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From Routine to Remarkable: Revealing Students' Creative Thinking in Mathematical Problem Solving

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Abstract

This study aims to analyze the creative thinking ability of fourth grade students in solving mathematical word problems, specifically on measurement topics. The research employed a descriptive qualitative approach involving 16 students of class IVB at SDN Perwira VII, Bekasi. Data were collected through tests, interviews, and observations, and validated using triangulation techniques. The analysis focused on three indicators of creative thinking: fluency, flexibility, and novelty. The findings reveal that students demonstrated varied levels of creative thinking. A small group of students achieved high fluency and originality in solving problems independently, while most students were still limited to linear thinking patterns and relied heavily on examples given by the teacher. The results emphasize the need for innovative teaching strategies that encourage exploration, multiple solution approaches, and contextual problem-solving. This study contributes to understanding how elementary school students develop creative thinking skills in mathematics and provides insights for improving classroom practices.

Keywords: Creative thinking, Mathematics learning, Word problems.

1 INTRODUCTION

Entering the 21st century, students are required to possess various higher-order thinking skills (HOTS), which are reflected in the 21st-century skills framework known as the 4Cs: creative thinking, critical thinking, collaboration, and communication. Among these four competencies, creative thinking plays a particularly essential role, as it enables students to generate diverse, flexible, and original ideas when solving problems. Recent studies (e.g., Al-Mahrezi & Ambusaidi, 2021; Kim, 2022; Ramadhan & Taufik, 2023) emphasize that creative thinking is not only related to academic performance but also contributes significantly to students' adaptability and innovation in responding to rapid societal and technological changes. This emphasis on higher-order thinking is echoed by local classroom research showing that carefully designed instructional methods can dramatically improve students' numeracy literacy. (Arahmah, Yudha, & Ulfa, 2021) documented a rise from **34.38%** before intervention to **81.25%** after the third cycle using the Student Facilitator and Explaining method illustrating that targeted teaching approaches can yield substantial gains in a real Indonesian elementary setting.

On the other hand, Indonesian students' literacy and numeracy performance at the international level remains a challenge. Results from the Programme for International Student Assessment (PISA) 2022 indicate that Indonesia's mathematics score is 366—well below the OECD average. This finding reflects the suboptimal development of problem-solving skills and the application of mathematical concepts in real-world contexts, both of which are strongly associated with creative thinking abilities. The OECD report (2023) further highlights that Indonesian students continue to struggle with non-routine tasks that require reasoning and flexible thinking. Supporting this, Atikah, Sarifah, and Yudha (2024) found that Indonesian students' mathematical literacy in the PISA 2022 framework remains low, particularly in interpreting information, connecting concepts, and applying suitable

strategies. Their findings reinforce the urgency of strengthening competencies related to creative thinking, such as flexibility, adaptability, and the ability to generate diverse solution pathways.

In the context of mathematics learning in elementary school, word problems serve as an important tool for fostering creative thinking skills. Word problems require students to understand context, interpret information, consider various possible strategies, and generate appropriate solutions. Several recent studies (Nurhayati & Lestari, 2020; Pratiwi, 2021; Rahmawati & Widodo, 2022) show that problem-based learning through word problems can enhance students' divergent thinking abilities. Nevertheless, in practice, many students still experience difficulties when dealing with word problems, particularly those involving measurement of length, weight, area, and volume. Sari and Putri (2021) found that errors frequently occur during the stages of understanding information, selecting appropriate units, and converting measurements.

Furthermore, recent research (Herawati et al., 2023; Dewi, 2022; Kurniawan & Safitri, 2024) indicates that elementary students' creative thinking abilities generally fall within the low to moderate category. Common challenges include students' tendency to produce only one solution strategy, limited originality in their ideas, and lack of familiarity with generating alternative solutions. However, studies focusing specifically on measurement topics in Grade IV remain limited, even though these concepts appear repeatedly in the curriculum and are highly relevant to daily life.

Based on these conditions, this study holds significant urgency in describing students' creative thinking abilities more comprehensively, particularly regarding the three key indicators proposed by Silver (1997): fluency, flexibility, and novelty. This research was conducted with Grade IVB students at SDN Perwira VII Bekasi Utara, who were learning mathematical word problems on measurement topics. A comprehensive analysis is needed to understand how students interpret contexts, determine strategies, and generate new ideas in solving mathematical problems.

Therefore, the aims of this study are to:

1. Describe students' fluency, flexibility, and novelty in solving mathematical word problems related to measurement.
2. Analyze how these creative thinking abilities influence students' learning outcomes in mathematics.

2 RESEARCH METHODS

This study employed a descriptive qualitative approach aimed at providing an in-depth depiction of students' creative thinking abilities in solving mathematical word problems on measurement topics. This approach was chosen because it enables the researcher to gain a comprehensive understanding of students' thinking processes, including the strategies they use, their level of flexibility in selecting solution methods, and their ability to generate new ideas.

