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ANALYSIS OF MATHEMATICAL CRITICAL THINKING ABILITIES OF ELEMENTARY SCHOOL STUDENTS

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Abstract
This study aims to analyze elementary school students' mathematical critical thinking skills through a Systematic Literature Review (SLR) approach based on the PRISMA guidelines. A total of 20 articles published between 2015 and 2025 were obtained from the Google Scholar and Publish or Perish databases and systematically analyzed through identification, selection, and content analysis stages. The review results indicate that learning models such as Problem Based Learning (PBL), Discovery Learning, and Realistic Mathematics Education (RME) are the most widely applied and proven effective in enhancing students' mathematical critical thinking skills. Furthermore, digital learning media such as investigation-based e-LKPDs, contextual mathematics comics, and interactive multimedia contribute positively to improving conceptual understanding and analytical ability. Several studies also highlight common challenges, including teachers' limited pedagogical competence and students' low learning motivation. Overall, this literature synthesis provides a comprehensive overview of trends, effectiveness, and challenges in developing mathematical critical thinking skills among elementary school students in Indonesia.
Keywoards: *critical thinking; mathematics; primary school*

Abstrak
Penelitian ini bertujuan untuk menganalisis kemampuan berpikir kritis matematis siswa sekolah dasar melalui pendekatan *Systematic Literature Review* (SLR) yang mengacu pada pedoman PRISMA. Sebanyak 20 artikel terbitan 2015–2025 yang diperoleh dari basis data *Google Scholar* dan *Publish or Perish* dianalisis melalui tahapan identifikasi, seleksi, dan analisis isi secara sistematis. Hasil kajian menunjukkan bahwa model pembelajaran *Problem Based Learning* (PBL), *Discovery Learning*, dan *Realistic Mathematics Education* (RME) paling banyak digunakan dan terbukti efektif dalam meningkatkan keterampilan berpikir kritis matematis siswa sekolah dasar. Selain itu, media pembelajaran digital seperti e-LKPD berbasis investigasi, komik matematika kontekstual, dan multimedia interaktif turut berkontribusi terhadap peningkatan pemahaman konsep dan kemampuan analitis siswa. Beberapa penelitian juga menyoroti kendala yang umum terjadi, yaitu keterbatasan kompetensi guru dan rendahnya motivasi belajar siswa. Secara keseluruhan, hasil sintesis literatur ini memberikan gambaran komprehensif mengenai tren, efektivitas, serta tantangan dalam pengembangan kemampuan berpikir kritis matematis siswa sekolah dasar di Indonesia.
Kata Kunci: Berpikir kritis; matematis; sekolah dasar

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Introduction

Education is one way to develop and improve the quality of human resources. Through education, each individual can hone their potential, making it easier to find solutions to various problems they face (Nurmalita & Hardjono 2020) . In 21st-century learning, the primary focus is on developing students' critical thinking skills, linking existing knowledge to real-world situations, and mastering information technology, communication, and collaboration skills. According to Sapriya (in Azmy & Yustitia , 2023), the goal of critical thinking is so that someone

is able to solve a problem by producing the right decision or answer. The Trends *in International Mathematics and Science Study* (TIMSS) found that Indonesian students' critical thinking skills are very low. This is in line with the results of the 2022 PISA (Philosophy of International Mathematics and Science) released by the OECD, which ranked Indonesia around 69th out of 81 countries for mathematics with a score of 366, 71st for reading with a score of 359, and 63rd for science with a score of 383. Although there is a slight improvement compared to the 2018 PISA results, these scores are still far below the OECD average of around 472 for mathematics, 476 for reading, and 485 for science, respectively (OECD, 2022) . This illustrates that Indonesian students' critical thinking skills have not yet reached the expected level. Students are often not given sufficient opportunities to solve problems independently by utilizing their analytical skills.

