



A descriptive analysis of fifth-grade students' creative thinking skills in solving perimeter problems of plane figures

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Abstract

Background: Creative thinking plays a central role in mathematics learning, especially in geometry, where students are required to explore various solution strategies and explain their reasoning clearly. Nevertheless, many elementary students still encounter difficulties in expressing and developing their mathematical ideas when solving problems.

Aims: This study aims to provide a descriptive account of fifth-grade students' creative thinking skills in solving perimeter problems of plane figures, viewed through the indicators of fluency, flexibility, originality, and elaboration.

Method: The research employed a descriptive quantitative design involving 24 fifth-grade students. Data were gathered through an open-ended test constructed to reflect the four indicators of creative thinking. Students' responses were scored using an assessment rubric, and the results were examined through descriptive statistical analysis, including the mean, score range, and standard deviation.

Results: Students' scores ranged from 21 to 84, with a mean of 54.2 (SD = 15.6), indicating that overall creative thinking performance was relatively low. Only 29.2% of students reached the predetermined mastery criterion. Among the four indicators, originality emerged as the strongest aspect, whereas elaboration showed the lowest achievement, revealing students' challenges in expanding and detailing their ideas

Conclusion: The findings suggest that students' creative thinking skills in perimeter problem solving require further development, particularly in elaborating mathematical reasoning. Strengthening open-ended and reasoning-oriented instructional practices may help enhance creative engagement in geometry learning.

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INTRODUCTION

Creative thinking has become an increasingly important competence in mathematics education (Samaniego et al., 2024; Suherman & Vidákovich, 2022). It involves not only arriving at correct answers but also exploring alternative solutions, applying diverse strategies, and articulating the reasoning behind each step (Chang & Li, 2025). Therefore, mathematics learning should provide opportunities for students to think openly and reflectively rather than merely follow predetermined procedures.

At the elementary school level, the development of creative thinking is particularly significant because students are transitioning toward more abstract forms of reasoning (Fakaruddin et al., 2024; Rahayuningsih et al., 2023). During this stage, learners begin connecting concrete experiences with symbolic representations, making it essential for instruction to encourage exploration and

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discussion. However, classroom practices often emphasize routine exercises and mechanical application of formulas, which may limit students' opportunities to develop and express their own ideas (Cirneanu & Moldoveanu, 2024; Leong et al., 2021).

Geometry, especially the topic of the perimeter of plane figures, offers meaningful opportunities to foster creative thinking. This topic requires students to understand spatial relationships, interpret visual representations, and apply measurement concepts in problem-solving situations. When students are engaged in open-ended or contextual tasks, they can demonstrate fluency in generating ideas, flexibility in selecting strategies, originality in proposing solutions, and elaboration in explaining their reasoning in detail (Oliveira et al., 2021).

Despite this potential, not all students are able to demonstrate these aspects of creative thinking consistently (Alabbasi et al., 2022). Many students can produce initial ideas but struggle to expand or justify them systematically. This condition suggests that creative thinking skills in mathematics, particularly within geometry learning, require closer examination to better understand students' characteristics and performance patterns (Schoevers et al., 2022).

Based on these considerations, a focused investigation is needed to describe how students demonstrate creative thinking within a specific mathematical context. By concentrating on perimeter problem solving, this study seeks to provide a clearer picture of fifth-grade students' creative thinking skills in geometry learning.

In mathematics education, creative thinking is understood as the ability to generate multiple solution possibilities and develop ideas in meaningful ways (Suherman & Vidákovich, 2022). This process reflects exploration, consideration of alternatives, and the ability to connect relevant concepts to the problem at hand (Jackson et al., 2022; Morgan, 2023). Mathematical creative thinking is commonly examined through four indicators: fluency, flexibility, originality, and elaboration (Weiss & Wilhelm, 2022). Fluency refers to the ability to produce numerous ideas or responses. Flexibility involves using different strategies or perspectives in solving a problem. Originality reflects the uniqueness or uncommonness of ideas, while elaboration refers to the ability to expand and clarify ideas in a structured manner. Together, these indicators form a comprehensive profile of students' creative thinking skills. In elementary classrooms, the development of these indicators is often uneven (Tao et al., 2023). Students tend to generate initial responses more easily than they develop detailed explanations. Moreover, instruction that emphasizes fixed procedures and single-solution approaches may restrict opportunities for exploring alternative strategies. Consequently, a clearer understanding of students' actual creative thinking performance is necessary to support instructional improvement.

