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Students' Creative Thinking Abilities in Solid Geometry Topics

Koriah Kartika Putri[1], Khansa Khadijatuzzahra[2*]

[1,2]Mathematic Education, Universitas Swadaya Gunung Jati, Perjuangan Street No. 1, Cirebon, West Java, Indonesia

*Coressponding author: khansazahrakh25@gmail.com

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Abstract

Creative thinking ability is an important ability for students and needed in future students. However, students' creativity thinking ability in Indonesia is still low. This low ability is shown by the PISA results that put Indonesia in 63rd place. This study aims to analyze students' creative thinking skills in the material solid figure. The subjects of this study were 33 grade IX junior high school students. This research is a qualitative descriptive study. The data collection technique in this study is a description of the techniques of creative thinking ability questions that represent each indicator of mathematical creative thinking skills. The results showed that overall mathematical creative thinking abilities of students were at a sufficient level. Based on gender, there are differences in students' creative mathematical thinking skills, where female students' abilities are better than male students'. In addition, their indicator are not yet well developed, namely elaboration.

Keywords: Creative Thinking; Gender; Solid Figure.

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1. Introduction

Mathematics is a subject taught at all levels of education in Indonesia because it is considered essential as a means of thinking to develop logical, systematic, objective, critical, rational, and creative thought patterns. This aligns with Ministerial Regulation No. 22 of 2006 concerning content standards for primary and secondary education, which states that mathematics needs to be taught to all students, starting from elementary school, to equip them with the ability to think logically, analytically, systematically, critically, and creatively, as well as the ability to collaborate.

According to existing ministerial regulations, creative thinking is one of the essential skills that students must possess, as this skill is highly needed for their future. This is in line with the opinion of Turkmen & Sertkahya (2015), who state that in educational systems, one of the most important skills that students should gain is creative thinking. Problem-solving skills enable learners to analyze complex problems, develop creative solutions, and implement those solutions effectively, leading to higher levels of innovation and creativity (Adeoye & Jimoh, 2023) . In the context of solid geometry, creativity plays a vital role in helping students visualize three-dimensional objects, explore spatial relationships, and develop unique problem-solving strategies. For example, when solving problems involving volume, surface area, or cross-sections, students often need to imagine the object from different perspectives, break it down into simpler shapes, or even create real-life analogies. Students struggle to understand and solve problems involving solids with curved surfaces due to the intricacy of these shapes (Arifin & Bonyah, 2024). These activities require not just logical thinking, but also the ability to think creatively and flexibly—skills that are crucial not only in mathematics but also in many real-world situations.

Creative thinking has always been associated with mathematics because mathematics is a way of finding solutions to problems by using knowledge of shapes and sizes and, most importantly, by recognizing and utilizing relationships between existing problems. Creativity plays a crucial role in mathematical performance, influencing students' ability to solve mathematical problems effectively (Vink, et.al, 2022). Therefore, the development of creativity is necessary to face the currents of globalization. Creativity involves the capacity to produce novel ideas, solve problems through unique approaches, and improve one's imaginative and productive capabilities, influencing behaviors positively (Karwowski & Beghetto, 2019). Therefore, by thinking creatively, we can discover new ways to solve problems.

This is in line with Hendriana et.al (2017), who states that the indicators of creative thinking are as follows: (1) Fluency – the ability to generate many ideas, which is essential in solid geometry when students are asked to find multiple ways to calculate volume or surface area using different known formulas or approaches; (2) Originality – the ability to come up with ideas in original, non-cliché, and uncommon ways, which supports students in devising unique visualizations or representations of complex 3D shapes; (3) Flexibility – the ability to present various solutions or approaches to problems, which allows students to switch between different strategies, such as breaking down solids into component shapes or rotating objects mentally to gain new perspectives; and (4) Elaboration – the ability to refine a situation or problem so that it becomes complete and to apply a general concept to a specific problem, which helps students provide detailed explanations and justifications when solving geometry problems, such as when applying general volume formulas to irregular or composite shapes. By developing these indicators, students not only improve their problem-solving capabilities in solid geometry but also strengthen their overall creative thinking skills.

Meanwhile, Johnson (Rochani, 2016) states that creative thinking is a habit of the mind trained by paying attention to intuition, activating imagination, uncovering new possibilities, opening up astonishing perspectives, and generating unexpected ideas. This means that with creative thinking, students can solve problems based on their creativity.

