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Exploring Students' Creative Thinking Processes in Solving Open-Ended Problems

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ABSTRACT

Creative thinking is a key competence in mathematics learning, particularly when students engage with open-ended problems that enable multiple strategies and solutions. This study aims to explore students' creative thinking processes in solving open-ended problems through a synthesis of recent empirical findings. A Systematic Literature Review was conducted following the stages of identification, screening, eligibility, and synthesis based on Snyder's guidelines. Twenty selected articles were analyzed using content analysis to identify cognitive patterns, strategy variations, and factors influencing students' creativity. The results reveal that students' creative thinking develops through several stages, including understanding the problem, generating ideas, selecting strategies, revising solutions, and providing mathematical justification. Creativity is reflected in students' ability to produce diverse ideas, shift strategies flexibly, generate original solutions, and elaborate their reasoning. Internal factors such as cognitive style and conceptual understanding, along with external factors such as task quality, instructional approaches, collaboration, and technology, significantly shape the creative thinking process. The review concludes that open-ended problems hold strong potential for fostering mathematical creativity and should be systematically incorporated into mathematics instruction. Structural implications include enhancing problem design, adopting creativity-oriented pedagogies, and developing process-based assessments to strengthen students' creative mathematical development.

INTRODUCTION

The ability to think creatively is one of the main competencies required in modern mathematics education, especially when students face open-ended problems that allow for a variety of strategies, approaches, and solutions. In the context of twenty-first century education, students are expected to generate original, flexible, and elaborative ideas when solving problems that do not have a single correct answer. This requirement relates to global mathematical literacy demands, which emphasize higher-order thinking skills in problem solving. Nieminen et al. (2021) show that open-ended tasks provide space for students to express agency, creativity, and idea exploration within collaborative learning. Those findings indicate that open-ended problems function not only as assessment tools but also as pedagogical instruments that stimulate creative thinking more deeply.

In recent years, researchers have increasingly focused on students' creative thinking processes in solving open-ended problems. This interest is driven by empirical evidence showing that the structure of open-ended problems affords cognitive flexibility, enabling students to use various strategies to find solutions. Usmiyatun et al. (2021) reveal that students' cognitive styles significantly influence how they solve open-ended mathematical problems. Students with reflective cognitive tendencies demonstrate more systematic thinking processes, whereas students with impulsive cognitive styles tend to produce ideas quickly with greater variation and creativity. The diversity of cognitive styles shows that the creative thinking process is not linear but develops through interactions among experience, prior knowledge, and the problem-solving strategies students choose.

Moreover, the characteristics of open-ended problems are considered to encourage greater originality because they do not constrain solution methods. Lely et al. (2020) find that students produce higher levels of creative responses when given open-ended mathematics problems compared to routine tasks. This is due to the wider exploratory space that open-ended problems provide, allowing students to construct various mathematical representations according to their individual understandings. Meanwhile, Molina et al. (2021) show that students with high creative thinking ability exhibit flexibility in changing strategies, developing alternative ideas, and elaborating solution steps more comprehensively. Such quality of creative thinking becomes an important indicator in assessing students' readiness to face modern mathematics learning challenges.

At the secondary school level, creative thinking ability is also influenced by readiness in fundamental concepts and prior learning experiences. Damayanti and Sumardi (2018) observe that junior high students who are accustomed to problem-based learning approaches tend to have better creative thinking ability than students who are accustomed to procedural instruction. Similarly, Setianingsih and Purwoko (2019) assert that presenting open-ended problems can improve students' ability to generate new mathematical ideas because they are encouraged to analyze situations more flexibly. These findings underscore the importance of regularly providing open-ended problem-based learning experiences so that students can consistently develop creative thinking processes.

