Algoritma : Jurnal Matematika, Ilmu pengetahuan Alam, Kebumian dan Angkasa
Volume. 4, Nomor. 4 Juli 2026
E-ISSN .: 3046-5427; P-ISSN .: 3032-6230, Hal 01-12
DOI: https://doi.org/10.62383/algoritma.v4i4.1001
Tersedia: https://journal.arimsi.or.id/index.php/Algoritma

Strategies for Enhancing Mathematical Creative Thinking in Elementary Schools: A Systematic Literature Review

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Abstract. Mathematical creative thinking is an essential competency that should be developed in elementary school students to support higher-order thinking skills, problem-solving abilities, and readiness to face the challenges of the twenty-first century. Although various instructional strategies have been implemented to enhance this competency, the existing research findings remain fragmented, highlighting the need for a systematic synthesis. This study aims to identify and analyze effective instructional strategies for improving elementary school students' mathematical creative thinking skills through a Systematic Literature Review (SLR). The literature search was conducted using Publish or Perish with Google Scholar as the primary database. A total of 500 articles were initially identified and screened based on the PRISMA 2020 guidelines and predetermined inclusion criteria. The screening process resulted in nine eligible articles for further analysis. The findings indicate that instructional strategies such as Realistic Mathematics Education (RME), Problem-Based Learning (PBL), Brain-Based Learning, the Open-Ended approach, and other innovative learning methods consistently contribute to improving students' mathematical creative thinking skills. Overall, student-centered, contextual, and problem-based learning approaches were found to be the most effective characteristics of instructional strategies for fostering mathematical creativity in elementary school students.

Keywords: Elementary School; Instructional Strategies; Mathematical Creative Thinking; Mathematics Education; Systematic Literature Review.

1. INTRODUCTION

Mathematical creative thinking refers to students' ability to generate diverse, innovative, and relevant ideas, strategies, and solutions when solving mathematical problems. This ability is commonly assessed through four key indicators: fluency, flexibility, originality, and elaboration (Adiansha et al., 2021). Similarly, Takaria & Sahusiwa (2020) emphasize that fluency, flexibility, and originality constitute fundamental dimensions of mathematical creativity, enabling elementary school students to construct multiple solution pathways and develop novel mathematical ideas. Therefore, creative thinking in mathematics is not merely concerned with obtaining correct answers but also with students' capacity to explore various approaches and build new understandings based on their prior knowledge and experiences (Wulandari et al., 2023).

Developing mathematical creative thinking has become one of the primary goals of twenty-first-century education. Creativity is widely recognized as an essential component of the 4C skills critical thinking, creativity, communication, and collaboration. Which are necessary for students to adapt to rapid technological developments and increasingly complex societal challenges (Lestari et al., 2024; Susilawati et al., 2024). Through the cultivation of creative thinking skills, students are expected to solve problems effectively, make flexible decisions, and apply mathematical concepts in meaningful and authentic contexts (Ndiung et

Naskah Masuk: 29 April 2026; Revisi: 27 Mei 2026; Diterima: 28 Juni 2026; Terbit: 10 Juli 2026.

al., 2021). Consequently, mathematics instruction in elementary schools should emphasize not only procedural competence but also the development of students' creativity and innovation.

Despite its importance, previous studies have shown that elementary school students' mathematical creative thinking skills remain insufficiently developed. Many students still rely heavily on procedures demonstrated by teachers, which limits their opportunities to independently explore alternative strategies and construct original solutions (Takaria & Sahusiwa, 2020). Teacher-centered instructional practices that prioritize correct answers, procedural accuracy, and curriculum completion often inhibit students from engaging in investigation, experimentation, and divergent thinking processes (Br Ginting et al., 2025; Usmar & Turmudi, 2026). As a result, a considerable gap persists between the competencies demanded by twenty-first-century education and the realities of mathematics classrooms.