According to Tatag (Ismara, Halini, & Suratman, 2017), students' creative thinking ability improves through problem-solving. One of the subjects closely related to problem-solving is Geometry. This is in line with the Ministry of Education and Culture Regulation No. 64 of 2013, which states that the goal of learning geometry is to develop logical, critical, analytical, meticulous, responsible, and resilient attitudes in problem-solving. Among the geometry topics, solid geometry is particularly effective for fostering creativity because it involves visualizing and manipulating three-dimensional objects, which requires flexible and imaginative thinking. Solid geometry is not only an abstract concept in textbooks but also appears in many real-life contexts—such as determining the volume of containers, designing packaging, estimating space in rooms or buildings, or even planning the layout of furniture. In professional fields like architecture, engineering, product design, and construction, the ability to creatively analyze and design solid forms is essential. These real-world connections make it easier for students to engage with problems that are meaningful and concrete, encouraging them to explore multiple strategies and apply their understanding in innovative ways. Furthermore, since solid geometry is taught across different educational levels in Indonesia, it provides continuous opportunities for students to refine and expand their creative thinking skills through increasingly complex problem-solving experiences.

Despite the importance of creative thinking skills in students, observations conducted by Fardah (2012) indicate that many teachers in both primary and secondary education still pay little attention to students' creative thinking abilities. This is further supported by the 2022 PISA (Program for International Student Assessment) results, which ranked Indonesia 69rd out of 80 countries. Similarly, the 2019 TIMSS (Trends in International Mathematics and Science Study) results ranked Indonesia 36th out of 64 countries. According to Eftafiyana, et.al (2018), the characteristics of TIMSS questions require students to have creative thinking skills, indirectly reflecting students' abilities in creative thinking.

If this problem is not addressed, the development of education in Indonesia may face several critical setbacks. First, students may struggle to adapt to increasingly complex real-world problems that require innovative solutions, limiting their competitiveness in both national and global arenas. Second, the continued neglect of creative thinking could hinder the effectiveness of STEM education reforms and the development of 21st-century skills, which are essential in the modern workforce. Third, the education system risks producing graduates who rely heavily on rote learning and standard procedures, rather than critical analysis and original problem-solving. This could further widen the gap between Indonesia and other countries in terms of educational quality and economic progress. Therefore, fostering creative thinking must be seen as a priority in shaping future-ready learners capable of contributing meaningfully to national development.

Meanwhile, observations by Katminingsih & Widodo (2015) reveal differences in creative thinking abilities based on gender. Additionally, according to Fardah (2012), students' mathematical creative thinking abilities vary significantly. These gender-based differences may have important implications for how students engage with geometry, particularly solid geometry, which often requires strong spatial visualization skills—a cognitive domain where some studies suggest males tend to perform better on average. However, female students may demonstrate strengths in detailed elaboration and perseverance in problem-solving, which are also essential components of creative mathematical thinking. If these gender-related tendencies are not acknowledged and addressed appropriately in classroom instruction, there is a risk that one group may be unintentionally favored or overlooked in developing their creative potential. For instance, geometry lessons that rely heavily on visual-spatial tasks without incorporating varied strategies (like storytelling, real-life applications, or hands-on modeling) may disadvantage some students. Therefore, educators should adopt a balanced approach that supports diverse thinking styles and ensures that both male and female students are equally challenged and encouraged to express creativity in mathematical problem-solving.

Based on the background above, the objectives of this study are to analyze the differences in creative thinking abilities based on gender and to assess the level of students' mathematical creative thinking abilities in each indicator. The findings of this research are expected to contribute practically to the development of mathematics curricula and teaching strategies in Indonesia. By identifying specific strengths and challenges faced by different student groups, such as those based on gender, educators can design more inclusive and differentiated instructional approaches that support the development of mathematical creativity for all learners. Furthermore, the insights gained from students' performance on each creative thinking indicator can help teachers select or create learning activities, especially in geometry, that stimulate fluency, originality, flexibility, and elaboration. Ultimately, this research can support the improvement of classroom practices, guide the formulation of more effective teacher training programs, and inform policymakers in creating a curriculum that better nurtures students' creative potential in mathematics.

