Journal of Primary Education
15 (2) (2026) : –

https://journal.unnes.ac.id/sju/index.php/jpe

Mapping Game-Based Learning in Lower Primary Mathematics Education: A Systematic Literature Review

Wahyu Asna Fauziatul Maghfiroh [1]✉, Panca Dewi Purwati

Universitas Negeri Semarang, Indonesia

Article Info

History Articles
Received:
10 Juni 2026
Accepted:
15 Oktober 2026
Published:
30 Desember 2026

Keywords:
Elementary School, Game-Based Learning, Lower Grades, Mathematical Learning, Systematic Literature Review

Abstract

This study aims to analyze the effect of Gamified-Branching Scenarios supported by Lumi Education on elementary school students' science literacy and decision-making skills, as well as to describe students' responses to the implemented learning. The study employed a mixed-methods approach with an explanatory sequential design, integrating quantitative and qualitative data to provide a more comprehensive understanding of learning outcomes and processes. The participants were 50 elementary school students, consisting of 25 students in the experimental class and 25 students in the control class. Data were collected through science literacy tests, decision-making tests, observations, questionnaires, and interviews. The results showed that the average science literacy score in the experimental class increased from 34 to 54, while in the control class it rose from 21 to 26. The average decision-making score in the experimental class increased from 50 to 74, compared to 46 to 53 in the control class. Statistical analysis indicated a significant effect on decision-making skills, but there was no significant difference in overall science literacy. However, indicator-based analysis showed improvement in all aspects of science literacy. Thus, Lumi Education-assisted learning creates an interactive experience, increases student engagement, and supports the development of decision-making skills in elementary school science learning.

✉ Correspondence address:
Kampus Sekolah Pascasarjana UNNES
E-mail: asnafauziah@students.unnes.ac.id

p-ISSN 2252-6404
e-ISSN 2502-4515

INTRODUCTION

Mathematics is one of the most important subjects in elementary school because an understanding of number concepts, place value, and arithmetic operations serves as the foundation for students to master mathematics at subsequent grade levels (Dewi, 2022; Ruiz et al., 2024). Mathematics taught in the early grades (grades 1–3) plays a crucial role in developing numeracy, reasoning, and mathematical problem-solving skills through learning activities that connect numbers, mathematical symbols, and everyday life (Utami et al., 2026; Vessonen et al., 2024). Nevertheless, lower-grade students, who are still in the transition phase from early childhood education to elementary school, often struggle to understand abstract mathematical concepts, including basic topics such as place value, arithmetic operations, and word problems (Aulia et al., 2024; Luthfi et al., 2026). Procedural-based instruction is not sufficiently effective in helping students develop their own understanding. Therefore, mathematics instruction, particularly in elementary school, needs to be delivered in a meaningful, relevant way to children's lives (Hikmah & Mufliva, 2025; Luthfi et al., 2026; Natacya et al., 2026; Vessonen et al., 2024).

One learning model that can be applied in elementary schools is Game-Based Learning. Game-Based Learning (GBL) is a learning model that can be applied in elementary school mathematics through various types of games, such as digital games, board games, traditional games, and adaptive games designed to meet learning objectives (Dan et al., 2024; Hikmah & Mufliva, 2025; Pan et al., 2022; Yulianto et al., 2026). GBL can help students build conceptual understanding through enjoyable game-based activities (Ilmiyah et al., 2024; Nurhasanah et al., 2024; Romadoni et al., 2024; Wardani & Himmah, 2026), including the concept of place value among second-grade students (Ergül & Dogan, 2022). The results of a meta-analysis also indicate that digital Game-Based Learning interventions positively affect students' academic achievement in school (Barz et al., 2024). Although its impact is significant, it can vary depending on the type of game, the learning outcomes being measured, and the subject matter (Gui et al., 2023). GBL is implemented in learning by integrating game rules, progressive challenges, feedback, strategy discussions, and post-game reflection into learning objectives, ensuring that game activities remain focused on achieving mathematical competencies and learning objectives (Guan et al., 2024; Hikmah & Mufliva, 2025; Pan et al., 2022). The selection of Game-Based Learning for lower-grade students must be based on student characteristics, developmental level, game difficulty, and the skills to be developed, for example, addition concepts through the Tic Tac Tika game (Maghfiroh & Sari, 2025) and the Going to Winner medium (Hikmah & Mufliva, 2025). Thus, the success of GBL is determined not only by the type of game or the sophistication of the technology but also by the alignment of the game design with mathematical concepts, teacher involvement, and the evaluation of students' learning processes and outcomes (Dan et al., 2024; Russo et al., 2024).

Game-based learning can be categorized into two types, digital and nondigital. The Digital Game-Based Learning (DGBL) model can be applied to mathematics instruction in elementary schools through games that utilize computers, Android apps, web-based games, and interactive platforms that integrate learning objectives with game mechanics (Dan et al., 2024; Muhaimin et al., 2025). The implementation of DGBL in learning typically uses progressive or tiered games that provide immediate feedback (Muhaimin et al., 2025; Pan et al., 2022; Rosmiandini et al., 2023). A K–12 study (Hussein et al., 2021) and a meta-analysis of mathematics instruction (Kusumawardani et al., 2025) indicate that DGBL has the potential to help students reduce their cognitive load. An example is an interactive number-arranging game on place value (Kusuma & Mizan, 2026). Nevertheless, the success of implementing DGBL in learning, particularly in mathematics, is not solely determined by how sophisticated and engaging the game's interface is, but is also influenced by

the teacher's pedagogical skills in conducting lessons and the suitability of the digital game to the students' characteristics and the resources available in the classroom (Rohmani et al., 2023).

Furthermore, non-digital or concrete game-based learning (GBL) can be implemented through board games, number cards, dice, manipulatives, and traditional games that directly engage students in mathematical activities without relying on digital devices (Nur, 2025; Russo et al., 2024). The number-line board game conducted by Lin (2022) can help students develop knowledge and skills in numbers and basic arithmetic. Additionally, research by Sari & Olkun (2024), Sella et al. (2023), and Sella et al. reports that non-digital GBL can improve number sense in first-grade students with low numerical ability. Non-digital GBL allows students to interact directly with the game medium, which is considered to provide hands-on learning experiences, given that lower-grade students are still in the operational stage (Lismayani et al., 2026; Lisnasari et al., 2024; Pujasmara et al., 2024). In addition, some traditional games, with adjustments to their rules and materials, can be considered part of ethnomathematics and can help preserve existing culture through play (Hardiyansyah et al., 2024; Nurhasanah et al., 2024). Studies on the ethnomathematics of the game of congklak (Asmaarobiyah et al., 2024; Jannah et al., 2023; Nurazizah, 2023), marbles (Ginting et al., 2026; Oktarina, 2022; Putra & Lestari, 2024; Ritonga & Suparni, 2024), engklek (Harahap & Jaelani, 2022; Rismadani et al., 2026; Sholihah et al., 2024), and jump rope (H. Aulia et al., 2023; Sahasika et al., 2025) indicate that traditional games can be integrated with mathematical concepts in GBL.