To address these challenges, researchers have implemented various instructional strategies aimed at enhancing students' mathematical creative thinking. A systematic review by Suretdawati (2022) identified several promising approaches, including Problem-Based Learning, Open-Ended learning, Project-Based Learning, Realistic Mathematics Education, Creative Problem Solving, Guided Inquiry, and Resource-Based Learning. Among these, the Open-Ended approach has been shown to encourage students to generate multiple solution strategies and significantly improve their mathematical creativity (Sonjaya & Yuliyanto, 2022). Likewise, Brain-Based Learning creates active and meaningful learning environments that facilitate students' expression of creative ideas and problem-solving abilities (Adiansha et al., 2021).

The integration of innovative instructional models has also demonstrated positive effects on students' mathematical creativity. The Treffinger learning model combined with the principles of Realistic Mathematics Education (RME) has been found to improve both mathematical creative thinking skills and mathematics learning outcomes among elementary school students (Ndiung et al., 2021). RME itself is considered particularly effective because it positions mathematics as a human activity closely connected to students' everyday experiences. Through collaborative discussions, contextual problems, and guided reinvention, students are encouraged to construct diverse and original mathematical strategies (Kusmaryono & Maharani, 2021; Wulandari et al., 2023). In addition, differentiated instruction accommodates students' varying learning needs and abilities, enabling them to develop their creative potential more effectively (Lestari et al., 2024).

Beyond inquiry- and problem-based approaches, Drill and Practice (D&P) has also emerged as a promising strategy for improving mathematical creative thinking in elementary schools. Takaria & Sahusiwa (2020) reported that structured and continuous engagement with contextual and non-routine problems significantly enhanced students' creativity across different levels of prior mathematical ability. Repetitive practice accompanied by meaningful feedback enabled students to strengthen indicators of fluency, flexibility, and originality while exploring multiple approaches to mathematical problem solving. These findings indicate that creativity can be fostered not only through exploratory learning models but also through carefully designed practice-oriented instruction.

Recent innovations in mathematics education have introduced additional approaches for promoting mathematical creativity. The GASING method (Gampang, Asyik, dan Menyenangkan; Easy, Fun, and Enjoyable Learning), for example, emphasizes gradual learning experiences that begin with concrete representations before progressing toward abstract concepts, thereby facilitating students' creative mathematical reasoning (Usmar & Turmudi, 2026). Similarly, the ARIAS learning model integrated with the Wordwall digital platform has been shown to improve students' engagement and mathematical creative thinking in learning fractions (Puspitasari & Yanuarto, 2026). Collectively, these findings suggest that mathematical creativity can be effectively nurtured through diverse instructional strategies that are responsive to students' characteristics and learning contexts.

Although research on enhancing mathematical creative thinking has grown substantially, existing findings remain scattered across various instructional models and pedagogical approaches. Previous reviews have predominantly emphasized the effectiveness of individual interventions without specifically synthesizing the dominant strategies implemented in elementary school mathematics education (Amanah et al., 2025; Suretdawati, 2022). Furthermore, differences in instructional characteristics, learning contexts, and creativity indicators have yet to be systematically consolidated to provide a comprehensive understanding of effective practices. Consequently, a systematic synthesis of empirical evidence is necessary to establish a stronger foundation for designing innovative mathematics instruction that aligns with elementary students' developmental needs and the demands of twenty-first-century learning.

Considering the fragmented evidence reported in previous studies, this review was conducted to examine and integrate existing findings on instructional strategies that promote mathematical creative thinking among elementary school students. By synthesizing the available evidence through a Systematic Literature Review (SLR), this study seeks to highlight

common instructional patterns, identify effective pedagogical characteristics, and offer evidence-based recommendations for improving mathematics teaching and learning at the elementary level.

2. RESEARCH METHOD

This research adopted a Systematic Literature Review (SLR) approach to examine and integrate findings from previous studies concerning instructional strategies that support the development of mathematical creative thinking among elementary school students. The review was carried out in accordance with the PRISMA 2020 (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines, which provide a structured framework for conducting and reporting systematic reviews with greater transparency and methodological rigor (Page et al., 2021). Accordingly, the review process consisted of four sequential phases: identifying relevant records, screening the retrieved studies, assessing their eligibility, and determining the final articles included in the review.