Furthermore, the creative thinking process in solving mathematical problems is linked to understanding the problem structure, the ability to represent information, and the capacity to connect various mathematical concepts. Supratman et al. (2025) emphasize that creative thinking is multidimensional, involving activities such as pattern recognition, idea generation, solution evaluation, and reflection on strategies used. In this context, open-ended problem solving becomes an important venue for observing how students develop and modify their creative ideas when confronted with mathematical challenges. Although research on students' creative thinking in solving open-ended problems is growing, there remains a need to understand the detailed unfolding of these thinking processes. Some existing studies have made important contributions but have not provided a comprehensive depiction of the patterns and dynamics of creative thinking. For example, Sa'idah et al. (2021) found variation in students' levels of creativity when solving open-ended problems, but that study focused more on final outcomes rather than the thinking processes involved. Yunadia et al.

(2023) report improvements in students' creative thinking through the provision of open tasks, but they did not elaborate on how stages of creative thinking develop during the problem-solving process. In addition, Triyani (2018) explored students' creative thinking in learning fractions using open-ended problems, but the study's subject coverage remained limited to a single mathematics topic.

From these three studies, a research gap can be identified showing that investigations into students' creative thinking processes when solving open-ended problems have not yet been analyzed comprehensively, especially with respect to strategy variation, the dynamics of creative thinking stages, and the influence of problem context on the emergence of creative ideas. This gap is important to examine because an in-depth understanding of the creative thinking process can help teachers design more effective instruction to develop students' creative thinking abilities. The novelty of this study lies in a structured exploration of students' creative thinking processes through a systematic synthesis of recent empirical studies that highlight variations in strategy, thinking patterns, and factors affecting creativity in open-ended problem solving. This review not only maps creative thinking abilities but also emphasizes the internal processes students undertake to produce creative solutions. At the end of this section, the research objective is formulated as identifying and analyzing students' creative thinking processes in solving open-ended problems based on a systematic synthesis of empirical findings.

METHODOLOGY

This study employs a Systematic Literature Review to identify, evaluate, and synthesize various studies on students' creative thinking processes in solving open-ended problems. The SLR approach is chosen because it enables the researcher to obtain a comprehensive overview of theoretical and empirical developments related to creative thinking ability and the dynamics of cognitive processes that arise in mathematical problem solving. The method follows the SLR guidelines proposed by Snyder (2019), which emphasize procedural transparency, replicability of the process, and consistency in synthesizing relevant literature findings. The SLR steps in this study include formulating research questions, searching the literature using keywords such as students' creative thinking, open-ended problems, mathematical creativity, and problem solving, and selecting articles based on predefined inclusion and exclusion criteria.

Article selection follows a descriptive PRISMA flow. In the Identification stage, a total of 236 articles were found in Google Scholar, Scopus, ScienceDirect, and Springer. During Screening, 124 articles were eliminated due to duplication and 71 additional articles were removed for being irrelevant to the topic of creative thinking processes in solving open-ended problems. The Eligibility stage resulted in 41 articles that met full-text availability and relevance to mathematics learning contexts. The Included stage produced 20 final articles that formed the basis for analysis and synthesis in this study. Descriptively, the PRISMA flow for this research is as follows: Identification (n = 236) → Screening (n = 112) → Eligibility (n = 41) → Included (n = 20). The selected literature was analyzed using content analysis techniques to identify patterns, stages, and creative thinking strategies reported in previous studies.

Thematic analysis was used to examine creative thinking processes from various research perspectives, including dimensions such as fluency, flexibility, originality, and elaboration that commonly appear in theories of mathematical creativity. The analysis process involved extracting core data from each selected article, grouping findings according to similar patterns of student thinking, and interpreting relationships among relevant variables. This analytical approach allows the researcher to gain a holistic understanding of how students develop creative ideas when solving open-ended problems, including the factors that influence those creative thinking processes.