Previous studies have provided an overview of the development of game-based learning (GBL) in mathematics education, both in digital games (Dan et al., 2024; Fadlillah et al., 2026; Hussein et al., 2021; Yulianto et al., 2026) and non-digital games (Russo et al., 2024). However, these studies differ in educational level, type of GBL, and analytical focus, and generally cover the entire elementary school level; thus, the characteristics of lower-grade classes have not yet been mapped in detail. Therefore, this study aims to map research on game-based learning in mathematics instruction for lower-grade elementary school students through a systematic literature review approach. Unlike studies that focus solely on the effectiveness of digital or traditional games, this study organizes the selected literature into five categories: publication trends, types of game media, mathematical competencies examined, research design, and research gaps. The author hopes that the results of this study can provide a structured overview of the characteristics of previous studies, as well as opportunities to develop GBL research that better suits the mathematics learning needs of grades 1–3 in elementary school. Based on these objectives, this study addresses the following five research questions:

RQ1. What are the trends in research publications on game-based learning in mathematics instruction for lower-grade elementary school students during the 2021–2026 period?

RQ2. What are the types and characteristics of game-based media used in mathematics instruction for lower-grade elementary school students?

RQ3. Which mathematical competencies or skills are the focus of development or assessment in game-based learning research involving lower-grade elementary school students?

RQ4. What research designs and methods have been used to examine the implementation of game-based learning in mathematics instruction for lower-grade elementary school students?

RQ5. What research gaps have been identified in the literature regarding game-based learning in mathematics instruction for lower-grade elementary school students, and what opportunities for further research can be developed?

METHOD

This study used the Systematic Literature Review (SLR) method to identify, select, and

synthesize research findings on the application of Game-Based Learning (GBL) in mathematics instruction for lower-grade elementary school students. The review procedure followed the 2020 Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines, particularly in reporting the processes for identifying, screening, assessing eligibility, and selecting articles for inclusion in the synthesis (Page et al., 2021). The use of systematic procedures aims to ensure that the source selection process is traceable and that the study's results are transparently understood.

Literature Search Strategy

The literature search was conducted in the Scopus and Google Scholar databases using the Publish or Perish (PoP) software. The search was limited to 200 Scopus publications and 200 Google Scholar publications from 2021 to 2026. The search keywords used were ("game-based learning" OR "educational game") AND mathematics AND ("elementary school" OR "primary school"). This search strategy was used to identify publications discussing the use of games in mathematics education in elementary schools. The search was conducted on June 24, 2026. To ensure the traceability of the search process, information regarding the databases, keywords, publication year range, and the number of search results was recorded before the selection phase began.

Inclusion and Exclusion Criteria

Article selection was based on inclusion and exclusion criteria established in accordance with the study's objectives. Articles were included if they were published between 2021 and 2026, discussed Game-Based Learning or the use of educational games in mathematics instruction, involved elementary school students in grades 1–3 as research subjects, were written in Indonesian or English, and were available in full text. Articles that do not meet one or more of these criteria were excluded from the study. Exclusion criteria include publications prior to 2021; studies on subjects other than mathematics; studies that do not address Game-Based Learning (GBL); studies involving only students in grades 4–6; publications in the form of conference proceedings, conference papers, or books; publications in languages other than Indonesian or English; and articles for which the full text is not accessible.

Article Selection Process

The selection process was conducted in stages, including record identification, duplicate removal, initial screening, full-text eligibility assessment, and article selection for the final synthesis. The initial search yielded 331 article records. A total of 17 duplicate records were removed, leaving 314 records for the screening stage. In the next stage, 194 records were excluded because they did not align with the research focus on mathematics learning in elementary school. Subsequently, 35 publications were excluded because they were proceedings, conference papers, or books (full text). Thus, 33 articles advanced to the full-text assessment stage. Of these, 23 articles were excluded because they focused on students in grades 4–6, leaving 10 articles that met all inclusion criteria and were analyzed in this study. The selection process is presented in the PRISMA 2020 diagram (Figure 1).