In mathematics learning, one of the essential skills that must be developed to support 21st-century skills is critical thinking in problem-solving. However, in practice, the mathematics learning process in the classroom still provides insufficient opportunities for students to practice their critical thinking skills. In mathematics lessons, students are required to solve problems carefully, systematically, and accurately. In reality, students are more directed to provide answers that align with examples or methods taught by the teacher. This limits the development of students' critical thinking, as they are less encouraged to seek alternative solutions that can hone their critical thinking skills (Ati & Setiawan 2020).

In the results of research conducted by Mu karomah in 2018, it was found that the critical thinking skills of students in grade IV of SDN Gelam 1 showed that the critical thinking skills of students in mathematics learning were still low. Learning was still dominated by teachers, students tended to only follow the directions and methods given by the teacher in solving number problems, without paying attention to their relationship to everyday problems related to mathematics material. Mathematics learning activities focused more on calculations alone and were rarely connected to concepts in students' lives. In addition, students were also less accustomed to expressing opinions or ideas in the mathematics learning process so they became passive (Mukaromah, 2018) .

According to Kusumaningtyas (in Nurmalita & Hardjono 2020) , one method that can be used to help students develop their critical thinking skills is the Indonesian Realistic Mathematics Education (PMRI) approach. Experts state that the PMRI approach places students' realities and experiences as the starting point for learning . The PMRI approach utilizes realities and situations that students can imagine as a means in the learning process to achieve predetermined goals. In PMRI, the real world is used as a starting point for developing ideas and concepts in mathematics learning. If mathematical concepts are instilled using the right approach and are able to train students' critical thinking skills, they will be encouraged to express their ideas and develop their abilities. This way, learning objectives can be optimally achieved, and student learning outcomes, including critical thinking skills, will further develop (Nurmalita & Hardjono 2020) .

Several previous studies have addressed critical thinking skills in mathematics learning, but the results show variation in the indicators used, the research context, and the educational level studied. Few studies have comprehensively examined elementary school students' mathematical critical thinking skills based on existing research findings. This situation indicates the need for systematic review to obtain a more comprehensive picture of mathematical critical thinking skills at this level.

Based on this, this study was conducted to review and analyze research findings related to elementary school students' mathematical critical thinking skills. The purpose of this study was to conduct a systematic literature review to identify characteristics, influencing factors, and learning strategies that have the potential to improve elementary school students' mathematical critical thinking skills.

Research Methods

This research applies the *Systematic Literature Review* (SLR) method with the aim of identifying, understanding, examining, and evaluating various relevant studies to answer the formulated research questions. The SLR implementation stages follow the PRISMA (*Preferred Reporting Items for Systematic Reviews and Meta-Analyses*) approach, which includes the process of journal selection, screening and determining inclusion criteria, coding based on keywords, information extraction, and analysis of journals that have passed the selection (Chiu et al., 2023). The entire series of methodological stages is presented visually in Figure 1, which depicts the process flow such as input, data processing and output. in implementing *a Systematic Literature Review* in a systematic and structured manner .

In determining the article selection criteria, this study applied the PICOC (*Population, Intervention, Comparison, Outcomes, & Context) method* as a basis for determining the study focus and limitations in the literature search. This method can help researchers identify the characteristics of the study population, the type of intervention studied, the comparison variables, the expected outcomes, and the appropriate research context, as shown in Figure 1 .