The literature search was performed in June 2026 using Publish or Perish (PoP) as the search tool, while Google Scholar served as the primary source of publications. To obtain studies that closely matched the objectives of this review, a search strategy was developed by combining several keywords with Boolean operators. The search terms included "mathematical creative thinking," "mathematical creativity," "elementary school," "primary school," "learning strategies," "instructional strategies," and "mathematics education."

The following search expression was applied:

("mathematical creative thinking" OR "mathematical creativity") AND ("elementary school" OR "primary school") AND ("learning strategies" OR "instructional strategies") AND ("mathematics education")

The search procedure initially retrieved 500 publications. After all records had been exported, each study was evaluated through the PRISMA 2020 selection procedure, including the stages of identification, screening, eligibility assessment, and final inclusion. Only studies that fulfilled the predefined inclusion criteria were retained for data extraction and subsequent analysis.

Table 1. Inclusion and Exclusion Criteria

Aspect	Inclusion Criteria	Exclusion Criteria
Publication Year	Articles published between 2021 and 2026.	Articles published before 2021
Educational Level	Studies involving elementary school or primary school students as research participants.	Studies conducted at other educational levels, such as junior high school, senior

		high school, higher education, or other settings.
Research Topic	Studies focusing on Mathematical Creative Thinking (MCT), or Mathematical Creativity.	Studies that do not address Mathematical Creative Thinking (MCT), or Mathematical Creativity.
Research Focus	Studies examining instructional strategies, models, methods, approaches, or learning media aimed at enhancing students' mathematical creative thinking skills.	Studies that do not discuss instructional strategies or are not intended to improve mathematical creative thinking skills.
Publication Type	Full-text empirical research articles published in academic journals.	Literature reviews, conference proceedings. Books, theses, dissertations, or articles without full-text access.
Language	Articles written in Indonesian or English.	Articles written in languages other than Indonesian and English.

Articles that did not meet these criteria including literature reviews, conference proceedings, studies conducted at educational levels other than elementary school, and articles that did not specifically address mathematical creative thinking skills—were excluded from the selection process.

The study selection procedure was conducted in accordance with the PRISMA 2020 framework. The initial search produced 500 records, which were subsequently examined through several screening stages. Duplicate publications were removed, and the remaining records were evaluated based on their titles and abstracts to eliminate studies that were not aligned with the objectives of this review. Articles that passed the screening stage underwent a full-text assessment to verify their compliance with the predefined inclusion criteria. Followingthis process, nine studies fulfilled all eligibility requirements and were selected for the final review.

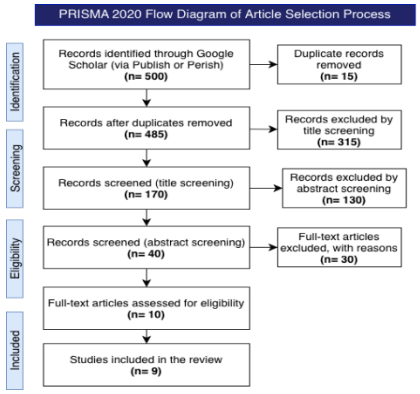

Figure 1. PRISMA 2020 flow diagram illustrating the study selection process.

To facilitate a consistent synthesis, data from the selected studies were compiled using a structured extraction form. The extracted information covered the study authors, publication year, research methodology, participant characteristics, instructional strategies, research instruments, and the principal findings concerning students' mathematical creative thinking.

Employing a standardized extraction procedure helped maintain the reliability and consistency of the information analyzed throughout the review.

The collected data were then examined through thematic analysis to identify recurring patterns across the selected studies. The analytical process involved four main steps: first, reviewing each article thoroughly to gain an overall understanding of its content; second, identifying evidence related to instructional strategies and mathematical creative thinking; third, organizing similar findings into broader thematic categories; and finally, integrating the identified themes to draw conclusions regarding effective instructional practices. The results of this analysis were used to determine the instructional approaches most frequently reported in the literature and to identify the common pedagogical characteristics associated with improvements in elementary school students' mathematical creative thinking.