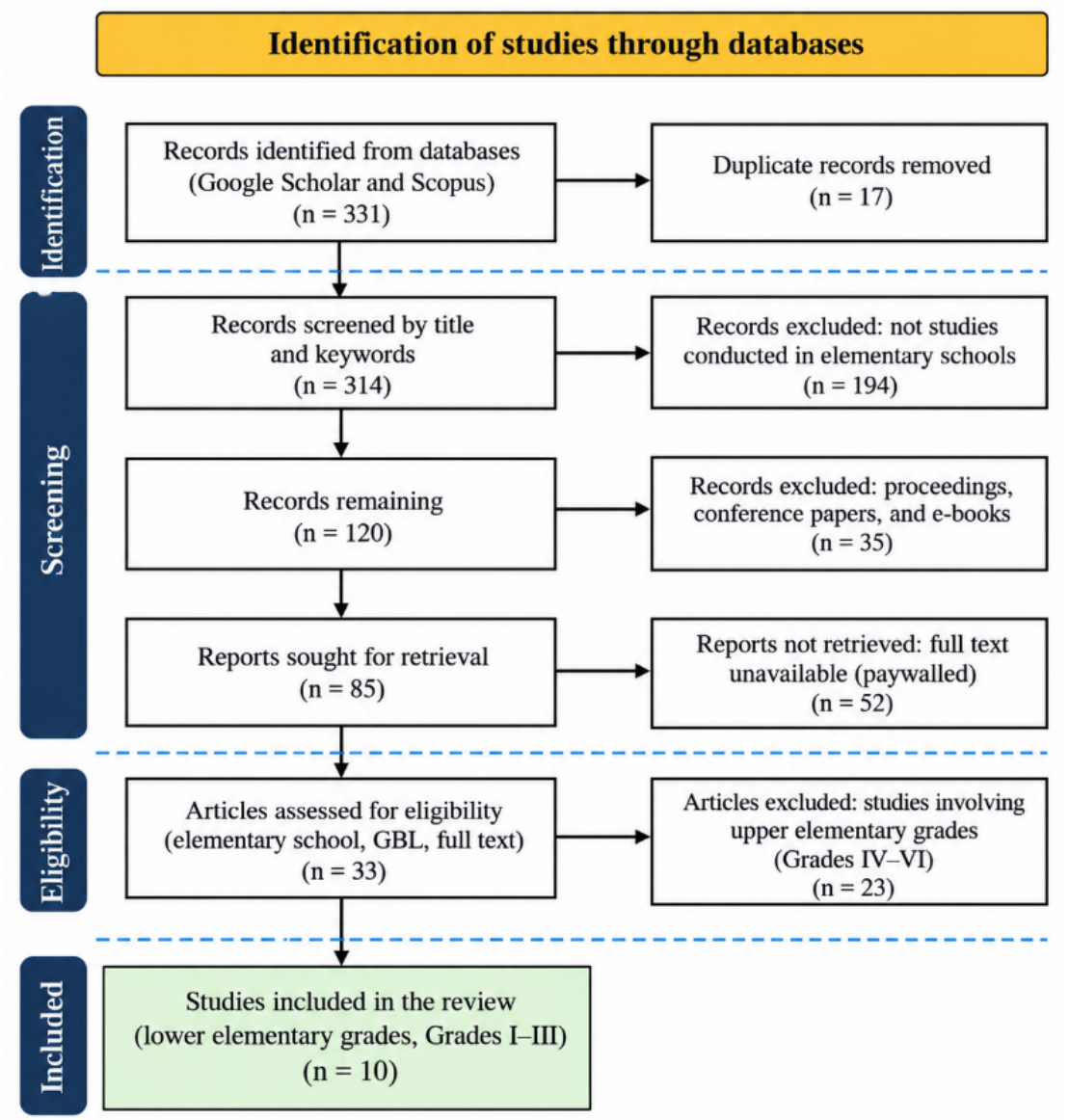


Figure 1 PRISMA 2020 Diagram

Data Extraction and Analysis

Articles that met the inclusion criteria were analyzed using a data extraction form designed based on the research questions. The information extracted included the authors' names and year of publication, the country or research context, the type and characteristics of the game-based media, the mathematical skills studied, the research design or methods, and the reported limitations and opportunities for further research. The data were then grouped by relevant themes to address each research question. Publication trends were analyzed descriptively by year of publication and, in addition, by country or research context. The types of game media, focus on mathematical skills, and research designs were categorized based on the information reported in each article. Research gaps were identified through a comparative synthesis of findings, including limitations reported by the authors and aspects that have not been extensively discussed in the body of the analyzed. This synthesis approach follows the principles of systematic literature reviews, which emphasize transparent procedures for source selection and analysis (Snyder, 2019; Xiao & Watson, 2017).

In addition to descriptive synthesis, keyword association mapping was conducted

emerging from the selected set of articles. This visualization was used to complement the content analysis, not as the sole basis for concluding the prevalence or absence of research topics. The interpretation of the mapping results was conducted by examining the context of the findings within the full text of each article. All results from data extraction and clustering were subsequently used to answer five research questions regarding publication trends, types of game media, the mathematical skills examined, research design, and gaps and opportunities for further research.

RESULTS AND DISCUSSION

This study analyzes 10 articles that met the inclusion criteria, namely research on Game-Based Learning (GBL) in mathematics instruction for first- through third-grade elementary school students. The analysis was conducted based on five research questions covering publication trends, types of game media, focus on mathematical skills, research design, and gaps and opportunities for further research.

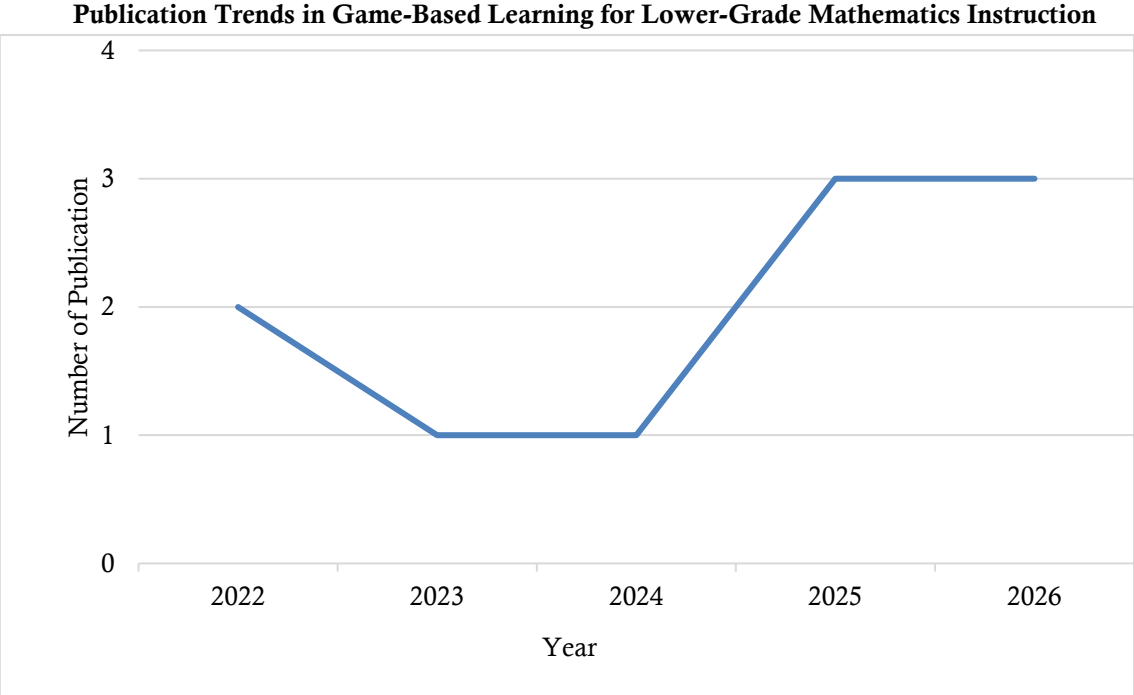


Figure 2. Distribution of Publication Years

Based on the distribution of publication years shown in Figure 2, the analyzed articles were published between 2022 and 2026. Publications on GBL in lower-grade mathematics education show an upward trend from 2024 to 2026. These findings indicate that this topic remains a focus of research in elementary school mathematics education. However, the number of articles analyzed is relatively limited; therefore, this trend should be understood as a pattern within the selected set of articles, rather than as a comprehensive picture of all GBL publications globally.

In addition to analyzing the distribution of publication years, the researchers examined the distribution of countries conducting research onthis topic. The results of this distribution are presented in Figure 3.

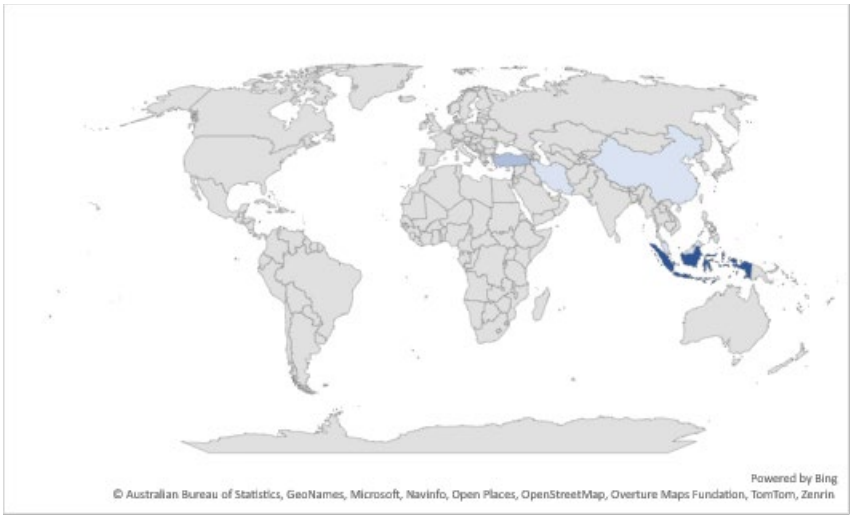


Figure 3 Distribution of Countries of Origin of Publications

Based on the countries of origin of the studies presented in Figure 3, Indonesia contributed five articles, Turkey two, and Iran, Malaysia, and China each one. Thus, Indonesia has the highest number of articles in the analyzed collection of studies. This distribution indicates that GBL research on lower-grade mathematics in this corpus is predominantly found in the Indonesian context. However, this distribution cannot be used to conclude that Indonesia has the highest global GBL research productivity, as the database, search strategy, time frame, and selection criteria were used.