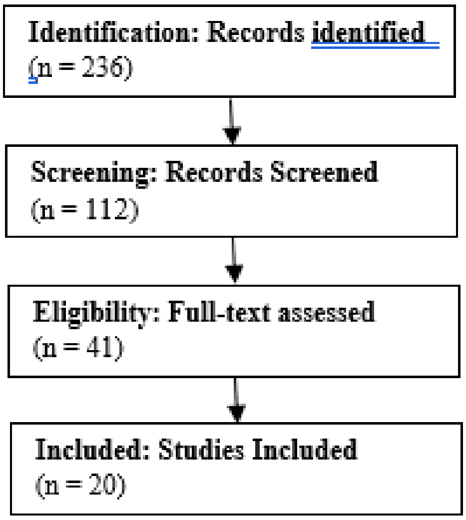

Figure 1. PRISMA Flowchart

RESULTS AND DISCUSSION

Characteristics of Students' Creative Thinking Processes in Solving Open-Ended Problems

The creative thinking processes of students in solving open-ended problems constitute a complex cognitive construction that includes generating ideas, adjusting strategies, testing possible solutions, and modifying mathematical representations according to the demands of the problem. Recent studies show that creative thinking ability does not emerge spontaneously but develops through a series of structured yet flexible cognitive processes. Lely et al. (2020) found that when students are presented with open-ended problems, they begin by forming an initial understanding of the information in the task, then attempt various approaches before deciding on the most effective strategy. These thinking stages indicate that creativity in mathematics is iterative, where students actively evaluate and refine their initial ideas to produce more mature solutions.

In the context of open-ended problem solving, thinking flexibility becomes an important indicator of students' creative ability. Molina et al. (2021) state that students with high cognitive flexibility can more easily shift from one strategy to another when encountering obstacles. For example, students may change their representation from a graphical form to a symbolic model or vice versa, depending on the needs of the problem. This flexibility is a hallmark of open-ended tasks, which provide room for students to modify their solution plans without being limited to a single procedure. Therefore, an open problem-solving environment helps elicit divergent thinking, which is a core characteristic of creativity.

In addition to flexibility, fluency or the ability to generate multiple ideas is also a key component of the creative thinking process. Sa'idah et al. (2021) reveal that students who demonstrate high fluency can propose several alternative solutions and are not fixated on a single pattern of problem solving. For example, students may find three or four different ways to determine numerical relationships or geometric patterns. Fluency reflects mathematical thinking agility and forms the foundation for students' ability to develop original solutions. This ability to generate many ideas makes open-ended problems effective tools for mapping students' creative capabilities.

Originality, or the ability to produce unique solutions, is another essential aspect of mathematical creativity. Triyani (2018) found that students with high levels of creativity can develop strategies that are not commonly used by others, such as constructing a fraction model that is not directly provided in the task. In this context, originality emerges because students are encouraged to develop representations that reflect their personal understanding of the problem. This shows that creativity in mathematics is not only about the correctness of the answer but about how students construct logical yet distinctive solutions. Thus, open-ended problems encourage students to move beyond procedural thinking and develop more innovative ways of reasoning.

The creative thinking process is also inseparable from elaboration, which refers to the ability to detail and expand ideas thoroughly. Yunadia et al. (2023) explain that students with strong elaboration skills can provide detailed explanations of their solution steps. For example, in solving geometric problems, students do not merely provide the final answer but also explain the relationships among sides, angles, and patterns formed. Elaboration demonstrates not only strong conceptual understanding but also that students can develop thought processes systematically. In educational contexts, elaboration is crucial because it indicates maturity of thinking and clarity of reasoning.

Beyond these elements of creativity, the creative thinking process is influenced by both internal and external factors. Usmiyatun et al. (2021) note that cognitive style plays an important role in determining how students process information. Reflective students tend to engage in deeper consideration before deciding on a strategy, while impulsive students tend to produce ideas quickly but with less systematic reasoning. This suggests that creative thinking does not follow a single pattern but develops according to individual characteristics. These cognitive differences are important for teachers when designing problem-based learning.