3. RESULTS AND DISCUSSION

Results

Characteristics of the Included Studies, Based on the selection process following the PRISMA 2020 guidelines, nine articles met all the predetermined inclusion criteria. All selected studies were published between 2021 and 2026 and focused on instructional strategies aimed at improving elementary school students' mathematical creative thinking skills. Most of the studies employed quantitative approaches using experimental or quasi-experimental designs to examine the effectiveness of specific instructional models. In contrast, one study adopted a qualitative classroom report approach to explore the development of students' mathematical creative thinking throughout the learning process (Kusmaryono & Maharani, 2021).

The synthesis revealed a variety of instructional strategies implemented across the nine studies, including Realistic Mathematics Education (RME) (Kusmaryono & Maharani, 2021; Wulandari et al., 2023), Problem-Based Learning (PBL) (Sidqi & Arifin, 2025), Brain-Based Learning (Adiansha et al., 2021), Differentiated Learning (Lestari et al., 2024), the Open-Ended approach (Sonjaya & Yuliyanto, 2022), the Treffinger model integrated with the principles of RME (Ndiung et al., 2021), the GASING method (Usmar & Turmudi, 2026), and the ARIAS model supported by Wordwall (Puspitasari & Yanuarto, 2026). All studies consistently reported improvements in students' mathematical creative thinking skills following the implementation of the respective instructional strategies, as evidenced by increases in N-gain scores, post-test results, or improvements in students' levels of mathematical creative thinking.

The essential information extracted from the nine selected studies is presented in Table.The table outlines the instructional strategies employed, research designs, and the principal findings reported in each study.

Table 2. Characteristics of the Reviewed Articles

Authors	Instructional Strategy	Research Design	Main Findings
(Adiansha et al., 2021)	Brain-Based Learning	True Experimental	Brain-Based Learning improved students' mathematical creative thinking through active and innovative learning experiences.
(Ndiung et al., 2021)	Treffinger Model Based on Realistic Mathematics Education (RME)	Quasi-Experimental	The implementation significantly enhanced students' mathematical creative thinking skills and mathematics learning outcomes.
(Kusmaryono & Maharani, 2021)	Realistic Mathematics Education (RME)	Qualitative	RME encouraged the development of students' imagination and mathematical creative thinking abilities.
(Sonjaya & Yuliyanto, 2022)	Open-Ended Approach	Experimental	Students' mathematical creative thinking improved, with an N-Gain score of 0.69.
(Wulandari et al., 2023)	Realistic Mathematical Education (RME)	Experimental	Most students achieved a highly creative category after the implementation of RME.
(Lestari et al., 2024)	Differentiated Learning	Quasi-Experimental	Students' mathematical creative thinking increased, with an N-Gain score of 59.2%.
(Sidqi & Arifin, 2025)	Problem-Based Learning	Quasi-Experimental	The experimental group demonstrated better performance than the control group in mathematical creative thinking.
(Puspitasari & Yanuarto, 2026)	ARIAS Model Assisted by Wordwall	Quasi-Experimental	The approach improved both students' mathematical creative thinking skills and classroom engagement.
(Usmar & Turmudi, 2026)	GASING Method *(Gampang, Asyik, dan Menyenangkan)*	Quasi-Experimental	The method enhanced students' mathematical creative thinking, achieving an N-Gain score of 48.27%.

Learning Strategies for Enhancing Mathematical Creative Thinking

The synthesis identified three major characteristics shared by the instructional strategies reported in the nine reviewed studies: Student-Centered Learning, Contextual and Problem-Based Learning, and Creative Learning Environments.