An analysis of author affiliations was conducted to identify the institutions that contributed to research publications on game-based learning in lower-grade mathematics education. Each author's institution was identified from the affiliations listed in the selected articles and assigned a code to facilitate data presentation and interpretation. The distribution of author institutions along with their respective codes is presented in Figure 4 and Table 1.

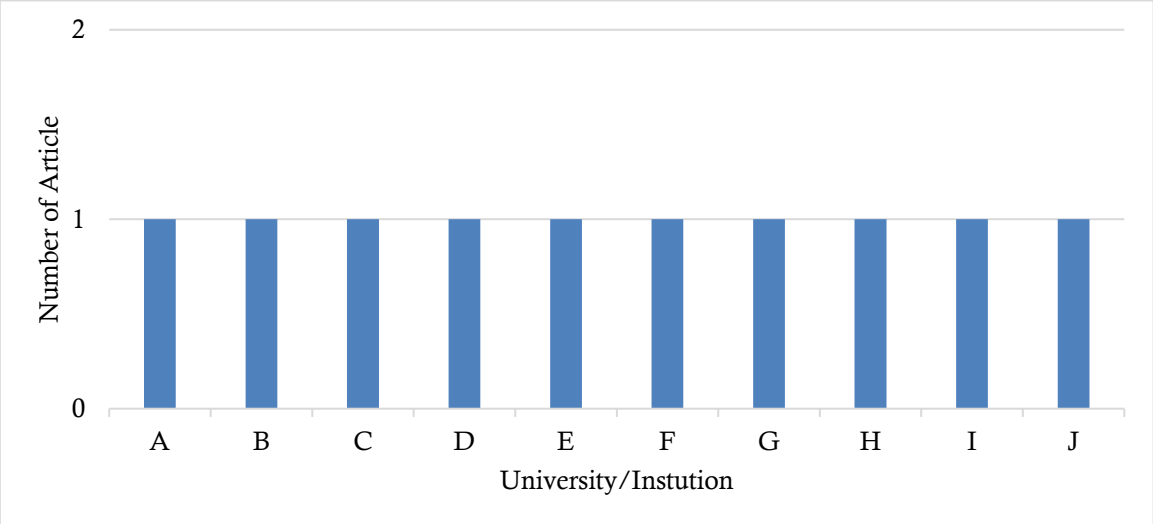


Figure 4 Distribution of Authors' Institutional Affiliations in Selected Articles

Table 1 List of Authors' Institutional Affiliations and Their Identification Codes

Name of Institution	Code
Allameh Tabataba'i University	A
Bahceseir University	B
Gazi University	C
Henan University	D
Palestine Ahliya University	E
Universitas Islam Indonesia	F
Universitas Muhammadiyah Prof. Dr. Hamka	G
Universitas Muhammadiyah Purwokerto	H
Universitas Nurul Jadid	I
Universitas PGRI Semarang	J

An analysis of keyword associations using VOSviewer yielded three clusters. The first cluster contained the keywords "digital game," "effectiveness," "average score," "behavior," "teacher," and "accordance." The second cluster included "achievement," "impact," "control group," "traditional teaching method," and "ADDIE model." The third cluster comprised "educational game," "implementation," "technology," "integration," "medium," "observation," and "black box testing." These three clusters illustrate themes related to the assessment of learning outcomes, the development of educational media, and the implementation of technology-based educational games. This mapping serves as an exploratory overview of keyword relationships within the corpus, while the research focus is determined through a careful reading of the article's content.

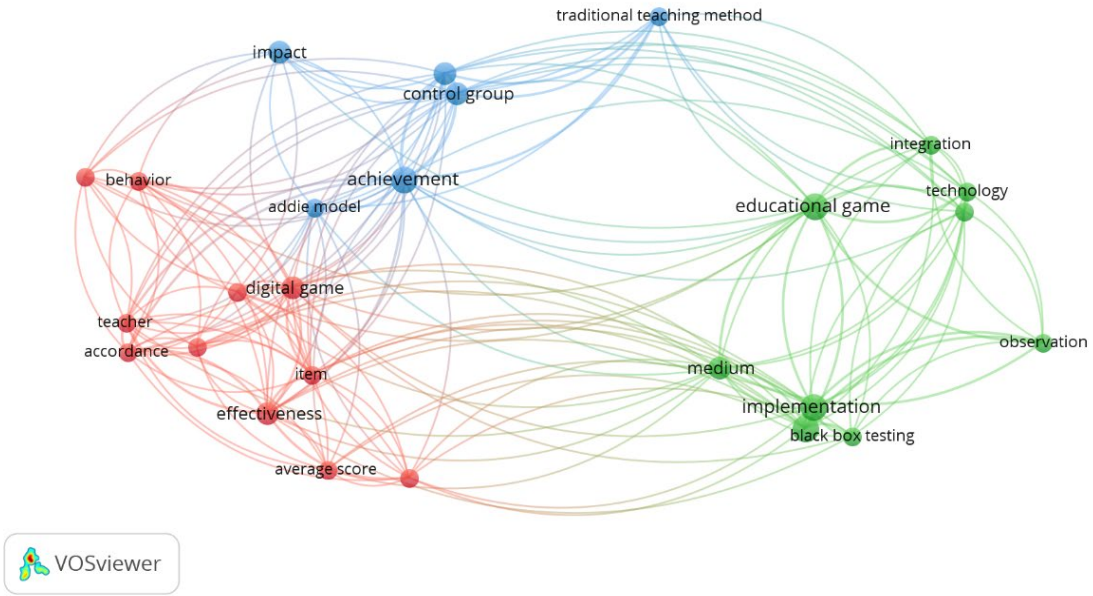


Figure 5 Keyword Associations Using VOSviewer

A bibliometric analysis using VOSviewer software on 10 articles regarding the application of Game-Based Learning in lower-grade elementary school mathematics instruction yielded three main clusters that illustrate trends in research focus.

The first cluster (red) consists of the keywords "digital game," "effectiveness,"

"average score," "behavior," "teacher," and "accordance." This cluster indicates that studies on the effectiveness of game-based media on student learning outcomes and behavior still dominate research. Most studies measure the success of these media through improvements in average scores and changes in learning behavior.