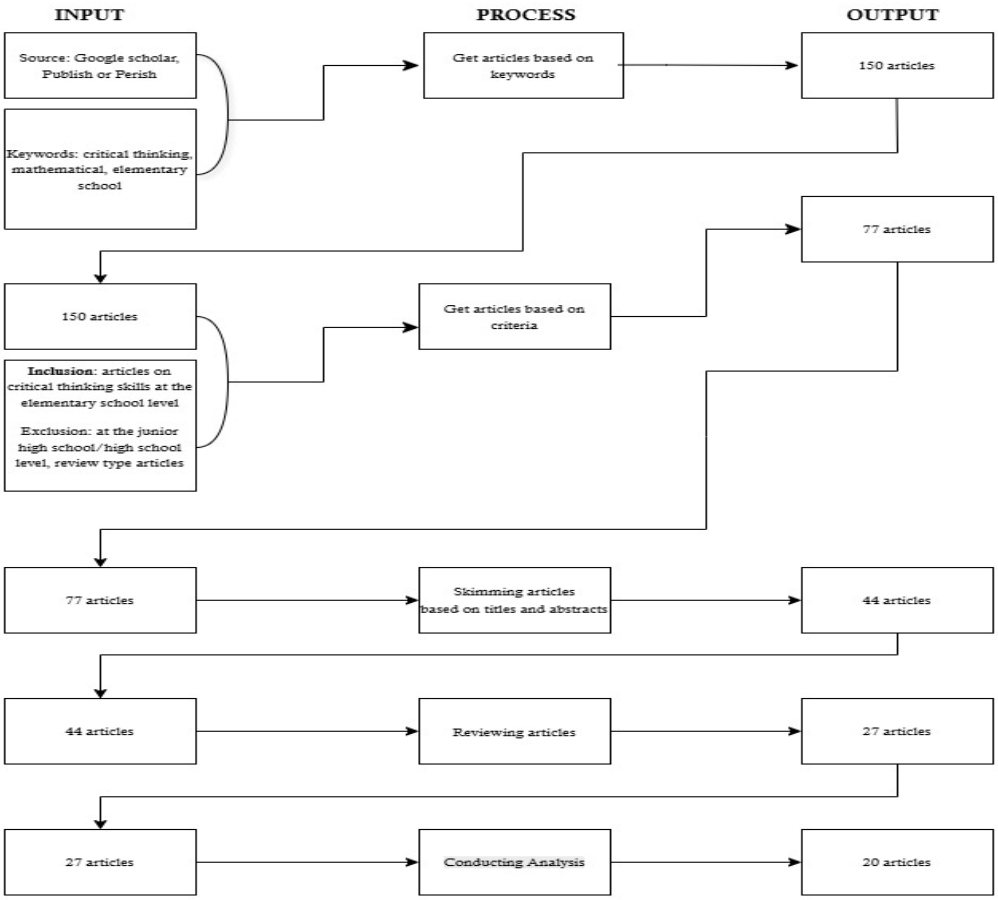

Figure 1. Research Methodology
Source: Researcher data processed, 2025.

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The initial stage of this research was conducted by selecting journals from various national and international databases. This process began with a search using keywords such as *critical thinking* , *mathematics* , and *elementary school* in several databases, including Google Scholar and Publish or Perish. From this initial search, approximately 150 journals were identified as potentially relevant to the research focus.

The next step was to apply inclusion and exclusion criteria to the collected journals. The inclusion criteria included articles discussing elementary school students' mathematical critical thinking skills published between 2015 and 2025. After the screening process was carried out according to the criteria, 77 articles remained suitable for further analysis.

The third stage involved reviewing the titles and abstracts of 77 articles that had passed the initial selection process through a *skimming process* to assess their relevance to the research focus. From this stage, 44 articles were deemed suitable and selected for further analysis. Next, an in-depth review of the articles' contents was conducted to obtain comprehensive information and ensure their suitability to the research focus, namely, elementary school students' critical mathematical thinking skills. The results of this in-depth review resulted in 20 articles being deemed suitable and used as primary sources for analysis.

The final stage is to conduct a content analysis of the 20 selected articles using a *Systematic Literature Review* approach . The purpose of this analysis is to group the important findings from each article and compile them into a complete conclusion, so that it can answer the research problem formulation and provide a comprehensive picture of the topic being studied regarding elementary school students' mathematical critical thinking skills .

Table 1PICOC method

Population (P)	Elementary School Students
Intervention (I)	Mathematical Critical Thinking Skills
Comparison (C)	n/a
Outcomes (O)	Improving Elementary School Students' Critical Mathematical Thinking Skills
Context (C)	Mathematics Learning in Elementary School

The formulation of research questions (*Research Questions*) is carried out to direct the review process towards the predetermined study objectives. These research questions become the primary focus of the literature search, selection, and analysis process, ensuring that the review results can comprehensively and measurably address the research focus. The research questions *are* shown in Table 2.