Although research on mathematical creative thinking continues to expand, descriptive studies that systematically map students' performance within specific topics at the elementary level remain limited. Many investigations focus on testing the effectiveness of particular instructional models, whereas fewer studies aim to describe students' existing levels of creative thinking in a focused mathematical context (Wei et al., 2022). In addition, variations across individual creative thinking indicators are not always analyzed in depth (Alabbasi et al., 2022). Without detailed profiling of each indicator, it is difficult to determine which aspects require greater instructional attention. Therefore, there is a need for a descriptive study that examines students' creative thinking skills specifically in the context of perimeter problems of plane figures.

Considering this gap, conducting a descriptive analysis of students' creative thinking skills becomes relevant and necessary. By examining how students demonstrate fluency, flexibility, originality, and elaboration in solving perimeter problems, this study seeks to provide a factual and structured account of their performance in geometry learning.

This study aims to describe and analyze fifth-grade students' creative thinking skills in solving perimeter problems of plane figures based on four indicators: fluency, flexibility, originality, and

elaboration, in order to obtain a clear profile of their creative thinking performance within this mathematical context.

METHOD

Research Design

This study adopted a descriptive research approach to explore how fifth-grade students demonstrate creative thinking when solving perimeter problems involving plane figures. Rather than introducing a specific instructional treatment, the research focused on examining students' written work as it naturally occurred during classroom learning activities. To guide the analysis, the study employed a problem-solving framework consisting of five interconnected stages: identifying the problem type, generating possible strategies, selecting an appropriate strategy, applying the chosen approach, and evaluating the obtained solution. These stages functioned as an analytical structure through which students' creative thinking processes were interpreted. The framework provided a systematic way to observe how creative thinking skills emerged throughout the progression of solving mathematical problems.

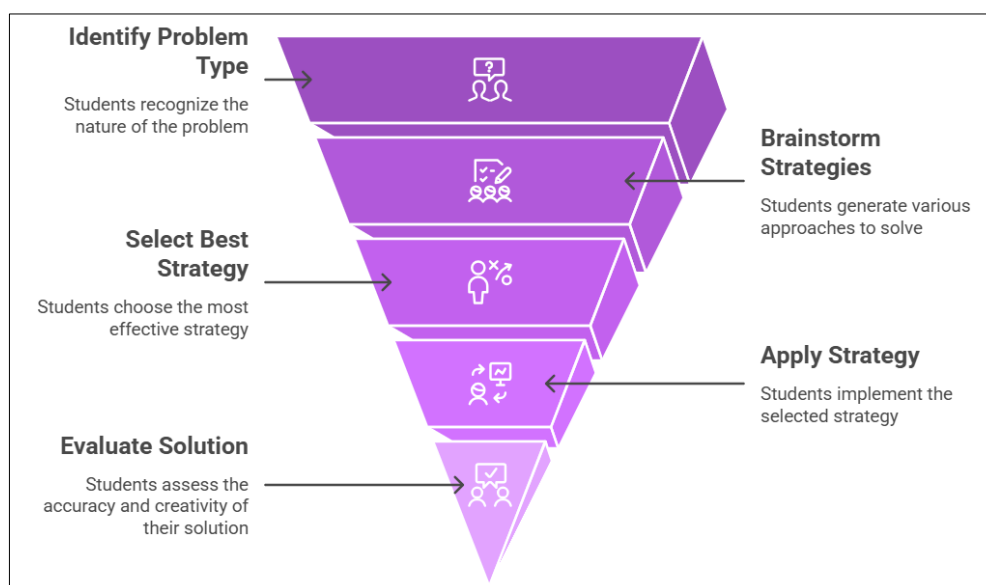


Figure 1. Problem-Solving Stages Applied in the Analysis

Participants

The participants were fifth-grade students enrolled in an elementary school where the concept of perimeter of plane figures is included in the mathematics curriculum. The selection was determined by the relevance of the grade level to the research topic. The students displayed varied academic characteristics, which allowed the study to capture diverse expressions of creative thinking. All participants completed the assigned tasks individually within the same instructional setting.

Research Procedure

Data were collected through a set of perimeter problem-solving tasks developed to encourage students to articulate their reasoning processes. The tasks were structured to allow multiple solution paths, enabling students to interpret the problem situation, consider different strategies, justify their choices, implement their solutions, and review the accuracy of their results. Students were asked to provide written explanations alongside their answers. These written responses served as the primary source of data for examining how creative thinking skills were demonstrated during each stage of problem solving.