1. **Research Setting and Participants**
   The research was conducted at SDN Perwira VII Bekasi Utara with Grade IVB students, consisting of 16 participants. This class was selected because measurement (length, weight, and area) is an essential topic in Grade IV and frequently appears in various everyday contexts. Moreover, the Grade IVB teacher reported that many students struggled with word problems, particularly in interpreting information and determining appropriate strategies. These conditions align with the focus of the study, which emphasizes analyzing students' fluency, flexibility, and novelty in mathematical problem solving..
2. **Research Procedure**
   The study was carried out in three phases: preparation, implementation, and analysis. In the preparation phase, the researcher developed a word problem test on measurement topics, which was validated by experts in mathematics and elementary education. The implementation phase took place over three meetings.

In the first meeting, students completed the word problem test individually within 60 minutes. In the second meeting, the researcher conducted classroom observations to examine students' interaction patterns and how they solved similar problems in a classroom setting. The observations focused on students' behaviors in selecting strategies, responding to confusion, and attempting alternative solutions. During the third meeting, the researcher conducted semi-structured interviews with selected students from each category (high, medium, low). The interviews focused on their reasons for selecting certain strategies, their understanding of the problem context, the difficulties they experienced, and the ideas that emerged while solving the tasks.

3. **Research Instruments**
   The main instrument in this study was a word problem test involving measurement contexts of length, weight, and area. Each problem was designed to provide opportunities for the emergence of fluency, flexibility, and novelty indicators. Instrument validation was carried out by two expert lecturers to ensure content relevance, difficulty level, and alignment with the research objectives. The observation instrument was used to record students' expressions, strategies used, critical events in the classroom, and responses to non-routine tasks. The interview guide consisted of open-ended questions such as "Why did you choose this method?", "Did you consider another way?", or "Have you encountered similar problems in your daily life?" In addition, the researcher used a creative thinking rubric based on Silver's (1997) indicators, which assess students' fluency in generating ideas, flexibility in strategy use, and novelty in producing original responses.
4. **Data Analysis Techniques**
   Data analysis was conducted in several stages. First, the researcher performed initial coding of students' test answers by identifying common patterns, strategies used, and errors made. The data were then grouped into categories of fluency, flexibility, and novelty according to the assessment rubric. The interview data were transcribed and analyzed using thematic categorization to identify themes related to students' thinking processes, such as their reasons for choosing strategies or the challenges they encountered. Students were subsequently classified into three categories of creative thinking ability—high, medium, and low—based on their total scores across the indicators. Triangulation was carried out by comparing the results of the tests, observations, and interviews to ensure data accuracy and minimize interpretation bias. Additionally, the researcher documented interview excerpts that reflected characteristics of creative thinking to strengthen the presentation of findings..

3 RESULT AND DISCUSSION

The results of the research were obtained through three data collection techniques—tests, observations, and interviews—conducted continuously to provide a comprehensive picture of students' creative thinking abilities. Based on the data analysis, the creative thinking skills of the fourth-grade students in Class IVB showed considerable variation. Of the 16 students involved, 3 students were categorized as high, 5 as moderate, and 8 as low.

Students in the high category demonstrated more fluent, flexible, and original thinking when solving mathematical word problems. They were able to generate more than one solution strategy, establish logical connections between pieces of information in the problem, and propose relevant new ideas. In contrast, students in the low category tended to struggle with understanding the information in the word problems, had difficulty selecting appropriate strategies, and often appeared confused when asked to explain their steps. This variation in performance indicates that students' creative thinking skills still require improvement through learning approaches that better support exploration and creative problem solving.

3.1 Results

The results of the research were obtained from tests, classroom observations, and interviews conducted with 16 fourth-grade students of Class IVB at SDN Perwira VII Bekasi Utara. The data revealed considerable variation in students' creative thinking abilities when solving mathematical word problems. Of the total participants, 3 students were categorized as high, 5 as moderate, and 8 as low. These differences became increasingly apparent when students were required to solve word problems that demanded not only computational skills but also contextual understanding, logical reasoning, and the ability to select appropriate solution strategies.

3.1.1 Students' Fluency, Flexibility, and Novelty in Solving Mathematical Word Problems

Analysis of the results from tests, observations, and interviews shows that students' creative thinking abilities in solving mathematical word problems vary considerably, particularly across the three key indicators of fluency, flexibility, and novelty. These indicators appeared with different levels of intensity in each student category.