The first characteristic, Student-Centered Learning, was identified in six studies, namely Differentiated Learning (Lestari et al., 2024), Brain-Based Learning (Adiansha et al., 2021), the Treffinger model integrated with RME principles (Ndiung et al., 2021), Problem-Based Learning (PBL) (Sidqi & Arifin, 2025), the GASING method (Usmar & Turmudi, 2026), and the ARIAS model supported by Wordwall (Puspitasari & Yanuarto, 2026). These instructional strategies provided students with opportunities to construct knowledge independently, collaborate with peers, express their ideas, and develop multiple problem-

solving strategies. All six approaches actively engaged students through discussion, idea exploration, and independent problem-solving activities.

The second characteristic, Contextual and Problem-Based Learning, was identified in five studies, including Realistic Mathematics Education (RME) (Kusmaryono & Maharani, 2021; Wulandari et al., 2023), Problem-Based Learning (PBL) (Sidqi & Arifin, 2025), the Treffinger model integrated with RME principles (Ndiung et al., 2021), and the Open-Ended approach (Sonjaya & Yuliyanto, 2022). These strategies employed contextual and open-ended problems as the starting point of instruction, encouraging students to develop multiple solution strategies rather than relying on a single correct answer.

The third characteristic was the creation of Creative Learning Environments, which was identified in four studies implementing Brain-Based Learning (Adiansha et al., 2021), the GASING method (Usmar & Turmudi, 2026), the ARIAS model supported by Wordwall (Puspitasari & Yanuarto, 2026), and Differentiated Learning (Lestari et al., 2024). These instructional strategies emphasized the importance of creating active, enjoyable, and interactive learning environments that encourage students' participation and engagement throughout the learning process.

Characteristics of Effective Learning Strategies

The synthesis revealed that all of the reviewed instructional strategies shared several common characteristics. These strategies provided students with opportunities to think independently, incorporated contextual problems, promoted collaboration through discussion, and facilitated the generation of multiple solution strategies.

In addition, almost all of the reviewed studies assessed mathematical creative thinking using four key indicators: fluency, flexibility, originality, and elaboration (Adiansha et al., 2021; Ndiung et al., 2021; Sonjaya & Yuliyanto, 2022; Usmar & Turmudi, 2026). All four indicators showed improvement following the implementation of the instructional strategies, although the magnitude of improvement varied across studies. In several studies, fluency and originality demonstrated relatively greater improvements than the other two indicators, although the extent of improvement differed depending on the instructional strategy and research context.

Discussion

The findings of this review indicate that student-centered learning is the primary characteristic of effective instructional strategies for enhancing elementary school students' mathematical creative thinking skills. This finding is consistent with the constructivist perspective, which views students as active participants in constructing knowledge through

learning experiences and social interaction. In the studies conducted by Adiansha et al., (2021), Ndiung et al., (2021), Lestari et al., (2024), Sidqi & Arifin, (2025), Puspitasari & Yanuarto, (2026), and Usmar & Turmudi, (2026), students were encouraged to explore ideas, develop their own problem-solving strategies, and engage in discussions with their peers. Such active participation promotes the development of divergent thinking, which serves as the foundation of mathematical creativity.

Furthermore, contextual learning through Realistic Mathematics Education (RME), Problem-Based Learning (PBL), and the Open-Ended approach has been shown to help students connect mathematical concepts with their everyday experiences (Kusmaryono & Maharani, 2021; Ndiung et al., 2021; Sidqi & Arifin, 2025; Sonjaya & Yuliyanto, 2022; Wulandari et al., 2023). The use of contextual and open-ended problems provides students with opportunities to generate multiple solution strategies, shifting the focus of learning from merely obtaining correct answers to understanding the reasoning process behind problem solving. Such learning conditions particularly foster the development of flexibility and originality, as students are encouraged to examine mathematical problems from multiple perspectives.

This review further suggests that the classroom environment substantially influences the development of students' mathematical creative thinking. Evidence from the studies conducted by Adiansha et al., (2021), Puspitasari & Yanuarto, (2026), and Usmar & Turmudi, (2026) indicates that learning environments characterized by active participation, positive interaction, and enjoyable learning experiences encourage students to become more confident in expressing and discussing mathematical ideas. When students feel comfortable sharing their thoughts without fear of making mistakes, they are more willing to explore alternative solutions, exchange perspectives with peers, and develop creative approaches to solving mathematical problems.