The second cluster (blue) consists of the keywords "achievement," "impact," "control group," "traditional teaching method," and "ADDIE model." This cluster indicates that many studies employ experimental designs that compare experimental and control groups. In addition, the ADDIE model is quite dominant in the development of educational media.

The third cluster (green) includes the keywords "educational game," "implementation," "technology," "integration," "medium," "observation," and "black box testing." This cluster illustrates the research focus on implementing technology-based educational games and on testing media.

The keywords with the strongest associations are "educational game," "achievement," "digital game," and "implementation." This indicates that research is primarily focused on developing and implementing games to improve mathematics learning outcomes. However, research on addition skills and mathematical problem-solving among lower-grade students remains very limited, as evidenced by the absence of the keywords "addition" and "mathematical problem-solving" in the VOSviewer visualization.

Types of Game Media Used

The analysis of 10 articles revealed a variety of game media, ranging from specially developed digital games and online gaming platforms to games based on physical objects. The types of media used in each article are presented in Table 2.

Table 2 Types of Game Media Used

Author (Year)	Types of Educational Games Used
Chen et al. (2026)	Competitive digital games built on Unity
Nalendra & Ratnasari (2026)	Digital Dakon built on Unity
Nugroho et al. (2026)	Number Monopoly
Shiddiq Windiarto & Jubair (2025)	2D arithmetic educational games built on Unity
Chasanah et al. (2025)	Math flashcards integrated with the "Magic Number Adventure Snakes and Ladders" game board.
Işık & Kaban (2025).	Digital escape game based on the Genially platform
Kocabatmaz & Saraçoğlu (2024)	Wordwall and Matific game platforms
Samavati dkk. (2023)	Adaptive games based on Polya's Theory
Rahayu & Rukmana (2022)	Bamboozle website
AlAli & Al Hosni (2022)	2D Android app: Second Grade Math App

Based on Table 2 above, digital media dominate research on game-based learning in lower-grade mathematics education, accounting for 8 out of 10 studies. Five studies developed digital games, either using Unity (Chen et al., 2026; Nalendra & Ratnasari, 2026; Shiddiq Windiarto & Jubair, 2025) or Android applications (AlAli & Al Hosni, 2022; Samavati et al., 2023). Furthermore, three studies utilized existing digital game platforms, such as Genially (Işık & Kaban, 2025), Wordwall, and Matific (Kocabatmaz & Saraçoğlu, 2024), and Bamboozle (Rahayu & Rukmana, 2022). Meanwhile, concrete media were found in only two studies: Monopoly by Nugroho et al. (2026) and the "Snakes and Ladders" flashcards by Chasanah et al. (2025).

These findings indicate a trend toward integrating technology into learning. This also means that the use of concrete and manipulative materials remains relatively limited. Only 1 out of 10 studies used concrete media. However, lower-

grade students (Grades 1–3 of elementary school) are still in the concrete operational stage of development and therefore require learning experiences that involve real-world experiences and hands-on activities (Lismayani et al., 2026; Lisnasari et al., 2024; Pujasmara et al., 2024). Interestingly, Nalendra & Ratnasari (2026) adapted "dakon," a traditional game, into a digital format. This demonstrates that traditional games can still be integrated with technology; however, the use of their concrete forms in GBL research remains rare. Thus, the development and testing of concrete media, including traditional games, still present opportunities for future research.

Focus on Mathematical Skills

The mathematical skills that are the focus of the research vary, ranging from basic arithmetic operations to problem-solving skills. Details of the skill focus in each article are presented in Table 3.

Table 3 Enhanced Mathematical Skills

Author (Year)	Enhanced Mathematical Skills
Chen et al. (2026)	Concepts of single fractions and adding fractions
Nalendra & Ratnasari (2026)	Arithmetic
Nugroho et al. (2026)	Place value and decomposition of numbers up to 100
Shiddiq Windiarto & Jubair (2025)	Arithmetic
Chasanah et al. (2025)	Addition and subtraction of whole numbers
Işık & Kaban (2025)	Not explicitly mentioned
Kocabatmaz & Saraçoğlu (2024)	Measurement (length, perimeter, area, and volume)
Samavati dkk. (2023)	Mathematical Problem Solving
Rahayu & Rukmana (2022)	Multiplication of natural numbers
AlAli & Al Hosni (2022)	Addition of two numbers between 99 and 999

Based on the focus of the research. Five of the ten articles by AlAli & Al Hosni (2022; Chasanah et al., 2025; Nalendra & Ratnasari, 2026; Rahayu & Rukmana, 2022; Shiddiq Windiarto & Jubair, 2025) focus on mastery of arithmetic operations, including addition, subtraction, and multiplication. Other studies examined more specific topics such as place value and number decomposition (Nugroho et al., 2026), the concept of fractions (Chen et al., 2026), and measurement (Kocabatmaz & Saraçoğlu, 2024). Samavati et al. (2023) targeted a specific skill, mathematical problem-solving, while another article (Işık & Kaban, 2025) did not explicitly mention a specific skill as its focus.

This indicates that the majority of research on Game-Based Learning in early-grade mathematics instruction is oriented toward the mastery of basic mathematical skills. More complex skills, such as reasoning, problem-solving, and conceptual understanding, have not been extensively studied. However, these skills play a crucial role in developing students' numeracy skills (Utami et al., 2026; Vessonen et al., 2024).

Research Designs Used

The analysis of 10 articles revealed that studies on game-based learning in lower-grade mathematics instruction employed a wide variety of research designs. The research designs identified included research and development, experimental, quasi-experimental, classroom action research, mixed methods, and pre-experimental. The research designs used in each study are presented in Table 4.

Table 4. Research Design Used

Author (Year)	Research Designs Used
Chen et al. (2026).	Experimental design
Nalendra & Ratnasari (2026)	Research and development (ADDIE model)
Nugroho et al. (2026)	Classroom Action Research (CAR)
Shiddiq Windiarto & Jubair (2025)	Research and development (R&D)
Chasanah et al. (2025)	Research and Development (ADDIE model)
Işık & Kaban (2025)	Mixed Methods
Kocabatmaz & Saraçoğlu (2024)	Quasi-Experimental Design
Samavati dkk. (2023)	Quasi-Experimental Design
Rahayu & Rukmana (2022)	Pre-Experimental Quantitative Design
AlAli & Al Hosni (2022)	Quasi-Experimental Design

The results of the analysis show that experimental and quasi-experimental designs are the most commonly used approaches. A total of five out of ten articles consist of one experimental study by Chen et al. (2026), one pre-experimental study by Rahayu & Rukmana (2022), and three quasi-experimental studies by AlAli & Al Hosni (2022; Kocabatmaz & Saraçoğlu, 2024; Samavati et al., 2023). These studies aimed to test the effectiveness of game-based media on students' mathematics learning outcomes.

In addition, research and development (R&D) studies are prevalent, including those conducted by Chasanah et al. (2025), Nalendra & Ratnasari (2026), and Shiddiq Windiarto & Jubair (2025). This indicates that the development of game-based media remains a primary focus of Game-Based Learning research among lower-grade students.