2. Methods

The research method used in this study is descriptive research, which is particularly suitable for exploring the nuances of students' creative thinking abilities in solid geometry. This method enables a comprehensive examination of both the patterns and variations in how students approach and solve problems, providing a detailed picture of their thinking processes. The type of research employed is qualitative, but it is supported by quantitative analysis to enhance the reliability and validity of the findings. The integration of qualitative and quantitative approaches allows for both in-depth interpretation of student responses and measurable, objective analysis of performance levels based on established criteria.

Quantitative data were derived from students' test results and subsequently analyzed and classified using the system by Astuti (2014), which categorizes students' creative thinking abilities into five levels:

Table 1 – Classification of Creative Thinking Levels

Percentage (%)	Classification
81-100	Excellent (Highly Creative)
61-80	Good (Creative)
41-60	Moderately Creative
21-40	Less Creative
0-20	Very Less Creative

This classification system allows for a standardized interpretation of students' performance on each indicator of creative thinking: fluency, originality, flexibility, and elaboration.

The research steps carried out include:

1. Identifying the problem – The researcher selected creative thinking problems from Rochmanto (2015), which are specifically designed to assess mathematical creativity in the context of solid geometry.
2. Administering the test – Students were given a creative thinking ability test consisting of tasks related to solid geometry.
3. Analyzing the test data – Responses were analyzed quantitatively using descriptive statistics to determine the percentage performance of each student. This was then followed by qualitative interpretation of the results per indicator to understand students' cognitive processes in-depth.

The sample size consisted of 33 students from a public junior high school in Brebes Regency. This sample size was selected based on its ability to reflect the characteristics of the population within a manageable scope, allowing for in-depth qualitative analysis while still yielding meaningful quantitative data. The school was chosen purposively based on accessibility, the curriculum used, and prior cooperation, ensuring the relevance of the sample to the research objectives.

To increase transparency and clarity in analysis, quantitative data were processed using descriptive statistical techniques, such as calculating the mean and percentage scores for each student and indicator. This data was then used to categorize students into their respective creative thinking levels. The complementary use of quantitative classification and qualitative interpretation ensures a more holistic understanding of students' creative thinking abilities and provides actionable insights for mathematics educators.

3. Results and Discussion

In the context of mathematics education, measuring students’ creative thinking abilities is essential, as creativity is not only a goal of modern education but also a core skill for problem-solving and innovation (Siswono, 2010). Particularly in mathematics, creative thinking allows students to explore multiple strategies, develop original ideas, and construct deeper understanding—skills that are vital for success in increasingly complex and dynamic real-world contexts (Silver, 1997; Lithner, 2008).

Solid geometry, as a spatially rich and visually demanding area of mathematics, presents unique opportunities to assess and develop students’ mathematical creativity. Research has shown that solving geometric problems—especially those involving three-dimensional objects—stimulates visualization, spatial reasoning, and flexible thinking (Presmeg, 2006; Sriraman, 2004). According to Sari & Suryadi (2015), geometry serves as a bridge between abstract mathematical concepts and real-life contexts, making it particularly effective for nurturing creative thinking. Measuring students' creative abilities in this topic can thus provide valuable insights into their conceptual understanding, representational fluency, and capacity to generate innovative solutions.

In this study, students’ mathematical creative thinking skills were measured through a test consisting of five essay questions focused on solid geometry. These questions were carefully constructed to align with the four recognized indicators of creative thinking:

1. Fluency – the ability to generate numerous ideas or solutions.
2. Flexibility – the capacity to approach problems from multiple perspectives.
3. Originality – the ability to produce unique or uncommon responses.
4. Elaboration – the skill to develop and expand on ideas in detail.

Students' responses to each question were assessed using a scoring rubric tailored to these indicators, following guidelines for evaluating mathematical creative thinking ability. The raw scores were then converted into grades using the classification system described earlier. These scores reflect students' performance in solving real-world problems related to solid geometry and provide a diagnostic picture of their creative thinking levels.

The importance of this measurement is twofold: it not only identifies students’ current proficiency in creative problem-solving but also provides actionable data for educators to design more targeted interventions that cultivate mathematical creativity—an increasingly emphasized competency in 21st-century learning frameworks (OECD, 2022).

The results of the creative thinking ability test can be seen in the following table:

Table 1 – Description of Students' Mathematical Creative Thinking Ability

Number of Students	Minimum Score	Maximum Score	Average Score
Overall	35	90	51,1
Male	35	60	42,3
Female	35	90	58,3

To provide a stronger context for the significant difference between male and female students' mathematical creative thinking ability, it is important to delve deeper into the concept of creative thinking ability and how gender may influence its development.

