriyanto (2023), The average score on the pretest was 58.7%, which is considered fair, while the average score on the posttest was 81.2%, which is considered excellent. Gamification-based STEM learning media improves the quality of learning because students actively participate in groups and help each other, which has an impact on their critical thinking skills.

Marpaung et al. (2025) explains that Quizalize-based gamification has been successful in improving critical thinking among third-grade students at Sanggar Belajar Pandan, Malaysia. Interactive features such as challenges, immediate feedback, and competitive elements have motivated students to engage more actively and develop critical thinking skills. Cloud-based learning with a gamification approach has proven effective in increasing students' active role in learning (Eang et al., 2025). In addition, learning becomes more exciting and interactive for students, and helps them hone their critical thinking skills, which are certainly needed in this modern era.

Overall, a comprehensive review of the scientific literature confirms that the gamification approach in basic education has great potential to improve students' cognitive categories, particularly in the area of critical thinking. Gamification is known for its use of elements as tools in delivering material that aims to build students' understanding, emphasizing not only the construction of knowledge but also critical thinking skills. In Indonesia, gamification is in line with deep learning, where learning emphasizes the principles of awareness, meaning, and enjoyment. In the field of education, gamification also has the power to be an approach that can be implemented in deep learning to realize the 8 dimensions of graduate profiles.

Implications and Additional Findings from the Research Results

At the elementary school level, there are several additional important findings that reinforce the relevance of the gamification approach in learning in the era of society 5.0. One of the findings related to the influence of gamification on student competencies is not only on critical thinking skills but also on creativity, motivation, learning outcomes, computational thinking, and even the prevention of bullying in schools.

Mohammed et al. (2024) in his research, he stated that gamified learning can improve student learning outcomes, including their achievement, engagement, and motivation during learning activities for fifth-grade students in Egypt. Supported by research conducted in Iran by Roshanpour and Nikroo (2020), which showed that virtual reality and gamification can increase intrinsic motivation. Learning using mechanisms such as points, leaderboards, badges, group assignments, and levels can lead to satisfaction, confidence, and enthusiasm for mastery. According to Ccoa et al. (2023) the gamification approach can reduce stress levels while studying and increase motivation through the use of Quizizz as an alternative evaluation tool. The learning outcomes also showed significant results using historical thinking-based gamification compared to traditional learning in fourth-grade elementary school (Martínez-Hita et al., 2021). Supported by Rahmawati et al. (2023), the implementation of problem-based gamification is thought to be highly

successful in real-world scenarios. In particular, gamification can enhance elementary school pupils' overall learning outcomes.

Gamification offers not only one skill but also other skills that can be improved and explored, namely creativity and innovation. Research by Al Ghozali et al. (2024) significantly increased students' creativity and innovation because it allowed students to explore new ideas. Supported by Sani and Ratri (2024) who stated that learning using gamification elements not only increases student motivation and engagement but also helps them master four communication skills, namely interacting with the community. The effective implementation of gamification also has an impact on improving computational skills in second grade (del Olmo-Muñoz et al., 2023).

In general, these additional findings indicate that the gamification approach has high flexibility for application in various educational settings and has great potential for improving the competencies needed by students in the future. This demonstrates that gamification not only more fun learning, but also functions as a pedagogical strategy that can comprehensively develop 21st-century skills.

CONCLUSION

The literature study leads to the conclusion that the gamification approaches, which is increasingly being adopted in elementary schools, it has been demonstrated that this approach enhances abilities related to critical thinking. It was found that gamification also contributes to strengthening students' cognitive, affective, and social aspects through increased motivation, creativity, and more meaningful learning engagement. Through the use of elements in learning, whether integrated with technology or using physical activities, students indirectly develop their abilities through enjoyable and meaningful learning experiences.

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