Instruments

Data were collected through a set of perimeter problem-solving tasks developed to encourage students to articulate their reasoning processes. The tasks were structured to allow multiple solution paths, enabling students to interpret the problem situation, consider different strategies, justify their choices, implement their solutions, and review the accuracy of their results. Students were asked to provide written explanations alongside their answers. These written responses served as the primary source of data for examining how creative thinking skills were demonstrated during each stage of problem solving.

Data Analysis

The analysis was conducted descriptively by examining students' written responses in relation to the five stages of problem solving illustrated in Figure 1. Attention was given to how students understood the nature of the problem, explored alternative strategies, determined their preferred approach, carried out the solution, and assessed the outcome of their work. Within this progression, the four indicators of creative thinking fluency, flexibility, originality, and elaboration were identified through patterns found in students' explanations and solution strategies. The analysis did not aim to measure effectiveness or compare groups; instead, it sought to portray the characteristics of students' creative thinking as reflected in their responses. The findings were then presented narratively to provide a coherent profile of students' creative thinking skills in the context of perimeter problem solving.

RESULTS AND DISCUSSION

Results

The study involved 24 fifth-grade students from a public elementary school in Pandeglang Regency during the odd semester of the 2025/2026 academic year. The participants represented one intact classroom group, and all students were included in the research through the use of a saturated sampling technique. This technique was selected to ensure that the analysis captured the complete range of students' creative thinking abilities within the class, without limiting the findings to a subset of individuals. By involving the entire population, the study was able to portray variations in performance more accurately, including differences in high, moderate, and low levels of achievement.

The implementation of saturated sampling also strengthens the descriptive nature of the study, as the results reflect the actual condition of students' creative thinking skills in mathematics learning on the topic of the perimeter of plane figures within that specific classroom context. Therefore, the findings provide a factual overview of students' performance based on the instrument administered. The detailed results of students' scores across the four indicators of creative thinking are presented in Table 1.

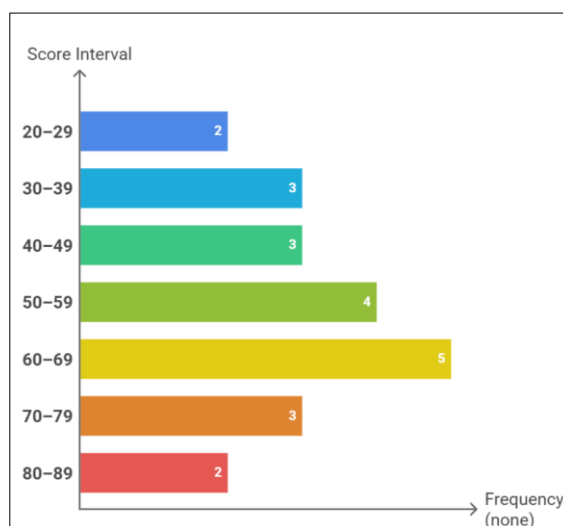
Table 1 presents the detailed results of students' performance on each indicator of creative thinking. The accumulated raw score obtained by all students was 416, with an average raw score of 17.3. After conversion to a 0–100 scale, the mean score reached 54.2. The highest score recorded was 84, while the lowest was 21. The standard deviation of 15.6 indicates a noticeable variation in students' levels of achievement.

Based on the Learning Objective Achievement Criteria (KKTP) set at 65, only 7 students (29.2%) reached the expected level of mastery. Meanwhile, 17 students (70.8%) scored below the criterion. This proportion shows that most students have not yet demonstrated satisfactory creative thinking performance in solving problems related to the perimeter of plane figures.