Creative thinking ability refers to the capacity to generate new, original, and effective ideas in problem-solving scenarios. In mathematics, this involves not only the ability to find multiple solutions to a given problem but also the flexibility to approach problems from different angles, the fluency to generate various responses, the originality to create unique solutions, and the elaboration to develop these ideas in detail (Sternberg, 2003). These components are crucial for mathematical creativity, especially in topics like solid geometry, where students are expected to visualize and manipulate complex three-dimensional shapes.

The observed gender differences in creative thinking ability, as shown in Table 1, suggest that female students outperform male students on both the maximum score and average score. Several factors may contribute to these differences. Research indicates that gender plays a role in the development of creativity, with some studies suggesting that female students may be more likely to engage in careful reflection and detailed problem-solving processes, which are key elements of creative thinking (Kaufman & Baer, 2004). Additionally, societal and educational factors could influence how male and female students approach mathematical tasks, with female students possibly receiving more encouragement to engage in creative problem-solving in educational contexts, while male students may be more inclined toward algorithmic or rote learning approaches (Gilligan, 1982).

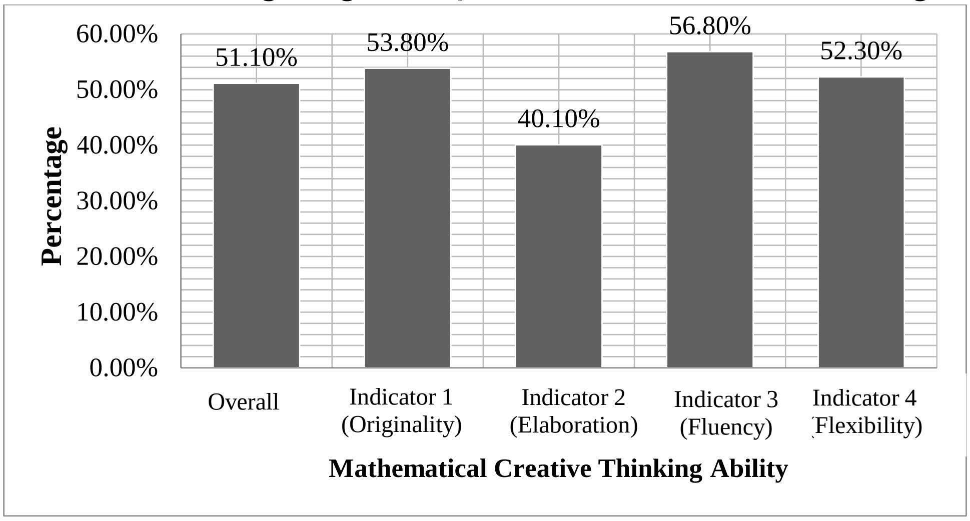
The large maximum score gap between male and female students indicates that female students are more likely to explore creative solutions, pushing the boundaries of conventional problem-solving methods. The 16-point average score difference further reinforces this observation, suggesting that female students may generally exhibit stronger creative thinking when approaching solid geometry problems.

This discrepancy may also be linked to gender stereotypes and mathematical self-concept, where societal expectations often position males as more mathematically inclined, potentially limiting the confidence and creative problem-solving abilities of male students in this domain (Beilock et al., 2010). However, as research by Hyde (2005) suggests, these differences in mathematical performance and creativity are not innate but can be shaped by educational experiences and societal influences.

The data from Table 1 not only highlights a clear gender gap in students' creative thinking abilities but also invites further investigation into how teaching strategies can be tailored to support and enhance the creative potential of both male and female students in mathematics education.

From this data, it can be concluded that female students are more creative than male students, and gender has an influence on students' mathematical creative thinking ability. This finding aligns with the opinion of Dilla et.al (2018), who stated that gender differences affect students' mathematical creative thinking ability, where female students tend to be more creative than male students. According to Dilla et.al (2018), this is because females tend to be more accurate and detail-oriented.