Table 2 Research Questions

#	Research Questions	Motivation / purpose / benefit
RQ1	What is the level of critical mathematical thinking ability of elementary school students in solving math problems?	Determining the level of students' critical thinking skills in solving problems in mathematics problems
RQ2	Identification of indicators of mathematical critical thinking skills that are most mastered and least mastered by elementary school students.	Analyze and determine the things that are obstacles for students in mathematical critical thinking.
RQ3	What factors influence the mathematical critical thinking skills of elementary school students?	Knowing and determining appropriate methods to improve students' critical mathematical thinking skills
RQ4	What is the contribution of the results of the study of mathematical critical	Make research results a benchmark in developing and improving learning strategies in the future.

	thinking skills to the development of mathematics learning strategies at the elementary school level?

Result and Discussion

Based on the analysis of 20 articles reviewed, it was found that elementary school students' critical mathematical thinking skills remain a major learning challenge. Most studies indicate that the application of innovative learning models, contextual approaches, and the use of digital media can significantly improve students' critical thinking skills. A summary of the analysis results from these 20 articles is presented in Table 3.

Table 3. Research analysis results

No	Article Title	Research result
1	Mathematical Critical Thinking Skills	This article emphasizes that critical mathematical thinking is not simply the ability to answer questions, but encompasses complex cognitive processes such as problem-solving, analysis, assessment, and decision-making. Consistent with Piaget's and Vygotsky's constructivist theories, this ability develops when students actively construct knowledge through experience and social interaction.
2	Improving the Understanding of Mathematical Concepts and Critical Mathematical Thinking Skills of Fifth Grade Elementary School Students through Exploratory Learning	This study demonstrates that exploratory learning significantly improves fifth-grade elementary school students' conceptual understanding and critical thinking skills compared to direct instruction. Consistent with Piaget's and Vygotsky's constructivist theories, this learning positions students as active subjects who construct their knowledge through exploration, interaction, and reasoning. The teacher acts as a facilitator, helping students construct concepts through experience and guidance within the zone of proximal development.
3	Analysis of Students' Critical Thinking Skills in Mathematics Subjects	This study shows that the critical thinking skills of fourth-grade students at SDN 03 Sebungkang are still very low, especially in formulating reasons and drawing conclusions. Contributing factors include low motivation, anxiety, and minimal interaction with teachers. According to Vygotsky's constructivist theory, improving these skills requires support from teachers as facilitators who provide guidance and opportunities for active thinking.
4	The Effectiveness of E-LKPD Based on an Investigative Approach on Elementary School Students' Critical Thinking Skills	This experimental study shows that e-LKPD based on an investigative approach significantly improves the critical thinking skills of fifth-grade elementary school students. Students who learn using e-LKPD achieve higher scores because they are accustomed to solving problems, determining strategies, and arguing logically. In line with Vygotsky's theory, the use of digital media can help students understand abstract concepts more concretely .
5	Critical Thinking Skills in Realistic Mathematics Approach in Elementary School	The use of the Realistic Mathematics Approach (RMA) effectively improves elementary school students' critical thinking skills. By utilizing real-world contexts as a basis for learning, students can connect abstract concepts to everyday experiences. In line with Vygotsky's constructivist theory, RMA positions the teacher as a facilitator, guiding interactions and discussions, allowing