Table 1. Results of the Creative Thinking Ability Instrument

No	Student Code Name	Indicator								Sum	Score
		Fluency		Flexibility		Originality		Elaboration			
		No 1	No 3	No 2	No 4	No 5	No 6	No 7	No 8		
1	A1	3	2	4	2	4	4	1	3	23	72
2	A2	3	2	4	2	4	4	3	4	27	84
3	A3	3	0	1	0	2	1	0	1	7	21
4	A4	3	3	4	1	3	3	0	2	17	53
5	A5	3	1	2	1	3	2	1	3	16	50
6	A6	3	0	4	0	4	2	0	4	18	56
7	A7	3	0	2	0	3	1	0	4	14	44
8	A8	3	3	2	4	4	4	2	4	27	84
9	A9	3	0	2	0	3	2	0	4	14	44
10	A10	3	1	1	1	4	2	0	0	11	34
11	A11	3	0	2	0	3	2	0	2	12	38
12	A12	3	1	4	1	3	2	1	4	18	56
13	A13	3	0	1	0	4	2	0	1	11	34
14	A14	3	1	2	2	3	3	0	0	14	44
15	A15	3	1	4	1	3	2	2	3	20	63
16	A16	3	2	4	2	3	2	2	3	21	66
17	A17	3	0	4	0	4	4	0	4	20	63
18	A18	3	2	4	2	4	4	2	2	24	75
19	A19	3	3	2	3	3	2	1	1	17	53
20	A20	3	2	4	2	3	4	3	3	25	78
21	A21	3	2	4	2	4	2	2	2	21	66
22	A22	3	0	4	0	4	4	0	4	20	63
23	A23	3	0	2	0	3	2	0	0	10	31
24	A24	3	0	1	0	3	2	0	0	9	28
Sum		72	26	68	26	81	62	20	58	416	1300
Average		49		47		71,5		39			

To illustrate how the scores are distributed across intervals, Figure 2 displays the frequency of students' scores.

**Figure 2.** Distribution of Students' Creative Thinking Scores by Interval

As shown in Figure 2, the largest concentration of students is found in the 60–69 interval. Although this range is close to the mastery criterion, it still indicates that many students have not fully met the required level of competence. A smaller number of students appear in the higher intervals (70–79 and 80–89), while several others remain in the lower score categories. This pattern reinforces the earlier statistical findings that students' creative thinking skills tend to cluster at a moderate level but generally remain below the mastery threshold.

Analysis of Creative Thinking Indicators

A more detailed examination was conducted based on the four indicators of creative thinking: fluency, flexibility, originality, and elaboration.

Fluency

In the first item measuring fluency, all students achieved the same score, resulting in a mean of 3.00 and a standard deviation of 0.00. This suggests that students were able to generate at least one relevant idea in responding to the problem. However, in the third item, the mean score decreased to 1.08 with a standard deviation of 1.10. This indicates differences among students in their ability to produce multiple ideas or alternative responses. Overall, the fluency indicator obtained a total score of 49, with an average of 2.04. These results imply that students are still limited in generating varied ideas when solving mathematical problems.

Flexibility

The flexibility indicator showed varying performance across items. In item two, the mean score was 2.83 with a standard deviation of 1.23, indicating that some students were able to apply more than one strategy. In contrast, item four produced a lower mean of 1.08 with a standard deviation of 1.14, suggesting that many students experienced difficulty in shifting perspectives or applying alternative solution methods. Overall, flexibility reached a total score of 47 with an average of 1.95. This finding reflects that students' ability to approach problems from different angles remains underdeveloped.

Originality

The originality indicator yielded relatively stronger results compared to the other indicators. In item five, the mean score was 3.38 with a relatively small standard deviation of 0.57, indicating consistent performance among students in producing unique or less common ideas. Item six showed a mean of 2.58 and a standard deviation of 1.02, reflecting a slight decline and greater variability. Among the four indicators, originality demonstrated the highest overall achievement.

Elaboration

The elaboration indicator revealed the lowest level of performance. In item seven, the mean score was 0.83 with a standard deviation of 1.05, showing that many students struggled to develop and explain their ideas in detail. Although item eight showed improvement with a mean of 2.42 and a standard deviation of 1.50, considerable variation among students remained evident. In general, elaboration recorded the lowest average score among the four dimensions. To provide a clearer comparison of the indicators, Figure 2 presents the average score of each creative thinking dimension.