The learning environment also affects students' creative thinking ability. Kartikasari and Usodo (2022) assert that the use of open-ended learning and creative problem solving can increase creativity because students are given space to explore their thoughts and try various strategies without fear of being wrong. Such learning, which emphasizes diversity of thought, encourages students to be more confident in expressing creative ideas. This approach is highly effective in developing creative thinking because it involves active engagement in mathematical experiences that require a combination of divergent and convergent thinking.

Open-ended problem solving also provides opportunities for students to build stronger mathematical reasoning. Wulandari et al. (2020) found that realistic mathematics education using open-ended tasks allows students to connect mathematical problems to real-life contexts, leading to more meaningful creative ideas. The activity of linking mathematical concepts to everyday experiences enriches the creative thinking process because students draw on real-world knowledge in their problem solving.

Overall, the literature indicates that students' creative thinking processes in solving open-ended problems include understanding the problem, generating ideas, evaluating strategies, modifying solutions, and constructing logical mathematical arguments. This ability reflects not only mathematical creativity but also students' readiness to face complex problems in the modern era that demand critical and creative thinking (Rahayuningsih et al., 2021).

Despite the consistent identification of fluency, flexibility, originality, and elaboration as core indicators of students' creative thinking in open-ended problem solving, the synthesized findings also reveal several conceptual and methodological limitations. First, many studies implicitly assume that the presence of multiple strategies or diverse solutions automatically indicates creativity, without sufficiently interrogating the mathematical depth or conceptual coherence of those strategies. As a result, creative thinking is sometimes reduced to quantitative variation rather than qualitative originality. Second, the dominant focus on observable problem-solving stages tends to underrepresent metacognitive regulation and affective dimensions, such as uncertainty management and risk-taking, which are crucial in genuinely creative mathematical activity. Third, most empirical studies examine creativity at a single point in time, limiting understanding of how creative thinking processes evolve longitudinally through repeated exposure to open-ended tasks. Consequently, while existing research confirms that open-ended problems facilitate creative thinking, it remains unclear under what conditions these processes lead to sustained creative competence rather than situational performance. This limitation underscores the need for future research to move beyond descriptive mapping toward more critical examinations of depth, durability, and quality in students' creative mathematical thinking.

Factors Influencing the Creative Thinking Process and Variations in Students' Strategies for Solving Open-Ended Problems

This discussion focuses on exploring the factors influencing the creative thinking process and the variety of strategies students use when solving open-ended problems. Creative thinking processes are influenced not only by students' internal abilities but also by instructional conditions, problem context, and learning design. Nieminen et al. (2021) show that open-ended real-life tasks provide greater opportunities for students to contribute actively to problem solving and share diverse strategies. This indicates that the nature of the problem, the degree of openness, and the authenticity of the context can influence the quality of creative ideas that emerge.

The first factor influencing creative thinking is the structure of the problem. Rahayuningsih et al. (2021) explain that open-ended problems that require divergent thinking encourage students to generate more alternative solutions. Problem structures that do not provide a single answer allow students to evaluate various possibilities and choose the most suitable strategy. In this context, students need the ability to organize information, recognize patterns, and develop diverse mathematical representations. This process trains cognitive flexibility, which is central to creative thinking.

The second factor is the variation in students' mathematical abilities and learning experiences. Rahmawati et al. (2025) found that students with high creative thinking levels tend to use more complex strategies compared to those with moderate or low creativity. They are able to describe solution steps more systematically and provide strong mathematical justification. In contrast, students with low creativity tend to generate fewer ideas and struggle to explain their strategy choices. These findings confirm that creative thinking processes are closely related to students' conceptual understanding.

The third factor relates to the learning approach. Gunur et al. (2019) show that problem-based learning supported by open-ended problems can improve critical thinking and facilitate creative thinking processes. This approach positions students as active participants, encouraging them to formulate problems, explore strategies, and develop creative solutions. Problem-based learning provides opportunities for collaboration, discussion, and comparison of strategies, all of which strengthen creative thinking. To provide a comparative overview of research focuses on creative thinking processes in open-ended problems, the following table summarizes findings from the five studies you provided. This table is relevant for showing differences in research focus, context, and key findings, thereby helping identify important factors in the creative thinking process.