In terms of fluency, only a small number of students were able to generate more than one method of solving a problem. Students in the high category demonstrated fluency by attempting multiple strategies, such as converting all units before calculating or solving the problem directly using mixed units. However, most students in the moderate and low categories appeared hesitant when asked to explore alternative approaches. During the interview, one student stated, "I only know the way the teacher taught us. If I have to try another method, I'm afraid I'll get it wrong." This reflects their limited ability to generate ideas spontaneously. Several low-category students even stopped working on the task when their initial strategy did not work, indicating that their fluency in problem-solving remained low.

Regarding flexibility, the majority of students did not yet demonstrate the ability to shift strategies or adjust their approach when the initial method was ineffective. Students in the high category showed better adaptability, attempting alternative strategies such as drawing simple sketches or making rough estimations before performing exact calculations. In contrast, students in the moderate category occasionally tried small variations but typically reverted to familiar procedures. Students in the low category showed the least flexibility; they continued to use the same method even when it was not suitable for the problem context. As one student explained, "I thought every problem had to use the same method," indicating a rigid mindset shaped by reliance on a single teacher-modeled procedure.

Meanwhile, novelty emerged as the rarest indicator. Only two students in the high category were able to produce original ideas by connecting the problem to real-life experiences—for example, comparing the weight of objects in the problem with their experiences weighing rice or sugar at home. Students in the moderate category provided standard responses and occasionally included simple examples, although these lacked significant originality. Low-category students tended to give short, passive answers that did not reflect creative thinking. In some cases, they merely copied their peers' work without attempting to develop their own ideas. This lack of novelty suggests that students are not yet accustomed to thinking independently or seeking solutions beyond the examples provided.

Overall, the combined analysis of the three indicators shows that students' creative thinking abilities still require substantial development. Students who demonstrate strong fluency and flexibility are more capable of generating novel ideas, whereas those who score low on the first two indicators generally fail to show any signs of originality.

3.1.2 The Impact of Creative Thinking Skills on Learning Outcomes

Creative thinking ability has been shown to have a direct impact on students' mathematics learning outcomes. Students in the high category not only completed the problems correctly but were also able to explain the reasoning behind their choice of strategies. They

appeared confident in trying different methods and demonstrated a deeper understanding of the underlying concepts.

In contrast, students in the low category, who produced very few ideas, often experienced repeated confusion. They struggled to understand the context of the problems, were unsure how to determine the initial steps, and tended to stop working when their first strategy failed. This directly affected the low scores they obtained. During the interview, one student stated, "If it's not the same as the example, I don't know where to start." This statement illustrates how limited creativity leads to dependency on examples and reduces their ability to engage in effective problem solving.

These findings collectively indicate that creative thinking plays an essential role in students' success in solving mathematical word problems. A complete summary of the data can be found in Tables 1–3.

3.2 Discussion

The findings of this study indicate that the creative thinking abilities of Grade IVB students remain within the low to moderate category. This result aligns with previous studies showing that elementary students' mathematical creativity often has not yet developed optimally. According to Guilford's Structure of Intellect model, creative thinking encompasses fluency, flexibility, and originality—components of divergent thinking. However, most students in this study did not consistently demonstrate divergent thinking skills. This was evident from their limited ability to generate alternative ideas, their difficulty in shifting perspectives when the first strategy failed, and the minimal emergence of new or original ideas.

From a metacognitive perspective, low creative thinking abilities may stem from students' underdeveloped skills in monitoring, evaluating, and adjusting their thinking strategies. Flavell emphasizes that metacognition is a crucial component of problem-solving because it enables individuals to review the steps they have taken. In this study, students in the low category tended to follow only one procedure without evaluating whether the strategy was effective. This suggests that their metacognitive skills need strengthening to help them think more flexibly rather than relying on a single, fixed method.

When compared to national conditions, these results are consistent with the PISA 2022 report showing that Indonesian students' mathematical literacy remains low. One key indicator of PISA mathematical literacy is the ability to formulate, apply, and interpret mathematics in various contexts, including non-routine word problems. The findings of this research show that these indicators—closely related to creative thinking—are still challenging for fourth-grade students. Moreover, recent results from the Minimum Competency Assessment (AKM) reinforce that Indonesian students' problem-solving and reasoning abilities are still weak, particularly when dealing with contextual problems. Thus, the findings of this study are in line with broader national educational trends.

Several factors may contribute to the low levels of creativity observed in mathematics learning. First, classroom learning remains highly procedural. Classroom observations revealed that students are accustomed to following a single example demonstrated by the teacher and rarely receive opportunities to explore alternative strategies. This leads students to believe that every mathematical problem has only one correct method. Second, students have limited exposure to open-ended problems, which are essential for encouraging the generation of diverse ideas and strategies. In practice, students are more frequently given routine problems solvable with a single formula. Third, pressure for high scores often shifts students' focus toward obtaining the correct answer rather than engaging in meaningful thinking processes. During interviews, some students admitted that they were afraid of making mistakes and preferred copying their peers' answers rather than trying their own strategies.