Picture 1. Percentage Diagram Graph of Mathematical Creative Thinking Ability



The bar graph showcases the percentage scores of mathematical creative thinking ability across five categories, providing a window into participants' creative strengths and weaknesses. The overall score stands at 51.10%, reflecting a moderate level of creativity, with individual indicators varying significantly: Fluency (Indicator 3) leads at 56.80%, followed by Originality (Indicator 1) at 53.80%, Flexibility (Indicator 4) at 52.30%, and Elaboration (Indicator 2) lagging at 40.10%. These results resonate with J.P. Guilford's (2014) framework of divergent thinking, which outlines fluency, flexibility, originality, and elaboration as essential creativity components. Guilford emphasized, "Creative thinking involves the ability to produce a large number of ideas (fluency), to shift perspectives (flexibility), to create novel ideas (originality), and to develop those ideas in detail (elaboration)." The high fluency score indicates participants are adept at generating multiple mathematical solutions, while their originality suggests a knack for proposing unique approaches. However, the low elaboration score reveals a challenge in adding depth to their ideas, which may hinder the quality of their mathematical reasoning.8

This data carries significant implications for enhancing mathematical creativity, as underscored by Torrance (2012), who stated, Creativity in mathematics is not just about finding the right answer but about exploring multiple pathways to that answer. The moderate flexibility score indicates participants can adapt their approaches to some degree, but their weakness in elaboration suggests difficulties in providing detailed proofs or justifications—key skills in mathematics. For instance, a student might propose several solutions and a novel method but struggle to expand on their reasoning, leading to incomplete arguments. Educators can address this gap by integrating activities that promote detailed explanations, such as writing comprehensive mathematical arguments or engaging in project-based learning. Meanwhile, leveraging the strengths in fluency and originality through open-ended problem-solving tasks can further nurture creative thinking, empowering students to tackle complex mathematical challenges more effectively and fostering innovation in the field.

The discussion of the data obtained in Figure 1 allows us to classify the average scores based on the classification made by Astuti (2014). According to this classification, the overall level of students' creative thinking ability falls into the "moderately creative" category. This means that students' mathematical creative thinking skills cannot yet be considered good.

Additionally, the analysis shows that students' mathematical creative thinking ability in the indicators of originality, fluency, and flexibility is at a "moderately creative" level. However, the elaboration indicator remains at a "less creative" level. The explanation for each is as follows:

1. Indicator 1 (Originality)

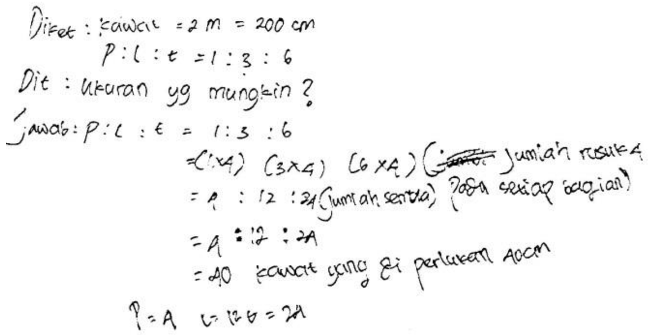
In this study, originality refers to the ability to produce unique and novel ideas. In mathematical problem-solving, this involves generating solutions that are both correct and uncommon. Originality is a key component of creative thinking, as it reflects the capacity to approach problems in innovative ways.

Problem No. 1

A 2-meter-long wire is provided. Determine the possible length, width, and height of a rectangular prism that can be formed using this wire if the ratio of its length, width, and height is 1:3:6.

In Problem 1, students were tasked with determining the dimensions of a rectangular prism formed from a 2-meter wire, given a specific ratio. This open-ended problem allowed students to explore multiple solution paths, encouraging original thinking beyond standard procedures. This question, which assesses originallity, consists of one problem with a maximum score of 4.

Picture 2. Students' Answers on the Originality Indicator



In Picture 2, the student answered by providing information about what is known, what is being asked, and the solution. It's known that the total length of the wire is 2 meters or 200 centimetres. The given ratio of length (p), width (l), and height (t) is 1:3:6. The question asks for the possible dimensions of the wire.

To solve this, the student first wrote down the ratio of length, width, and height as 1:3:6. Then, the student multiplied each number in the ratio by 4, resulting in a new ratio of 4:12:24. These values were then added together, yielding a total of 40. This total represents a possible length of the wire in centimetres, meaning the dimensions of the wire could be 4 cm in length, 12 cm in width, and 24 cm in height.

On the originality indicator, students' performance falls into the moderately creative category. More than 25% of students were able to use the correct method and obtain the correct answer by applying the concept of ratio to solve the problem. These students successfully understood the information provided in the problem, which helped them determine possible dimensions for the rectangular prism. They were able to generate new ideas based on their thinking by identifying different possible measurements.