On the other hand, the mixed-methods approach used by Işık & Kaban (2025) and the classroom action research by Nugroho et al. (2026) remain relatively limited in scope. However, both approaches have the potential to provide a more comprehensive picture of the learning process, student interactions, and the implementation of games in a classroom context.

Research Gaps and Opportunities for Further Research

Research gaps were identified by comparing the characteristics of the media type, focus on mathematical skills, and research design. A summary of the findings and opportunities for further research is presented in Table 5.

Table 5 Research Gaps and Opportunities for Further Research

Aspect	Findings in the Corpus	Opportunities for Further Research
Grade Level	The final analysis included only 10 articles that met the criteria for students in grades 1–3. A total of 23 articles were excluded during the full-text review stage because they focused on grades 4–6.	Expand research that specifically considers the developmental characteristics and learning needs of students in grades 1–3.
Type of Media	Eight articles used digital games, and two articles used concrete or manipulative games.	Develop and test concrete games as well as combinations of concrete and digital media.
Mathematical Skills	The research focus included basic arithmetic operations, arithmetic, place value, number	Expand the study of mathematical problem-solving and other skills that are

Aspect	Findings in the Corpus	Opportunities for Further Research
	decomposition, measurement, and fractions. Problem-solving was specifically addressed in one article.	currently underrepresented in the corpus.
Research Design	Developmental and quasi-experimental studies were each found in three articles; other designs were each found in one article.	Expand research approaches that can explain the learning process, student experiences, game implementation, and learning outcomes more comprehensively.

A synthesis of ten articles reveals that research on game-based learning in lower-grade mathematics education still has several research gaps. These gaps relate to student characteristics, types of media, the mathematical skills being developed, and the focus of the research.

First, research involving lower-grade students remains relatively limited. During the full-text review stage, 23 articles were excluded because they focused on upper grades (IV–VI), while only 10 articles met the criteria for lower grades (I–III). This indicates that the implementation of Game-Based Learning for students in grades I–III has not been extensively explored.

Second, existing research is dominated by the use of digital media and technology-based platforms. Various media such as Android apps, Unity, Wordwall, Matific, Genially, and online gaming platforms are the most widely used. In contrast, concrete or manipulative game-based media suited to the characteristics of lower-grade students remain relatively rare.

Third, the mathematical skills developed have largely focused on basic arithmetic and computational operations. Research with more complex focuses, such as reasoning, problem-solving, and conceptual understanding, has not been extensively studied.

Fourth, most studies have used experimental and developmental research designs to test the effectiveness of game-based media on learning outcomes. Research exploring students' thought processes, learning interactions, or the implementation of games in daily instruction remains relatively limited.

Furthermore, few studies have examined the relationship between basic mathematical skills and higher-order thinking skills in the context of game-based learning. Research integrating multiple mathematical skills into a single game-based medium is also still limited.

Based on these findings, future research should expand its focus to include lower-grade students, develop a variety of game-based media, and explore mathematical skills that have not yet been extensively studied. Furthermore, a more diverse range of research approaches is needed to gain a more comprehensive understanding of the implementation of Game-Based Learning in elementary school mathematics instruction.

CONCLUSION

This study concludes that GBL research in elementary mathematics for grades 1–3 during 2021–2026 was dominated by digital games and focused primarily on arithmetic skills, with research and development and quasi-experimental designs being the most frequently used. The findings identify research gaps in the limited use of concrete game media, the development of problem-solving skills, and the application of diverse research designs. Therefore, further research is needed to develop GBL that incorporates concrete and hybrid media and targets a broader range of mathematical competencies in lower elementary education.

REFERENCES

ta, I. G. P., & Suarsana, I. M. (2026). Systematic Literature Review : Eksplorasi

Etnomatematika Permainan Kelereng dalam Pembelajaran Matematika Kontekstual di Sekolah Dasar. *Inspirasi Dunia: Jurnal Riset Pendidikan Dan Bahasa*, *5*(2), 119–128. https://doi.org/10.58192/insdun.v5i2.4287

Guan, X., Sun, C., Hwang, G. jen, Xue, K., & Wang, Z. (2024). Applying game-based learning in primary education: a systematic review of journal publications from 2010 to 2020. In *Interactive Learning Environments* (Vol. 32, Number 2, pp. 534–556). Routledge. https://doi.org/10.1080/10494820.2022.2091611

Gui, Y., Cai, Z., Yang, Y., Kong, L., Fan, X., & Tai, R. H. (2023). Effectiveness of digital educational game and game design in STEM learning: a meta-analytic review. *International Journal of STEM Education*, *10*(1), 1–25. https://doi.org/10.1186/s40594-023-00424-9

Harahap, N. S., & Jaelani, A. (2022). Etnomatematika pada Permainan Tradisional Engklek. *Paradikma Jurnal Pendidikan Matematika*, 15(1), 86-90 https://jurnal.unimed.ac.id/2012/index.php/paradikma/article/view/35995

Hardiyansyah, W., Turmuzi, M., & Nurmawanti, I. (2024). Efektivitas Pembelajaran Etnomatematika "Permainan Sampat" Terhadap Hasil Belajar Matematika Siswa Kelas II SDN 2 Kekeri. *Jurnal Ilmiah Profesi Pendidikan*, *9*(1), 412–418. https://doi.org/10.29303/jipp.v9i1.2076

Hikmah, P. D., & Mufliva, R. (2025). Pengembangan Media Pembelajaran Matematika "Going To Winner" Berbasis Game di Kelas I Sekolah Dasar. *Jurnal Didaktika Pendidikan Dasar*, *9*(2), 725–746. https://doi.org/10.26811/didaktika.v9i2.1803

Hussein, M. H., Ow, S. H., Elaish, M. M., & Jensen, E. O. (2021). Digital Game-Based Learning in K-12 Mathematics Education: A Systematic Literature Review. *Education and Information Technologies*, *27*(2), 2859–2891. https://doi.org/10.1007/s10639-021-10721-x

Ilmiyah, E. A., Susilo, T. A. B., & Maqfiro, M. L. H. (2024). Pengaruh Media Board Game terhadap Hasil Belajar Siswa pada Pembelajaran Matematika Kelas II Sekolah Dasar. *JIKAP PGSD: Jurnal Ilmiah Ilmu Kependidikan*, *8*(2), 238–245. https://ojs.unm.ac.id/JIKAP/article/view/61182

Işık, H. K., & Kaban, A. L. (2025). The Effects of Educational Digital Escape Games on Achievement and Motivation in Mathematics Courses. *Journal of Educational Technology and Online Learning*, *8*(1), 136–151. https://doi.org/10.31681/jetol.1603015