These findings have important implications for mathematics instruction in elementary schools. Teachers need to go beyond teaching procedures and instead create learning environments that foster creativity. One useful strategy is the integration of open-ended

problems, which allow students to discover more than one correct answer or solution method. Contextual Teaching and Learning (CTL) can also help students connect real-life situations with mathematical concepts, enabling them to generate new ideas more easily. Furthermore, the problem-based learning (PBL) model is effective for enhancing divergent thinking because it places students in situations that require exploration, discussion, and reasoning.

From a curriculum perspective, the Merdeka Curriculum emphasizes higher-order thinking skills (HOTS), including creativity. However, its implementation still requires adequate support, such as appropriate instructional materials, project-based assessments, and professional development for teachers to design learning experiences that nurture creative thinking. Schools also need to provide opportunities for students to discuss, experiment, and reflect, as creativity cannot develop without chances to explore and learn from mistakes.

Evidence from another recent classroom action study indicates that when teachers implement active, innovative, and creative learning models, student achievement can rise from high but not yet perfect levels to full mastery in just two cycles, reinforcing the need for instructional change. (Herzamzam, Kusuma, Utami, & Yudha, 2025).

Overall, this discussion highlights that creative thinking is closely linked to the quality of mathematics learning. Efforts to enhance creativity depend not only on the students themselves but also on instructional design, classroom culture, and effective teaching practices.

3.3 Table

Table 1. Summary of Students' Fluency in Creative Thinking Skills (CTS)

Category	Number of Students	Characteristics
High	3	Provide more than one method of solution
Moderate	5	Provide one method with slight modifications
Low	8	Provide only one method, often with errors

Table 1 show that the fluency indicator was most frequently found among low-category students, totaling 8 students. This indicates that the majority of students were only able to provide a single method of solution and often made mistakes. In contrast, only 3 students were the high category, capable of generating more than one way to solve the problem. These findings suggest that students' ability to produce a variety of ideas remains limited.

Table 2. Summary of Students' Flexibility in Creative Thingking Skills (CTS)

Category	Number of Students	Characteristics
High	2	Consistenly use alternative strategies
Moderate	4	Follow one strategy, occasionally attempt small variations
Low	10	Rely on fixed procedures, often make mistakes

Table 2 shows that the flexibility indicator is also still low. Of the 16 students, 10 fall into the low category, following only standard procedures and often making errors. Only 2 students are able to use alternative strategies consistently. This condition illustrates that most students are not yet accustomed to using different approaches in solving problems.

Table 3. Summary of Students' Creative Thinking Novelty Results

Category	Number of Students	Characteristics

High	2	Providing unique answers by connecting them to everyday experiences.
Moderate	3	Provide standard answers with slight variations
Low	11	Monotonous answers with no new ideas

Table 3 shows that the novelty indicator is the least frequently demonstrated. A total of 11 students fall into the low category, giving monotonous answers without introducing any new ideas. Only 2 students are able to provide unique responses by connecting the problem to their daily experiences, such as comparing the story problem to weighing rice at home. Thus, novelty is the weakest indicator among the three aspects of creative thinking examined in this study.

4 CONCLUSION

The findings of this study indicate that the creative thinking abilities of fourth-grade students at SDN Perwira VII Bekasi Utara vary widely and generally fall within the low to medium categories. Most students have not yet been able to demonstrate the three indicators of creative thinking—fluency, flexibility, and novelty—at an optimal level. In terms of fluency, some students were able to produce answers, but their responses were limited to a single method of completion without attempting alternative approaches. Flexibility was also weak, as students tended to rely on the same procedures even when multiple strategies were available. Meanwhile, novelty emerged as the lowest-performing indicator, with only a small number of students capable of generating unique ideas or solutions that differed from the common patterns used by their peers.

These findings suggest that students' mathematics learning experiences are still dominated by procedural instruction and single-example demonstrations, which do not sufficiently encourage exploration or divergent thinking. The impact of this is clearly reflected in their learning outcomes: students with higher creative thinking abilities are more capable of selecting appropriate strategies, understanding the context of word problems, and achieving higher scores. In contrast, students with lower creative thinking abilities tend to struggle with comprehending information, feel hesitant to try new strategies, and achieve less optimal learning results.

In conclusion, creative thinking plays an essential role in improving students' conceptual understanding and overall mathematics performance. Enhancing students' creative thinking should therefore be a key focus in the learning process, particularly through the use of open-ended problems, exploratory activities, and instructional models that provide opportunities for students to develop diverse ideas and solution strategies. Consistent implementation of these approaches is expected to help students improve their creative thinking skills and positively influence their academic achievement.

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