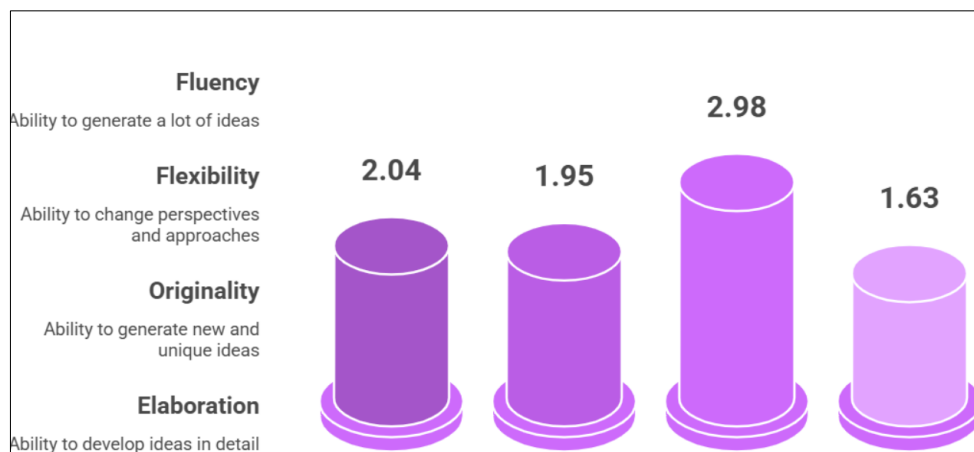


Figure 3. Average Score of Each Creative Thinking Indicator

Figure 3 highlights that originality achieved the highest average score (2.98), whereas elaboration obtained the lowest (1.63). This comparison suggests that students are relatively capable of proposing initial ideas but encounter challenges when required to expand and explain those ideas systematically.

Overall Interpretation

Taken together, the findings indicate that students' creative thinking skills in learning the perimeter of plane figures have not yet reached an optimal level. While the ability to produce original ideas appears relatively strong, students demonstrate moderate fluency and flexibility and face notable difficulties in elaborating their reasoning. The overall mean score of 54.2 and the low proportion of students achieving mastery further underline the need for instructional strategies that provide greater opportunities for idea development, exploration of alternative approaches, and detailed explanation in mathematical problem-solving contexts.

Discussion

The results of this study provide a detailed picture of how fifth-grade students demonstrate creative thinking when solving perimeter problems of plane figures. The overall mean score of 54.2 indicates that students' performance remains below the expected mastery level (Akinpelu et al., 2025). Although a small proportion of students achieved the criterion, most of them have not yet reached a satisfactory level of creative mathematical reasoning. This finding suggests that the ability to think creatively in the context of perimeter problems is still developing and requires further instructional attention (Richit et al., 2021).

The distribution of scores shows that students' achievements are concentrated in the middle range, particularly just below the mastery threshold. This pattern reflects that many students are approaching the expected level but have not fully mastered the skills required to solve problems creatively (Karunaratne & Calma, 2024). The relatively wide spread of scores also indicates differences in how students interpret and respond to open-ended mathematical tasks (Urrutia & Araya, 2022). Such variation may stem from differences in conceptual understanding, confidence in expressing ideas, or prior learning experiences (Smith et al., 2022).

A closer examination of the four indicators reveals an uneven development of creative thinking dimensions. Among them, originality appears as the most prominent aspect. Students were generally able to produce responses that were not merely repetitive or imitative. In perimeter-related tasks, this was reflected in their attempts to construct unique arrangements of shapes or alternative numerical solutions. This outcome suggests that students possess the initial capacity to generate ideas independently when given the opportunity (Bizami et al., 2023).

However, the ability to elaborate ideas remains limited. Many students provided brief answers without sufficient explanation or justification. In solving perimeter problems, elaboration involves detailing calculation steps, clarifying how side lengths are determined, and explaining why a particular strategy is appropriate (Lehmann, 2023). The relatively low performance in this indicator indicates that students often stop at obtaining an answer without fully articulating the reasoning behind it. This gap between idea generation and idea development becomes one of the central findings of the study.

Flexibility also requires attention. While some students demonstrated the ability to adjust their approach, many relied on a single, familiar procedure. In the context of perimeter problems, flexible thinking can be seen when students reorganize shapes, decompose figures into simpler parts, or apply different computational strategies (Dahshan & Galanti, 2024). The limited evidence of such variations suggests that students may not yet feel comfortable experimenting with multiple approaches. This tendency points to learning practices that might emphasize fixed procedures over exploratory thinking (Christou et al., 2024).

The fluency indicator presents a slightly different pattern. Students were generally capable of producing at least one relevant solution, yet only a few were able to propose several alternatives. Fluency in creative mathematical thinking involves generating multiple possibilities within a

problem situation (Rahayuningsih et al., 2021). The findings imply that students may need more structured exposure to open-ended tasks that explicitly invite more than one answer. Without such practice, students may assume that each problem has only one correct pathway.