		students to actively construct understanding and develop logical and analytical thinking skills.
6	Literature Review: Differentiated Learning to Improve Critical Thinking Skills in Mathematics	This study confirms that differentiated learning effectively enhances critical thinking because it adapts to students' learning styles and ability levels. Consistent with Piaget's and Vygotsky's learning theories , students construct knowledge through experience and guidance within the zone of proximal development. This also aligns with Bloom's revised taxonomy, which emphasizes the development of higher-order thinking skills (C6) such as analyzing, evaluating, and creating.
7	Analysis of the Level of Critical Thinking Ability of Elementary School Students Reviewed from the Level of Mathematical Ability	The results show that the critical thinking skills of fifth-grade students at SDN Jember Lor 1 are in the moderate category (average 71.8), with most students still relying on formulas without logical reasoning. According to Piaget and Vygotsky's theories, students need guidance to develop reasoning through challenging activities within the zone of proximal development.
8	Critical Thinking Skills in Mathematics Learning	Research results show that differentiated learning effectively improves critical thinking skills by tailoring the learning process to each student's needs. Consistent with Piaget's and Vygotsky's theories, differentiation helps students build knowledge through experience and developmentally appropriate guidance. It also supports higher cognitive domains in Bloom's revised taxonomy, such as analyzing, evaluating, and creating, which are essential for 21st-century learning.
9	*Application of Talking Stick Co-operative Model to Improve Students' Mathematics Learning Activity and Result in Primary School* (Iim Fatimah, et al. , 2025)	*Talking Stick* model has been proven effective in increasing students' math learning activities and outcomes. This improvement demonstrates that collaborative learning can stimulate social interaction and critical thinking, aligning with Piaget and Vygotsky's view that knowledge is formed through experience and social guidance within an active learning context.
10	*Realistic Mathematics Education* Model to Improve Motivation and Learning Outcomes of Fourth Grade Students of UPTD SDN 1 Tegalgirang (Sony Oktaviana, 2023)	The results obtained using the RME model have proven effective in improving learning outcomes and motivation by linking mathematical concepts to students' real-life experiences. This improvement reflects the fact that understanding is more easily formed when students actively construct meaning through relevant contexts, aligning with the constructivist perspectives of Piaget and Vygotsky.
11.	Developing Mathematical Thinking in the Primary Classroom: Liberating Students and Teachers as Learners of Mathematics (Hudson, Henderson & Hudson, 2015)	A study of 24 primary school teachers in Scotland showed that a constructivist-based mathematical thinking development program had a transformative impact. Teachers became more confident, reflective, and creative in their teaching, and were able to avoid procedural approaches that lead to *symbolic violence* . From a Vygotskyian theoretical perspective, the teacher's role as *a more knowledgeable other* is key in providing *scaffolding* appropriate to students' needs.
12.	The Implementation of Mathematics Comic through Contextual Teaching and Learning to Improve Critical Thinking Ability and Character (Lestari, Ahmadi & Rochmad, 2021)	This quasi-experimental study demonstrated that a Pancasila-based math comic using the CTL approach effectively improved students' critical thinking skills and character. Significant improvements were seen in learning outcomes and the values of discipline and hard work. These findings suggest that contextual learning that combines engaging visuals and character values helps