Table 1. Overview of Empirical Studies Related to Students' Creative Thinking in Open-Ended Problems

Author(s)	Year	Focus of the Study	Key Findings Related to Creative Thinking
Lely et al.	2020	Fifth-grade students' strategies in solving open-ended problems	Students showed varied strategy use and higher creative responses with open-ended tasks
Sa'idah et al.	2021	Creative thinking ability in solving open-ended questions	Students demonstrated differences in fluency, flexibility, and originality across tasks
Yunadia et al.	2023	Students' creative thinking in open-ended problem solving	Students with higher creativity levels generated more elaborate and varied solutions
Triyani	2018	Creative thinking process in solving fraction open-ended tasks	Students produced unique strategies and engaged in iterative idea development
Rahmawati et al.	2025	Creative thinking process based on students' creativity level	Creativity level influenced strategy complexity and depth of mathematical reasoning

The table shows that research on students' creative thinking processes has different focal points, yet all highlight the importance of creativity in solving open-ended problems. Analysis of the table indicates that fluency, flexibility, originality, and elaboration are consistently used as indicators for assessing students' creative thinking. The table also illustrates that variations in creativity levels affect problem-solving strategies. For example, Rahmawati et al. (2025) emphasize the relationship between creativity level and the depth of mathematical reasoning, while Triyani (2018) highlights that creative thinking develops iteratively through the modification of ideas.

Another factor influencing the creative thinking process is social context and collaboration. Nazareth et al. (2019) show that collaborative open-ended tasks can enhance students' creativity because they allow students to exchange ideas, refine strategies, and produce more varied solutions. Collaboration provides space for students to develop ideas through interaction and discussion. Thus, a collaborative learning environment becomes an important factor in fostering creative thinking.

In addition, the difficulty level of the problem also affects the quality of creative solutions produced by students. Kholil (2020) explains that problems with moderate to high difficulty levels encourage students to use more innovative strategies because they cannot rely on routine procedures. This indicates that creativity tends to emerge when students are faced with challenges that demand deep analysis and non-linear thinking. From all the discussions above, it can be concluded that students' creative thinking processes in solving open-ended problems are influenced by problem characteristics, individual abilities, learning contexts, and the presence of social interaction. Students exhibit varied strategies that reflect the complexity of creative thinking processes, and these variations can be used by teachers to design more effective learning for developing students' creativity (Van Hooijdonk et al., 2023).

Conceptual Model of Students' Creative Thinking Processes in Solving Open-Ended Problems and Learning Implications

This third discussion formulates a conceptual model of students' creative thinking processes based on the synthesis of empirical findings from various studies, while also elaborating on the learning implications for developing mathematical creativity in classrooms. Students' creative thinking in solving open-ended problems involves not only cognitive aspects but also affective, metacognitive, and experiential factors. Rahmawati et al. (2025) affirm that students' creativity levels influence the depth of reasoning and the complexity of strategies chosen when facing open-ended mathematical tasks. Students with high creativity levels tend to use more analytical strategies, while those with low creativity levels tend to produce minimal solutions without elaboration. These findings show that understanding variations in creativity is essential for developing a comprehensive creative thinking model for different student characteristics.

The first conceptual model derived from the literature is a cyclical model of creative thinking. Based on Triyani (2018), students' creative thinking processes proceed through the stages of understanding the problem, generating initial ideas, testing ideas, and revising them based on self-evaluation. This cycle illustrates that creative thinking is iterative and reflective, rather than merely generating the first idea that comes to mind. The revision stage plays a crucial role in producing more mature creative solutions, a stage often overlooked in traditional mathematics instruction. Therefore, teachers need to provide time and space for students to evaluate and refine their ideas.