Jannah, M., Suryandari, K., Nurjanah, S., Muhtadin, L., Hidayati, Y. M., & Desstya, A. (2023). Analisis Etnomatematik dalam Permainan Congklak sebagai Media Pembelajaran Bangun Datar dan Bangun Ruang di Sekolah Dasar. *Pendas: Jurnal Ilmiah Pendidikan Dasar*, *8*(1), 3818–3821. https://pdfs.semanticscholar.org/9fd3/85393baf35a8f393335e1d621a88289b26c1.pdf

Kocabatmaz, H., & Saraçoğlu, G. K. (2024). The Effect of Educational Digital Games on Academic Success and Attitude in 3rd Grade Mathematics Class. *Participatory Educational Research*, *11*(2), 230–244. https://doi.org/10.17275/per.24.28.11.2

Kusuma, R. V., & Mizan, S. (2026). Transformation of Number System Learning through an Interactive Number Stacking Game for Elementary School Students. *OMEGA: Jurnal Keilmuan Pendidikan Matematika*, *5*(1), 84–91. https://doi.org/10.47662/jkpm.v5i1.1179

Kusumawardani, S., Efendi, A., & Sumaryati, S. (2025). Can digital games ease cognitive load? A systematic review and meta-analysis in mathematics learning. *Jurnal Math Educator Nusantara, 11*(2), 319–340. https://doi.org/10.29407/jmen.v11i2.27331

Lin, C.-H. (2022). Developing mental number line games to improve young children's number knowledge and basic arithmetic skills—Journal *of Experimental Child Psychology*, *222*.
https://doi.org/10.1016/j.jecp.2022.105479

Lismayani, D., Sutisnawati, A., & Maula, L. H. (2026). Penerapan Media Benda Konkret untuk Meningkatkan Pemahaman Konsep Penjumlahan dan Pengurangan Peserta Didik Kelas Ii Sd Negeri 1 Cipetir Kabupaten Sukabumi. *Pendas : Jurnal Ilmiah Pendidikan Dasar,* (Vol. 11, Number 03).
https://journal.unpas.ac.id/index.php/pendas/article/view/56502/34314

Lisnasari, S. F., Jainab, D., & Pelista. (2024). Dampak Penggunaan Media Konkret dalam Manajemen Pembelajaran Terhadap Kemampuan Numerasi Siswa Sekolah Dasar. *Jurnal JIPDAS (Jurnal Ilmiah Pendidikan Dasar)*, *4*(4), 449–457. https://doi.org/10.37081/jipdas.v4i4.2889

Luthfi, S., Kur'aini, N., Syazwani, N. I., & Kowiyah. (2026). Pembelajaran Matematika Bermakna Melalui Konteks Cerita dalam Operasi Penjumlahan dan Pengurangan di Kelas Rendah Sekolah Dasar. *SIGMA: Jurnal Pendidikan Matematika*, *18*(1), 559–570. https://journal.unismuh.ac.id/index.php/sigma/index

Maghfiroh, W. A. F., & Sari, E. F. (2025). Perancangan Media Permainan Penjumlahan "Tic Tac Tika" untuk Meningkatkan Kemampuan Penjumlahan Siswa Sekolah Dasar. *Joyful Learning Journal,* (Vol. 14, Number 4). https://journal.unnes.ac.id/sju/index.php/jlj

Muhaimin, Y. Y., Wardani, S., Harianingsih, Subali, B., & Widiati, N. (2025). Digital-Based Mathematics Learning in Primary Education: Systematic Literature Review. *Journal of Educational Sciences*, *9*(4), 2138–2151. https://doi.org/10.31258/jes.9.4.p.2138-2151

Nalendra, M. A., & Ratnasari, C. I. (2026). A Digital Dakon Game for Elementary Mathematics Learning: An ADDIE-Based Development. *Bit-Tech*, *8*(3), 3895–3906. https://doi.org/10.32877/bt.v8i3.3748

Natacya, T. D., Subali, B., & Ellianawati. (2026). Tinjauan Sistematis: Model Pembelajaran dalam Pemecahan Masalah Soal Cerita Matematika di Sekolah Dasar (2020-2024). *Jurnal Sekolah*, *10*(2), 400–416.
https://jurnal.unimed.ac.id/2012/index.php/js/article/view/71418

Nugroho, A., Oktaufika, Y., & Wibowo, A. P. (2026). Integration of Problem-Based Learning and Number Monopoly: Strategies for Improving Elementary School Students' Mathematical Literacy. In *Journal Eduscience (JES* (Vol. 13, Number 3).
https://jurnal.ulb.ac.id/index.php/eduscience/article/view/9194/5812

Nur, M. A. (2025). Meta Analisis Pengaruh Permainan Tradisional terhadap Hasil Belajar Matematika Siswa Sekolah Dasar di Indonesia. *Kognitif: Jurnal Riset HOTS Pendidikan Matematika*, *5*(2), 494–505. https://doi.org/10.51574/kognitif.v5i2.2921

Nurazizah, K. (2023). Etnomatematika: Meningkatkan Minat dan Pemahaman Matematika melalui Media Permainan Congklak. *Jurnal Ilmiah Pendidikan Matematika Al Qalasadi*, *7*(2), 138–147. https://doi.org/10.32505/qalasadi.v7i2.6793

Nurhasanah, Sesrita, A., & Muhdiyati, I. (2024). Pengaruh Permainan Tradisional Congklak Terhadap Pemahaman Konsep Perkalian Siswa Kelas II SDN Cisarua 01. *Cendikia Jurnal Pendidikan Dan Pengajaran*, *2*(5), 362–369. https://jurnal.kolibi.org/index.php/cendikia/article/view/1500

Oktarina, E. (2022). Exploration of Traditional Game of Marbles in Maths Learning in

Primary School. *Pedagogik Journal of Islamic Elementary School*, 161–170. https://doi.org/10.24256/pijies.v5i1.3757

Page, M. J., McKenzie, J. E., Bossuyt, P. M., Boutron, I., Hoffmann, T. C., Mulrow, C. D., Shamseer, L., Tetzlaff, J. M., Akl, E. A., Brennan, S. E., Chou, R., Glanville, J., Grimshaw, J. M., Hróbjartsson, A., Lalu, M. M., Li, T., Loder, E. W., Mayo-Wilson, E., McDonald, S., … Moher, D. (2021). The PRISMA 2020 statement: An updated guideline for reporting systematic reviews. In *BMJ* (Vol. 372). BMJ Publishing Group. https://doi.org/10.1136/bmj.n71

Pan, Y., Ke, F., & Xu, X. (2022). A systematic review of the role of learning games in fostering mathematics education in K-12 settings. In *Educational Research Review* (Vol. 36). Elsevier Ltd. https://doi.org/10.1016/j.edurev.2022.100448

Pujasmara, D. D., Humaira, J., Alifah, P. Z., Martiana, Y. A., & Rostika, Rd. D. (2024). Peningkatan Hasil Belajar Penjumlahan dan Pengurangan Bilangan Siswa Kelas I dengan Media Konkret. *Jurnal Pendidikan Guru Sekolah Dasar*, *1*(2), 10. https://doi.org/10.47134/pgsd.v1i2.211