		students actively construct knowledge, aligning with Piaget's and Vygotsky's constructivism and the higher-order thinking domains in Bloom's revised taxonomy.
13.	Discovery Learning and Critical Mathematical Thinking Skills of Elementary School Students (Bahauddin Azmy & Via Yustitia, 2023)	The results of this study prove that the Discovery Learning model is effective in improving students' critical thinking skills in the material on the volume of cuboids. This is in line with Bruner's theory of discovery learning, which emphasizes the importance of active student involvement in discovering concepts through direct experience.
14.	Implementation of Problem Based Learning Model to Improve Learning Outcomes and Critical Thinking Skills in Mathematics in Fourth Grade Students (Isnanto S. Utomo & Agustina TA Hardini, 2023)	Classroom action research shows that PBL effectively improves critical thinking skills and student learning outcomes. Significant improvements in each cycle reflect that problem-solving encourages active knowledge construction, in line with the theories of Piaget, Vygotsky, and Bruner, as well as the development of higher-order thinking in Bloom's revised taxonomy.
15.	The Effectiveness of Using the Problem Based Learning (PBL) Learning Model on Elementary School Students' Critical Thinking Skills in Mathematics (Winda S. Faudziah & Indra A. Budiman, 2023)	A Systematic Literature Review (SLR) identified primary PBL studies (2016–2022). Synthesis results: The majority of studies reported PBL to be effective in improving elementary school students' critical thinking skills; studies were classified by year, level, material, method, and outcome.
16.	Implementation of the Problem Based Learning (PBL) Model in Blended Learning to Improve Collaboration, Critical Thinking, and Concept Mastery (Christine Sipahutar, 2022)	The results of the CAR (Care and Development) showed that blended learning-based PBL effectively improved students' collaboration and critical thinking. This finding aligns with Piaget's constructivist theory, which emphasizes active learning through experience, and Vygotsky's theory, which highlights the importance of social interaction and scaffolding in building knowledge.
17.	Efforts to Improve Mathematics Learning Outcomes and Motivation Using the Course Review Horay Type Cooperative Learning Model (Asrizal Wahdan Wilsa, Khoimatun, Tri Oktaviyani, 2023)	The Course Review Horay model effectively improves learning outcomes and motivation by creating an active and enjoyable learning environment. This improvement demonstrates that positive emotions and social interactions strengthen student engagement, aligning with Rogers' humanistic theory and social constructivism, which emphasize the role of experience and relationships in meaningful learning.
18.	Implementation of the Jigsaw Type Cooperative Learning Model in Improving Mathematics Learning Outcomes (I. Supriyati, RAK Dewi, KD Khoimatun, 2022)	The use of the Jigsaw model effectively improves learning outcomes by fostering responsibility and collaboration among students. This improvement reflects the fact that stronger understanding is formed through social interaction and mutual teaching, in line with Vygotsky's view of the collaborative construction of knowledge.
19.	*Optimizing Mathematical Problem-Solving Skills Among Students Through Metacognitive-Based Teaching Materials Development* (Liyana Sunanto, Mahpudin, 2023)	Research into the ADDIE model has produced a valid and effective metacognitive-based teaching tool for improving problem-solving skills in primary school teacher education (PGSD) students. This strategy fosters thinking awareness and self-reflection, in line with Flavell, Piaget, and Bloom's revised theories on cognitive control and the development of higher-order thinking.

20.	Analysis of the Low Mathematical Problem-Solving Ability of Grade III Students on Simple Fractions (Putri & Sunanto, 2024)	Third-grade students still experience difficulty solving simple fraction problems, particularly comparing fractions, understanding story problems, and determining unlike denominators. Contributing factors include poor memory, poor interest in learning, and a weak understanding of fraction concepts. Teachers are advised to provide practice problems based on everyday life, understand students' learning styles, and utilize relevant learning media .

Based on the results of the article analysis , Table 2 shows a variety of strategies and approaches used to improve mathematical critical thinking skills. Learning models such as PBL, Discovery Learning, and Course Review Horay can encourage students to actively solve problems, express opinions, and draw logical conclusions. Furthermore, the use of innovative media such as investigation-based e-LKPD, contextual math comics, and interactive multimedia has been shown to increase students' motivation, conceptual understanding, and reflective abilities. However, some studies still find limitations in aspects of learning independence, low motivation, and the dominance of traditional lecture methods. This indicates the need for pedagogical transformation that places more emphasis on active, collaborative, and problem-solving-based learning.

The results of the in-depth review of the literature review conducted will be explained again in Table 4 by grouping each article into several categories.