The second model is a multidimensional model that incorporates four indicators of mathematical creativity, namely fluency, flexibility, originality, and elaboration, as seen in Sa'idah et al. (2021). These four dimensions operate simultaneously in the creative thinking process when students solve open-ended problems. Fluency appears when students generate multiple solution ideas. Flexibility emerges when students shift from one strategy to another. Originality is evident in solutions that differ from those typically produced by other students. Elaboration is shown through detailed explanations that justify the solution. This multidimensional view offers a more complete analytical framework for mapping creative thinking abilities in the classroom.

In addition to cyclical and multidimensional models, the literature synthesis also reveals an interaction model between internal and external factors influencing the emergence of student creativity. Usmiyatun et al. (2021) indicate that cognitive style is an internal component affecting how students execute creative processes. Reflective students are stronger in analysis and evaluation stages, while impulsive students generate ideas more quickly but may require support in elaboration. External factors such as supportive learning environments, innovative instructional approaches, and high-quality open-ended problems also shape the patterns of creative thinking. Kartikasari and Usodo (2022) demonstrate that open-ended learning and creative problem solving approaches foster learning environments that optimally support creativity. This illustrates that creativity does not develop in isolation but is the result of interaction between individual abilities and learning experiences.

The use of open-ended problems to develop and assess mathematical creativity shows that problem design quality significantly influences the creative thinking process. Van Hooijdonk et al. (2023) find that elementary students can display high creative potential when given problems that are challenging and contextually relevant. When problems are designed with an appropriate degree of openness, students are encouraged to use more varied strategies and avoid reliance on routine procedures. Therefore, teachers must ensure that problems are neither too easy nor too difficult so that creative thinking is not hindered. Furthermore, the role of collaboration as a trigger for creativity must be emphasized. Nazareth et al. (2019) show that collaboration in solving open-ended problems enables students to exchange ideas, improve strategies, and expand their exploratory thinking. Social interaction becomes an essential catalyst for the emergence of new ideas that may not appear in individual work. In collaborative learning contexts, students can develop ideas through peer support, indicating that creativity is not solely an individual ability but one that grows within a learning community.

The use of technology in mathematics learning also has important implications for creative thinking processes. Studies such as Wulandari et al. (2020) show that realistic mathematics education supported by technology can enhance the quality of students' mathematical representations. Technology can provide conceptual visualizations that help students understand mathematical structure more deeply. Thus, digital tools that support idea exploration can accelerate students' creative processes in solving open-ended problems.

Developing learning models that foster creativity must also account for metacognitive aspects that allow students to monitor their thinking processes. Supratman et al. (2025) highlight that metacognitive reflection is part of the creative thinking process because it enables students to evaluate the effectiveness of the strategies used and identify potential improvements. Therefore, instruction that provides space for metareflection will cultivate students who can develop creativity more independently and sustainably. Another conceptual model emerging from the synthesis is a developmental stages model of creativity. From several findings, including Rahmawati et al. (2025) and Molina et al. (2021), it can be concluded that students progress from the stage of simple idea exploration to strategy development and eventually mathematical justification. In the initial stage, students gather information and try to identify patterns. In the second stage, they begin to choose strategies and develop solutions. In the final stage, they articulate mathematical reasoning that supports their solutions. Differences in students' creativity levels determine whether they reach the final stage successfully or remain at the exploration phase.

From the overall synthesis, it can be concluded that the conceptual model of students' creative thinking processes in solving open-ended problems consists of several key components: problem understanding, strategy exploration, idea development, solution modification, metacognitive reflection, and mathematical justification. These components do not occur linearly but in a cyclical and dynamic manner. Findings from Nieminen et al. (2021) and Van Hooijdonk et al. (2023) reinforce the view that students need learning environments that provide space for exploration and intellectual freedom.