Putra, E. D., & Lestari, W. I. (2024). Etnomatematika pada Permainan Tradisional Neker (Kelereng). *Laplace : Jurnal Pendidikan Matematika*, *7*(1), 236–247. https://doi.org/10.31537/laplace.v7i1.1799

Rahayu, I. R., & Rukmana, D. (2022). The Effect of Game-Based Learning Model Assisted bu A Bamboozle on the Multiplication Operation Skills of Elementary School Students. *Primary: Jurnal Pendidikan Guru Sekolah Dasar*, *11*(4), 1265–1274. https://doi.org/10.33578/jpfkip.v11i4.9000

Rismadani, R. P., Fuadiah, N. F., & Masnunah. (2026). Penerapan Etnomatematika Permainan Tradisional Engklek dalam Pembelajaran Matematika Materi Bangun Datar Siswa Kelas 3 SDN 28 Banyuasin. *Jurnal Papeda*, *8*(1), 25–34. https://e-journal.unimudasorong.ac.id/index.php/jurnalpendidikandasar/article/view/3850

Ritonga, M., & Suparni. (2024). Eksplorasi Etnomatematika Pada Permainan Tradisional Kelereng. *EDUCOFA: Jurnal Pendidikan Matematika*, *1*(1), 71–84. https://doi.org/10.24952/ejpm.v1i1.11402

Rohmani, Elizar, Sartipa, D., Distrik, I. W., Herpratiwi, & Maulina, D. (2023). The Effectiveness of Digital Game-Based Learning in Elementary Schools: A Literature Review. *International Conference on Child Education 2023*, 1(2), 26-35 https://proceeding.unimar.ac.id/index.php/icce/article/view/65

Romadoni, J., Mailansa, E., & Saparina, M. (2024). Rancang Bangun Game Edukasi Matematika untuk Tingkat Sekolah Dasar Kelas 1 dan 2 Berbasis Android. *Explore: Jurnal Sistem Informasi Dan Telematika*, *15*(1), 60. https://doi.org/10.36448/jsit.v15i1.3496

Rosmiandini, L. A., Nafisah, R. A., Bintang, & Sihombing, V. R. (2023). Game Edukasi Matematika Berbasis Android untuk Anak Sekolah Dasar: Uji Coba dan Peningkatan Hasil Belajar. *Jurnal PANCAR Pendidik Anak Cerdas dan Pintar*, *7*(1), 251–258. https://jurnal.unugha.ac.id/index.php/pancar/article/view/611

Ruiz, C., Kohnen, S., von Hagen, A., Kwok, F. Y., & Bull, R. (2024). Which domain-specific skills at the beginning of formal schooling predict later mathematical achievement? A systematic review and meta-analysis. *Educational Research Review*, *42*, 1–21. https://doi.org/10.1016/j.edurev.2023.100583

Russo, J., Kalogeropoulos, P., Bragg, L. A., & Heyeres, M. (2024). Non-Digital Games That Promote Mathematical Learning in Primary Years Students: A Systematic Review. In *Education Sciences* (Vol. 14, Number 2, pp. 1–19). Multidisciplinary Digital Publishing Institute (MDPI).

https://doi.org/10.3390/educsci14020200

Sahasika, W., Fiantika, F. R., & Prayogo. (2025). Eksplorasi Etnomatematika dalam Permainan Tradisional Lompat Tali pada Pembelajaran Berhitung Siswa Kelas II Sekolah Dasar. *Pendas: Jurnal Ilmiah Pendidikan Dasar*, *10*(1), 221–228.
https://journal.unpas.ac.id/index.php/pendas/article/view/23872

Samavati, M., Ardakani, S. P., Jamehbozorg, Z., Zavaraki, E. Z., & Aliabadi, K. (2024). The Impact of Adaptive Game-Based Instruction on Mathematical Performance of Students With Mathematics Learning Disorder in A Mobile Learning Environment. *Journal of Psychological Science*, *23*(135), 1–20.
https://doi.org/10.52547/JPS.23.135.1

Sari, M. H., & Olkun, S. (2024). Improving Low Mathematics Achievers' Number Sense via Number Line Training with Board Games. *Journal of Education and Future*, (26), 41–56. https://doi.org/10.30786/jef.1371037

Sella, F., Jay, T., & James-Brabham, E. (2023). Designing and Evaluating a Novel Board Game to Improve Early Numerical Skills. *Loughborough University*, 1-24
https://www.nuffieldfoundation.org/project/designing-evaluating-novel-board-game-improve-early-numerical-skills

Shiddiq Windiarto, M., & Jubair, A. M. (2025). Design and Development of a Unity 2D Math Educational Game for Elementary Students' Arithmetic Skills. *Journal of Computing and Informatics*, *02*(02). https://ejournal.duniakampus.org/index.php/joki

Sholihah, W., Basri, H., Ghafur, A., & Salman. (2024). Eksplorasi Etnomatematika pada Permainan Tradisional Engklek. *Kognitif: Jurnal Riset HOTS Pendidikan Matematika*, *4*(3). https://doi.org/10.51574/kognitif.v4i3.1943

Snyder, H. (2019). Literature review as a research methodology: An overview and guidelines. *Journal of Business Research*, *104*, 333–339. https://doi.org/10.1016/j.jbusres.2019.07.039

Utami, N. D., Mariana, N., & Ekawati, R. (2026). The Impact of Ethnomathematics Approach on Numeracy and Mathematical Reasoning Skills of Elementary School Students: A Systematic Literature Review. *Jurnal Riset Pendidikan dan Inovasi Pembelajaran Matematika (JRPIPM)*, *10*(1), 74–89. https://doi.org/10.26740/jrpipm.v10n1.p74-89

Vessonen, T., Dahlberg, M., Hellstrand, H., Widlund, A., Korhonen, J., Aunio, P., & Laine, A. (2024). Task Characteristics Associated with Mathematical Word Problem-Solving Performance Among Elementary School-Aged Children: A Systematic Review and Meta-Analysis. *Educational Psychology Review*, *36*(4). https://doi.org/10.1007/s10648-024-09954-2

Wardani, M. S., & Himmah, W. I. (2026). Traditional Game-Based Learning for Mathematics in Elementary School: A Systematic Literature Review. *Desimal: Jurnal Matematika*, *09*(02), 228–254. https://doi.org/10.24042/djm.v9i2

Xiao, Y., & Watson, M. (2017). Guidance on Conducting a Systematic Literature Review. In *Journal of Planning Education and Research* (Vol. 39, Number 1, pp. 93–112). SAGE Publications Inc.
https://doi.org/10.1177/0739456X17723971

Yulianto, D., Situmeang, M. S., Astari, & Nurcahyo, R. (2026). Digital Game-Based Learning in Primary Mathematics: A Systematic Review and Meta-Analysis of Research Trends and Learning Outcomes. *Range: Jurnal Pendidikan Matematika*, 7(2), 479-531. https://jurnal.unimor.ac.id/index.php/JPM/article/view/10225