Among the instructional approaches identified in this review, Realistic Mathematics Education (RME) was the strategy most frequently reported, either as an independent instructional approach or in combination with the Treffinger model (Kusmaryono & Maharani, 2021; Ndiung et al., 2021; Wulandari et al., 2023). However, its frequent use should not be interpreted as conclusive evidence of superior effectiveness. The reviewed studies differed considerably in terms of research design, participant characteristics, instructional duration, and assessment procedures, making direct comparisons across strategies difficult. Consequently, further comparative investigations are needed to determine the relative effectiveness of different instructional approaches in enhancing mathematical creative thinking among elementary school students.

The reported improvements in the four indicators of mathematical creative thinking; fluency, flexibility, originality, and elaboration suggest that innovative instructional strategies contribute not only to better mathematics learning outcomes but also to the enhancement of students' cognitive processes. Strategies that encourage students to generate multiple ideas, explore various solution pathways, and independently construct mathematical arguments are more likely to promote the comprehensive development of mathematical creativity.

Although all reviewed studies reported positive outcomes, this review also identified several limitations. Most studies employed quasi-experimental designs with relatively small sample sizes and short implementation periods, limiting the generalizability of their findings. In addition, few studies directly compared the effectiveness of different instructional strategies or examined their long-term impact on students' mathematical creative thinking skills. Therefore, future research should conduct comparative studies involving larger samples, more diverse educational settings, and longer intervention periods to provide stronger empirical evidence regarding the most effective instructional strategies.

Overall, the findings of this synthesis suggest that the effectiveness of instructional strategies depends not only on the instructional model employed but, more importantly, on learning characteristics that actively engage students. Effective mathematics instruction should be student-centered, incorporate contextual problems, encourage students to generate multiple solution strategies, promote collaboration, and create an active and enjoyable learning environment. These characteristics may serve as practical guidelines for elementary school teachers in designing mathematics instruction that effectively fosters students' mathematical creative thinking skills.

4. CONCLUSION

This systematic literature review explored a range of instructional approaches designed to strengthen mathematical creative thinking among elementary school students. Based on the analysis of nine selected empirical studies, the review demonstrates that various instructional strategies can effectively foster students' creativity in mathematics. The reviewed approaches include Realistic Mathematics Education (RME), Problem-Based Learning (PBL), Brain-Based Learning, Differentiated Learning, the Open-Ended approach, the Treffinger model integrated with RME, the GASING method, and the ARIAS model supported by Wordwall.

The synthesis further indicates that successful instructional practices share several common pedagogical characteristics regardless of the specific learning model employed. These characteristics include encouraging active student participation, connecting mathematical

concepts with authentic real-world situations, providing open-ended learning tasks, facilitating collaboration among learners, and creating supportive classroom environments that encourage exploration and creative expression. Such learning conditions contribute to the development of the four essential dimensions of mathematical creative thinking, namely fluency, flexibility, originality, and elaboration.

Among the reviewed approaches, Realistic Mathematics Education (RME) appeared most frequently, highlighting its widespread application in elementary mathematics instruction. This pattern suggests that contextual learning remains a valuable framework for helping students construct mathematical understanding while simultaneously developing creative thinking skills. In addition, recent studies demonstrate an increasing interest in integrating digital learning media and innovative instructional practices, such as Wordwall, Brain-Based Learning, and the GASING method, to create more engaging mathematics learning experiences.

Overall, this review offers evidence that improving mathematical creative thinking requires learning environments that actively involve students in constructing knowledge rather than merely mastering procedures. The findings may serve as a useful reference for teachers when selecting or designing instructional strategies that encourage creativity, collaboration, and meaningful mathematical learning. Future investigations are encouraged to compare different instructional approaches across broader educational contexts, involve larger participant groups, and examine long-term instructional effects in order to strengthen the evidence regarding the most effective strategies for developing mathematical creative thinking in elementary education.

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