The learning implications of this conceptual model are far-reaching. First, teachers must design open-ended problems that are varied and contextually relevant, with an appropriate level of openness to facilitate creative thinking processes. Second, teachers should adopt instructional approaches that allow students to explore ideas and engage in self-reflection, such as problem-based learning, creative problem solving, and realistic mathematics education. Third, collaboration must be encouraged to activate the exchange of creative ideas among students. Fourth, technology should be optimized to enrich mathematical representation and support students' creative idea exploration. Fifth, creativity assessment should prioritize the process rather than the final product, as shown by Sa'idah et al. (2021). In this way, mathematics learning can become a space where students' creativity develops systematically and purposefully.

CONCLUSION

This study shows that students' creative thinking processes in solving open-ended problems constitute a multidimensional cognitive sequence involving fluency, flexibility, originality, and elaboration. These processes occur through understanding the problem, exploring strategies, developing ideas, modifying solutions, engaging in metacognitive reflection, and providing mathematical justification. The literature synthesis demonstrates that variations in students' creative abilities arise from internal factors such as cognitive style and conceptual understanding, as well as external factors such as problem quality, instructional approaches, collaboration, and technological support. These findings affirm that open-ended problems have strong potential to develop students' mathematical creativity by providing broad exploratory space and opportunities to generate diverse solution strategies.

Structurally, the implications of this study highlight the need for instructional designs based on open-ended problems, the strengthening of creative learning approaches, the integration of technology that supports mathematical exploration, and the development of assessment systems that focus on students' creative processes. Educational institutions need to provide training for teachers to understand the dynamics of students' creativity and to design appropriate learning practices. With well-designed instructional strategies and a strong supportive ecosystem, students' creativity in mathematical problem solving can develop optimally and contribute to improving the overall quality of mathematics learning.

LITERATURE

Damayanti, H., & Sumardi, S. (2018). Mathematical Creative Thinking Ability of Junior High School Students in Solving Open-Ended Problem. *Journal of Research and Advances in Mathematics Education*, 3, 36-45. https://doi.org/10.23917/jramathedu.v3i1.5869.

Gunur, B., Ramda, A. H., & Makur, A. P. (2019). Pengaruh Pendekatan Problem Based Learning Berbantuan Masalah Open-Ended Terhadap Kemampuan Berpikir Kritis Ditinjau Dari Sikap Matematis Siswa [The Influence Of The Problem-Based Learning Model Assisted By Open-Ended Problems Towards Mathematical Critical Thinking Skills Based On Students'mathematical Attitude]. *JOHME: Journal of Holistic Mathematics Education*, *3*(1), 1-15.

Kartikasari, I. A., & Usodo, B. (2022). The Effectiveness Open-Ended Learning and Creative Problem Solving Models to Teach Creative Thinking Skills. *Pegem Journal of Education and Instruction*, *12*(4), 29-38.

Kholil, M. (2020, February). Students' creative thinking skills in solving mathematical logic problem with open-ended approaches. In *Journal of Physics: Conference Series* (Vol. 1465, No. 1, p. 012044). IOP Publishing.

Lely, M., Putra, Z., & Syahrilfuddin, S. (2020). Fifth Grade Students' Creative Thinking in Solving Open-Ended Mathematical Problems. , 3, 58-68. https://doi.org/10.33578/jtlee.v3i1.7829.

Molina, N. B., Djong, K. D., Dosinaeng, W. B. N., & Jagom, Y. O. (2021). Kemampuan Berpikir Kreatif Siswa Dalam Menyelesaikan Soal Open Ended. *Asimtot: Jurnal Kependidikan Matematika*, *3*(2), 187-199.

Nazareth, E., Romlah, S., Safitri, J., Yuliati, N., Sarimanah, E., Monalisa, L. A., & Harisantoso, J. (2019, March). The students' creative thinking ability in accomplishing collaborative learning-based open-ended questions. In *IOP Conference Series: Earth and Environmental Science* (Vol. 243, No. 1, p. 012145). IOP Publishing.