When the four indicators are considered together, a consistent theme emerges. Students appear more confident in proposing initial ideas than in expanding, refining, or varying those ideas. In other words, creative thinking in this classroom context tends to be introductory rather than fully developed. This imbalance suggests that instructional approaches may have provided space for idea expression but not yet sufficient guidance for deeper reasoning and explanation (Rapanta & Felton, 2022).

Overall, this descriptive analysis shows that fifth-grade students' creative thinking skills in solving perimeter problems are present but not yet balanced across dimensions. The relatively stronger originality contrasted with weaker elaboration and flexibility indicates that creativity in mathematics learning requires sustained and intentional support (Ji & Wong, 2025). Encouraging students to explain their reasoning, compare alternative solutions, and reflect on their strategies may help foster a more comprehensive development of creative thinking skills in elementary mathematics classrooms (Torres-Peña et al., 2025).

Implications

The results of this study imply that the development of creative thinking skills in solving perimeter problems of plane figures requires more deliberate instructional support at the elementary level. The relatively low overall average score, combined with the imbalance among indicators, indicates that classroom learning still tends to emphasize obtaining correct answers rather than encouraging students to explore, explain, and refine their ideas. Although students showed promising ability in generating original responses, their limited performance in elaboration and flexibility suggests that learning activities need to provide more structured opportunities for reasoning, discussion, and reflection. Mathematics instruction may therefore benefit from integrating open-ended perimeter tasks, guided questioning, and collaborative problem-solving experiences that allow students not only to propose solutions but also to justify and compare them. Strengthening these dimensions in classroom practice can contribute to a more balanced development of creative mathematical thinking.

Limitations

This study was conducted in a single fifth-grade classroom with a relatively small number of participants, which means the findings describe the characteristics of creative thinking within a specific context rather than representing broader populations. In addition, the focus on one mathematical topic, namely the perimeter of plane figures, limits the scope of interpretation, as students' creative thinking abilities may differ across other areas of mathematics. The reliance on a written test instrument also restricts the extent to which students' reasoning processes can be fully captured, particularly those that may emerge through oral explanation or interactive discussion. Consequently, while the study provides a clear descriptive account of students' performance in this context, the results should be interpreted within these boundaries.

Suggestions

Considering the patterns identified in this descriptive analysis, several directions may be proposed for future practice and research. In classroom settings, teachers are encouraged to design perimeter-related problems that allow multiple solution paths and require students to explain their reasoning in detail, thereby strengthening elaboration and flexibility alongside originality. Curriculum planning may also incorporate explicit attention to creative thinking indicators so that assessment and instruction align more consistently with higher-order thinking goals. For further

investigation, studies involving larger samples and varied school contexts would provide a more comprehensive understanding of elementary students' creative thinking development. Exploring additional mathematical topics and employing complementary data collection methods, such as interviews or classroom observations, may also enrich insights into how students construct and communicate creative ideas in mathematics learning.

CONCLUSION

This study provides a descriptive overview of fifth-grade students' creative thinking skills in solving perimeter problems of plane figures and reveals that their overall performance has not yet reached the expected mastery level. The average score of 54.2 and the limited proportion of students who achieved the established criterion indicate that creative mathematical reasoning in this context is still developing. Although students demonstrated relative strength in generating original ideas, their abilities in fluency, flexibility, and particularly elaboration were less consistent, suggesting that many students can initiate ideas but encounter difficulties when required to expand, vary, or clearly justify their reasoning. The concentration of scores near but below the mastery threshold further reflects that students possess emerging creative potential that has not yet been fully nurtured. Taken together, these findings highlight the need for mathematics learning experiences that encourage not only idea generation but also deeper explanation, strategic variation, and reflective reasoning in order to support a more balanced development of creative thinking skills at the elementary level.

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AUTHOR CONTRIBUTIONS STATEMENT

Teti Husniati conceptualized the study, designed the research framework, developed the creative thinking assessment instrument, conducted data collection and statistical analysis, and prepared the initial draft of the manuscript. Atep Sujana contributed to the refinement of the research design, provided theoretical guidance related to mathematics education at the elementary level, and critically reviewed the methodology and results sections. Encep Supriatna supported the data interpretation process, strengthened the analytical discussion, and ensured the alignment between research objectives and findings. Supriadi contributed to manuscript revision, language refinement, and overall academic quality control to ensure the manuscript met publication standards.

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