However, a significant number of students still used incorrect methods. These students struggled to comprehend the given information, leading to misinterpretation and incorrect solutions.

2. Indicator 2 (Elaboration)

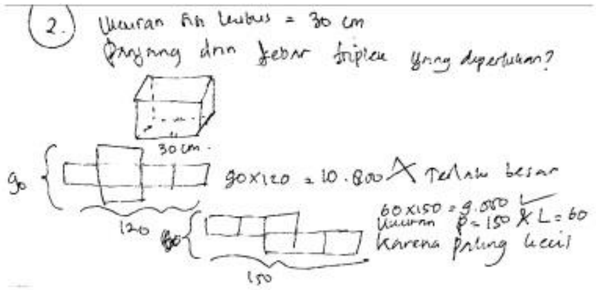
In this study, Elaboration is the ability to expand on ideas by adding details and developing them further. In mathematics, this involves applying general concepts to specific problems and providing thorough explanations.

Problem No. 2

A box in the shape of a cube is made from plywood. If the cube's edge length is 30 cm, what are the minimum length and width of the plywood required to construct the box? Explain!

Problem 2 required students to calculate the minimum size of plywood needed to construct a cube, applying their understanding of cube nets. This problem assessed students' ability to elaborate on their knowledge by translating a three-dimensional object into a two-dimensional representation and determining precise measurements. This question, which assesses elaboration, consists of one problem with a maximum score of 4.

Picture 3. Students’ Answers on the Elaboration Indicator



In Picture 3, the student began by illustrating two different possible net shapes of a cube. Using the information provided in the problem, the student determined that the first net had a length of 40 cm and a width of 90 cm, while the second net had a length of 150 cm and a width of 60 cm.

To find the required plywood area, the student calculated the area of each net by multiplying the length by the width. The first net resulted in an area of 10,800 cm², while the second net resulted in 9,500 cm². Since the question asked for the minimum size needed, the student concluded that the minimum area of plywood required for a cube with side length of 30 cm is 9,500 cm².

On the elaboration indicator, students' performance falls into the less creative category. Many students were unable to fully understand the problem, which prevented them from applying the correct concept to a specific situation. This led to incorrect answers. Only 3% of students were able to provide a well-detailed solution with the correct answer. These students successfully used the net of a cube concept to determine the minimum plywood size required to construct a cube. They understood that using the correct cube net structure would lead them to the correct dimensions.

3. Indicator 3 (Fluency)

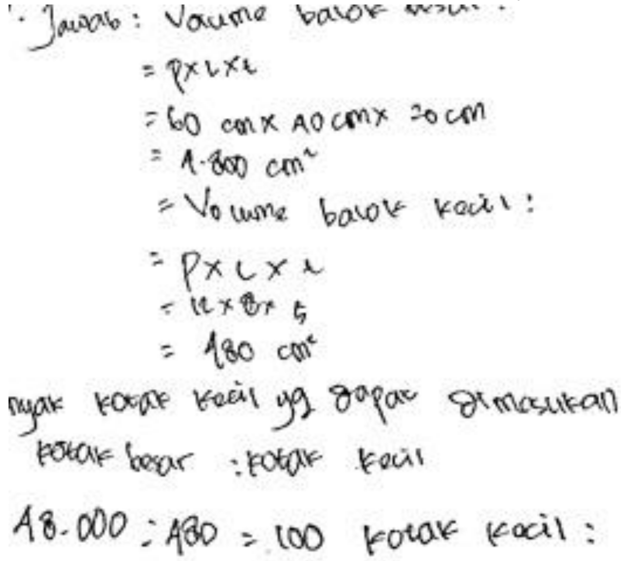
In this study, fluency is the capacity to generate numerous ideas or solutions to a problem. In mathematics, this reflects the ability to produce multiple correct answers or approaches efficiently.

Problem No. 4

A large rectangular box PQRS.TUVW has dimensions of 60 cm (length), 40 cm (width), and 20 cm (height). Smaller rectangular boxes with dimensions of 12 cm × 8 cm × 5 cm will be placed inside the large box. Can these small boxes completely fill the large box? If so, how many small boxes can fit inside? Explain your reasoning!

In Problem 4, students were asked to determine if smaller boxes could completely fill a larger box and, if so, how many would fit. This problem assessed fluency by requiring students to consider various configurations and calculations to arrive at a solution. This question, which assesses fluency, consists of one problem with a maximum score of 4.