Nieminen, J., Chan, M., & Clarke, D. (2021). What affordances do open-ended real-life tasks offer for sharing student agency in collaborative problem-solving?. *Educational Studies in Mathematics*, 109, 115-136. https://doi.org/10.1007/s10649-021-10074-9.

Putri, A. O., & Regina, E. P. (2025). Analisis Kemampuan Berpikir Kreatif Siswa dalam Menyelesaikan Soal Open-Ended Ditinjau dari Gaya Kognitif. *Mandalika Mathematics and Educations Journal*, *7*(3), 1198-1209.

Rahayuningsih, S., Sirajuddin, S., & Ikram, M. (2021). Using Open-ended Problem-solving Tests to Identify Students' Mathematical Creative Thinking Ability. , 8, 285-299. https://doi.org/10.17275/per.21.66.8.3.

Rahayuningsih, S., Sirajuddin, S., & Ikram, M. (2021). Using open-ended problem-solving tests to identify students' mathematical creative thinking ability. *Participatory Educational Research*, *8*(3), 285-299.

Rahmawati, I. A., Setianingsih, R., & Sulaiman, R. (2025). Proses Berpikir Kreatif Siswa SMP Dalam Menyelesaikan Open–Ended Problem ditinjau dari Tingkat Berpikir Kreatif: Studi Deskriptif Kualitatif. *Journal of Mathematics Education and Science*, *8*(1), 100-113.

Sa'idah, U., , B., & , S. (2021). Students' Creative Thinking Ability in Solving Open-Ended Questions. *Advances in Social Science, Education and Humanities Research*. https://doi.org/10.2991/assehr.k.211122.038.

Setianingsih, L., & Purwoko, R. Y. (2019). Kemampuan berpikir kreatif siswa SMP dalam menyelesaikan soal open-ended. *JRPM (Jurnal Review Pembelajaran Matematika)*, *4*(2), 143-156.

Snyder, H. (2019). Literature review as a research methodology: An overview and guidelines. *Journal of Business Research, 104*, 333–339.

Supratman, M., Ardana, I. M., Suharta, I. G. P., & Astawa, I. W. P. (2025). Eksplorasi Berpikir Kreatif Matematis; Pola Dan Proses. *Media Pendidikan Matematika*, *13*(1), 392-401.

Titikusumawati, E., Sa'dijah, C., As'ari, A. R., & Susanto, H. (2019, June). An analysis of students' creative thinking skill in creating open-ended mathematics problems through semi-structured problem posing. In *Journal of Physics: Conference Series* (Vol. 1227, No. 1, p. 012024). IOP Publishing.

Triyani, S. (2018). Exploring Student's Creative Thinking Process Using Open-Ended Problem In Learning Fraction. .

Usmiyatun, U., Darmayanti, R., Safitri, N., & Afifah, A. (2021). Cognitive style, thinking ability, mathematical problems, how do students solve open-ended problems?. *AMCA Journal of Science and Technology*. https://doi.org/10.51773/ajst.v1i2.276.

Van Hooijdonk, M., Mainhard, T., Kroesbergen, E., & Van Tartwijk, J. (2023). Creative problem solving in primary school students. *Learning and Instruction*. https://doi.org/10.1016/j.learninstruc.2023.101823.

Wulandari, N. P. R., Dantes, N., & Antara, P. A. (2020). Pendekatan pendidikan matematika realistik berbasis open ended terhadap kemampuan pemecahan masalah matematika siswa. *Jurnal Ilmiah Sekolah Dasar*, *4*(2), 131-142.

Yunadia, M., Ruslan, R., Rusli, R., & Hastuty, H. (2023). Students' Creative Thinking Ability in Solving Open-Ended Problems. *ARRUS Journal of Social Sciences and Humanities*. https://doi.org/10.35877/soshum1692.