Table 4. Journal Category Grouping

No	Author	Year	Domain	Focus	Object	Method
1	Hardika Saputra	2020	Mathematics Education	The concept of mathematical critical thinking	Conceptual articles (elementary school students & general)	Literature study / theoretical review
2	Itoh Masitoh, Sufyani Prabawanto	2015	Elementary School Mathematics Education	Exploratory learning	Fifth grade elementary school students	Quasi-experimental
3	Olenggius JD, Dwi CW, Susi S.	2020	Mathematics Education	Analysis of critical thinking skills	15 fourth grade students of SDN 03 Sebungkang	Qualitative descriptive
4	Vivi Puspita, Ika Parma Dewi	2021	Mathematics Education	Investigation-based e-LKPD	68 fifth grade elementary school students	Quasi-experimental
5	Ika Sartika	2019	Mathematics Education	Realistic Mathematical Approach	Elementary school students	Conceptual study
6	Lisda Minangkabau, Putriyani S, Suarti Djafar, Nurdin	2024	Mathematics Education	Differentiated learning	Elementary & Middle School Students (Literature)	Literature review
7	Nur Fitri Amalia, Leni Nur Aini, Syukron Makmun	2020	Mathematics Education	Analysis of the level of critical thinking skills	26 fifth grade students of SDN Jember Lor 1	Descriptive

8	Lisda Minangkabau et al.	2024	Mathematics Education	Differentiated learning & critical thinking	Elementary school students (literature)	Literature review
9	Iim Fatimah, Dadang Suhada, Khoimatun	2025	basic education	Mathematics learning activities & outcomes using the Talking Stick model	Fourth grade students of SDN 2 Benda Karangampel (35 students)	PTK (3 cycles)
10	Sony Oktaviana	2023	basic education	Motivation & learning outcomes with the RME model	Fourth grade students of SDN 1 Tegalgirang (20 students)	PTK (2 cycles)
11	Brian Hudson, Sheila Henderson, Alison Hudson	2015	Teacher Education / Curriculum	Developing mathematical thinking in the classroom & changing teacher practices	24 primary school teachers in Scotland	Design research, action research
12	Farida Puput Lestari, Farid Ahmadi, Rochmad	2021	basic education	Critical thinking & character education with math comics	Fourth grade elementary school students in Semarang (experimental & control)	Quasi-experiment
13	Bahauddin Azmy & Via Yustitia	2023	Learning Model / Mathematics	The effect of Discovery Learning on critical thinking	Fifth grade elementary school students (n=40)	Quasi-experimental (posttest-only nonequivalent) - t-test
14	Isnanto S. Utomo & Agustina TA Hardini	2023	Problem Based Learning / Mathematics	Implementation of PBL for critical thinking & learning outcomes	Fourth grade elementary school students (n=27)	Classroom Action Research (2 cycles)
15	Winda S. Faudziah & Indra A. Budiman	2023	Systematic Literature Review (PBL)	The effectiveness of PBL on critical thinking	Research articles (primary studies)	Systematic Literature Review
16	Christine Sipahutar	2022	PBL in Blended Learning	Collaboration, critical thinking, concept mastery	Fourth grade elementary school students (n=20)	PTK (one-group pre-post)

17	Asrizal Wahdan Wilsa, Khoimatun, Tri Oktaviyani (2023)	Elementary Education (Mathematics)	Improve learning outcomes and motivation with Course Review Horay	Sixth grade students of SDN 1 Jayalaksana, Indramayu (24 students)	Classroom Action Research (CAR), 2 cycles	Asrizal Wahdan Wilsa, Khoimatun, Tri Oktaviyani (2023)
18	I. Supriyati, RAK Dewi, KD Khoimatun (2022)	Elementary Education (Mathematics)	Improving fraction learning outcomes with Jigsaw	Fifth grade students of MI Uswatun Hasanah, Cirebon (20 students)	Classroom Action Research (CAR), 2 cycles	I. Supriyati, RAK Dewi, KD Khoimatun (2022)
19	Liyana Sunanto, Mahpudin (2023)	Higher Education (PGSD)	Development of metacognitive-based teaching materials to improve problem solving	3rd semester student of Elementary School Teacher Education, Pelita Bangsa University	Research & Development (R&D), ADDIE model	Liyana Sunanto, Mahpudin (2023)
20	Putri & Sunanto	2024	Elementary School Mathematics Education	Difficulty analysis & problem solving skills	Third grade elementary school students	Qualitative descriptive (literature study)

Based on the classification in Table 2, most studies highlight the role of mathematics education and learning strategies as the primary domain. Innovative learning media such as e-LKPD (learning materials for students), math comics, and interactive multimedia also receive significant research attention due to their proven effectiveness in improving motivation and learning outcomes. Meanwhile, topics related to curriculum, teacher roles, and the integration of character education remain limited. This presents an opportunity for further research to focus more attention on aspects of curriculum management, teacher competency, and character values in mathematics learning.