Picture 4. Students' Answers on the Fluency Indicator



In Picture 4, the student wrote down the formula for the volume of a rectangular prism. There are two rectangular prisms involved: a large one and a smaller one. The large rectangular prism has dimensions of length × width × height, where the length is 60 cm, the width is 40 cm, and the height is 20 cm. Using these values, the volume of the large rectangular prism is calculated to be 48,000 cm^3.

The small rectangular prism has dimensions of 12 cm in length, 8 cm in width, and 5 cm in height, giving it a volume of 480 cm^3. To find out how many small boxes can fit into the large one, the student compared their volumes by dividing 48,000 by 480. This results in 100, meaning that 100 small boxes can fit inside the large rectangular prism.

On the fluency indicator, this falls into the sufficient category. Students were able to answer in several ways, although many of their reasoning was still incorrect. However, about 50% of students answered using only one method without providing any justification.

4. Indicator 4 (Flexibility)

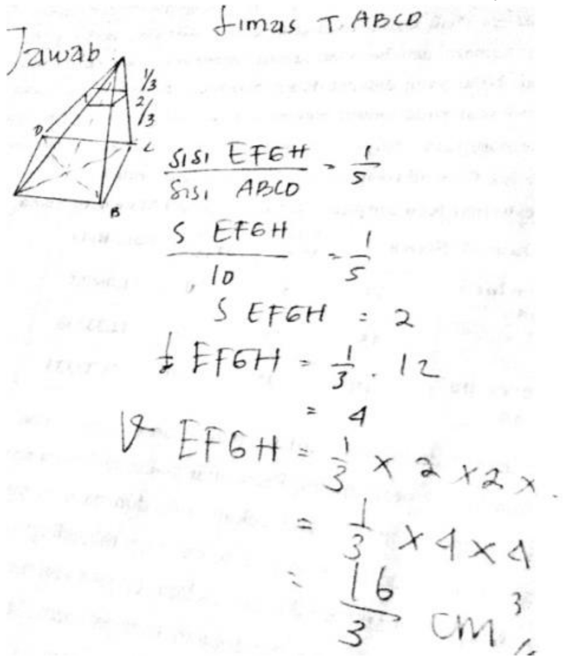
Flexibility involves the ability to approach problems from different perspectives and adapt strategies as needed. In mathematics, this means shifting between various methods or representations to find solutions. The questions related to this indicator consist of two questions with a maximum score of 8.

Problem No. 3

Given that pyramid T.ABCD has a square base with a side length of 10 cm and a height of 12 cm. The pyramid is then cut at a height of 2/3 from the base on plane EFGH, so that the ratio of the sides of plane ABCD to EFGH is 1:5. Determine the volume of the upper part of the pyramid!

Problem 3 challenged students to calculate the volume of the upper part of a truncated pyramid. This required them to apply different geometric principles and consider alternative approaches, demonstrating flexibility in their problem-solving processes.

Picture 5. Students' Answers on the Flexibility Indicator



In Picture 5, the student is solving a problem related to a pyramid labeled T.ABCD. Inside this pyramid, there is a smaller, similar pyramid labeled EFGH. The task is to find the volume of the smaller pyramid.

The student begins by identifying that the side length of the square base EFGH is one-fifth the length of the side of the square base ABCD. Given that the side length of ABCD is 10 cm, the student calculates the side length of EFGH to be 2 cm.

Next, the student continues by calculating the volume of the smaller pyramid EFGH. They assume both the base and the height of the smaller pyramid are 2 cm. However, later in the process, they revise the side length and height to 4 cm. Using this corrected information, the student concludes that the volume of the smaller pyramid is 16 divided by 3 cm^3.

This discrepancy suggests a possible correction or change in assumption during their solution process. The final answer noted is 16 divided by 3 cm^3 as the volume of the smaller pyramid.

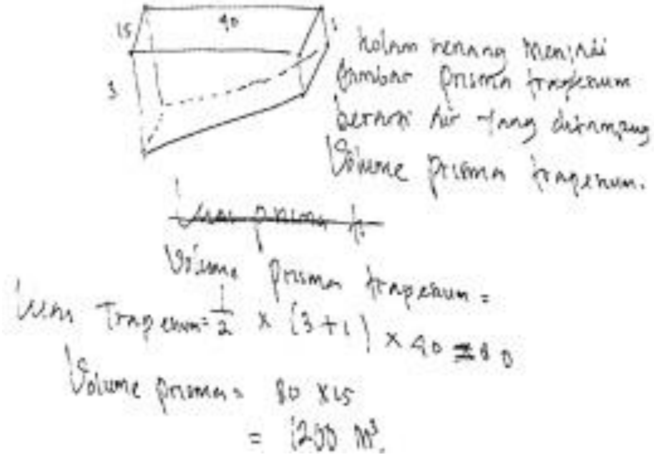
Some students were able to answer this question correctly. They tried to understand the problem by first sketching a diagram, then breaking it down step by step until they identified the necessary parts to solve the question. However, there were still students who attempted to answer without making a sketch first, which led to misunderstandings and failure to comprehend the problem properly.

Problem No. 5

A swimming pool has a length of 40 m and a width of 15 m. The pool has two depths: the shallowest part is 1 m deep, and the deepest part is 3 m. Determine the volume of water the swimming pool can hold. Explain your answer!

In this question, students were asked to solve a problem related to the volume of a swimming pool shaped like a trapezoidal prism, given its dimensions. They were also required to sketch the shape of the pool. In this case, students were expected to solve the problem using a cause-and-effect relationship: since the swimming pool is in the shape of a trapezoidal prism, they needed to use the volume formula for a prism with a trapezoidal base.

Picture 6. Students' Answers on the Flexibility Indicator



In Picture 6, the student is solving a problem involving the volume of a trapezoidal prism, which is described as a water container shaped like a trapezoidal prism.

The student starts by identifying the dimensions of the trapezoid forming the base of the prism. The lengths of the parallel sides are 3 m and 1 m, and the height of the trapezoid is 40 m. Using the trapezoid area formula, the student calculates the area of the base as 80 m^2.

Then, the student multiplies the base area by the height (or length) of the prism, which is 15 m. This results in a final volume of 1,200 m^3 for the trapezoidal prism.

Some students were able to create the required sketch as instructed in the question and understood the correct approach. However, many students still made calculation errors, and some did not draw the sketch at all, leading to confusion about the shape mentioned in the problem.

Based on the data above, students' creative mathematical thinking ability in the elaboration indicator was the lowest compared to flexibility, originality, and fluency. This finding aligns with research conducted by Syafi'i et.al (2011), which states that elaboration is the lowest achievement among all creative thinking indicators. Elaboration refers to a student's ability to develop existing ideas by adding or refining details of an object or concept to make it more comprehensive and applicable in solving specific problems.

Therefore, in elaboration, students are required to analyze and continuously refine their skills in detailing and applying their ideas to solve problems and express their answers. To improve students' elaboration skills, a learning approach that allows students to explore and express their thoughts freely is needed. One such method is Open-Ended learning.

This aligns with Hashimoto's statement (Silver, 1997; Noer, 2011) that open-ended learning provides students with the flexibility to present their answers. Noer (2011) also supports this by stating that students' creative mathematical thinking skills in open-ended learning are higher than those in conventional learning.

4. Conclusions

Based on the analysis and discussion, it can be concluded that there is a notable difference in students' mathematical creative thinking abilities based on gender, with female students demonstrating higher levels of creativity than male students. This result is supported by Katminingsih & Widodo (2015), who noted that female students often show more thoroughness and detail-oriented reasoning in mathematics tasks. Fardah (2012) also observed that female students tend to be more engaged in activities that involve explanation and interpretation—skills that align closely with higher performance in elaboration and fluency.

Overall, students' mathematical creative thinking abilities fall into the "moderately creative" category. The indicators of originality, fluency, and flexibility showed average development, but elaboration remained the weakest aspect. This indicates that while students are able to generate ideas and consider multiple perspectives, they often struggle to expand and refine those ideas into well-developed solutions. Hendriana et.al (2017) emphasized the importance of elaboration in problem-solving, as it helps bridge abstract concepts with specific applications—an essential skill in topics like solid geometry.

These findings highlight the importance of adapting mathematics instruction to support creative thinking, particularly in elaboration. Educators can implement strategies that promote deeper exploration of ideas, such as requiring students to explain the reasoning behind their answers, compare multiple solutions, or relate mathematical problems to real-life contexts. Strengthening these instructional practices could help students reach higher levels of creative thinking and better align classroom learning with the broader goals of the national mathematics curriculum.

Conflict of Interest

The authors declare no conflicts of interest.

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