Based on the classification of 20 articles, the research topics can be divided into several main domains:

1. Mathematics Education and Learning Models (40%): focus on PBL, Discovery Learning, RME, and differentiated learning.
2. Learning Media and Innovation (25%): includes e-LKPD, math comics, and interactive multimedia.
3. Analysis of Learning Abilities and Outcomes (20%): highlights the level of students' critical abilities, motivation, and learning outcomes.
4. Curriculum Development and Teachers (10%): discusses the role of teachers in developing mathematical thinking.
5. Character Education (5%): integration of character values in mathematics learning.

This distribution shows that most research still focuses on learning strategies and innovative media as an effort to improve elementary school students' mathematical critical thinking skills.

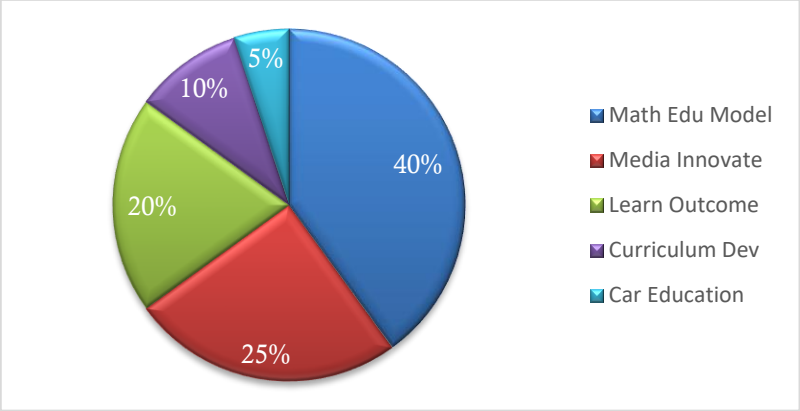

Figure 2. Journal category group distribution

The figure above shows the distribution of research domains. The most prominent discussion is mathematics education through the application of learning models (40%), followed by media innovation (25%). This focus aligns with the demands of 21st-century learning, which emphasizes critical thinking skills, technology utilization, and contextual learning. Meanwhile, topics related to curriculum, the role of teachers, and character education remain limited, thus providing opportunities for further research.

Conclusion

Based on the results of a review of 20 articles, it can be concluded that elementary school students' critical mathematical thinking skills are still relatively low and require appropriate learning strategies. Innovative learning models such as PBL, Discovery Learning, RME, and the use of digital learning media can make a positive contribution to improving students' critical thinking skills. This literature review can contribute to the development of science by mapping various effective strategies for developing mathematical critical thinking skills in elementary school students through the application of learning innovations based on empirical evidence.

Teachers need to regularly participate in training to improve their competency in implementing innovative learning models such as Problem-Based Learning, Discovery Learning, and Realistic Mathematics Education, which can develop students' critical mathematical thinking skills. Schools should also provide interactive digital facilities and media to increase students' motivation and understanding of mathematical concepts. Furthermore, mathematics learning should be implemented collaboratively through group discussions, the use of higher-order thinking problems, and the development of teaching tools that support critical thinking skills. Research is needed to examine the integration of character education into mathematics learning to strengthen students' critical thinking and positive attitudes. Furthermore, ongoing studies on improving teachers' pedagogical competencies and developing adaptive digital media are needed. Longitudinal studies are also crucial to assess the long-term impact of innovative learning models on elementary school students' critical thinking skills and mathematics achievement.

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