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How do students create and manipulate geometric figures in HOTS-based cuboid problems?

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Abstract
Geometric intuition is a cognitive skill that supports students in solving geometry problems, one of the more challenging branches of mathematics. This study explores students' ability to create and manipulate geometric figures when working on Higher Order Thinking Skills (HOTS) problems involving cuboids. Employing a qualitative descriptive approach, the study involved 29 eighth-grade students. Data were collected through HOTS-based problem-solving tests and validated interview protocols. Students' abilities to mentally construct and transform geometric figures were assessed using two indicators: (1) visualizing shapes based on imagination and (2) generating new geometric configurations. The findings revealed that most students were unaware of alternative geometric forms embedded within the problem context. The study concludes that students across all performance levels, from low to high, demonstrated the ability to visualize shapes based on imagination. However, only students in the medium category were able to generate a new shape in one problem, whereas those in the high category successfully created new shapes in two problems.

Keywords: Geometric reasoning, Higher-order thinking skills (HOTS), Shape construction and manipulation.

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Introduction

Geometry is a branch of mathematics that is closely associated with visualization (Safrida et al., 2020). It involves the study of points, lines, planes, angles, and dimensions (Naidoo & Kapofu, 2020). Additionally, geometry encompasses concepts of shape, position, and properties (Hendriyanto et al., 2021). Despite its significance, geometry is considered one of the most challenging areas of mathematics for students to learn (Dinda Nur Salsabila et al., 2023). This is evident in its prominent inclusion in the Indonesian curriculum, underscoring its importance (Suwito, 2019). However, due to the abstract nature of geometric content (Pangestika et al., 2022) students often show low interest in this field, which negatively impacts their learning outcomes. Beyond its abstractness, students also face epistemological difficulties, such as mentally transforming two-dimensional shapes into three-dimensional forms and estimating the dimensions of three-dimensional objects (Sudirman et al., 2023). Consequently, students' performance in solving geometry problems on the Minimum

Competency Assessment (AKM) Numeracy test remains low, largely due to limited interest and understanding of geometry (Ali & Ni'mah, 2023).

One of the key abilities that can aid in solving geometry problems is geometric intuition. This stems from the idea that humans acquire knowledge through intuition (El-taro & Aryani, 2022). Fundamentally, geometric intuition refers to the ability to analyze, comprehend, and solve mathematical problems by directly forming perceptions of quantitative relationships and other essential properties of objects, often with the aid of numerical reasoning (Zhou & Yang, 2023). According to Mutammam et al. (2023) geometric intuition involves the capacity to visualize, construct, and mentally organize geometric shapes when solving geometry problems. Lin & Chen (2021) further assert that geometric intuition is applied in understanding mathematical concepts, proving theorems, deriving formulas, and solving mathematical problems.

Geometric intuition comprises several components that are commonly used in designing tasks or assessment instruments. Among these components is the ability to mentally create and manipulate geometric figures. This particular skill enhances students' creativity and imagination in problem-solving. Students can approach problems using reasoning that involves manipulating and transforming one shape into another (Fujita et al., 2020). Such geometric manipulation also supports the development of algebraic understanding through previously acquired geometric knowledge (Fachrudin et al., 2023). In addition to mentally visualizing geometric forms, drawing objects is another effective strategy for solving geometry problems (Dwi Octaviani et al., 2021). Given the variation in how each student conceptualizes geometric shapes, differences in their responses are common. There are two indicators of the ability to mentally create and manipulate geometric figures, adapted from Mutammam et al. (2023) that (1) guessing shapes based on students' imagination, and (2) constructing new geometric forms.

Difficulties in problem-solving often stem from a lack of critical thinking skills (Shida et al., 2023). Yet, Higher Order Thinking Skills (HOTS) are considered essential cognitive abilities that require teachers to actively cultivate them in students as part of 21st-century learning development (Yanti & Anas Thohir, 2024). As a result, many educational systems have begun integrating HOTS into student learning (Setyaningrum et al., 2024). Since 2017, the Indonesian National Examination has adopted HOTS-type questions, a practice that continues in subsequent years (Saputra et al., 2022). HOTS are crucial for students because real-world problems are complex, require extensive analysis, and demand more than mere memorization of facts or concept (Tania, 2021). In addition to fostering critical thinking, HOTS also support students in developing creativity, problem-solving abilities, and decision-making skills (Windasari & Cholily, 2021). There are three categories of higher-order thinking: analyzing (C4), evaluating (C5), and creating (C6) (Nafiati, 2021). The ability to mentally create and manipulate geometric figures falls under the analytical level of thinking, as it is typically elicited through HOTS-based problems. This is because such abilities are components of geometric intuition, which shares a conceptual foundation with analytical thinking. Moreover, both HOTS and the skill of mentally creating and manipulating geometric figures encourage students to think creatively.

One of the geometry topics taught in junior high school (*Sekolah Menengah Pertama* or SMP) is three-dimensional shapes. A cuboid is one type of polyhedron with flat faces, characterized by a rectangular base. A cuboid has several properties, including three pairs of opposite congruent faces. Additionally, it consists of 12 edges, eight vertices, 12 face diagonals, four space diagonals, and six diagonal planes. The net of a cuboid is composed of rectangular plane figures. The surface area of a cuboid is calculated by summing the areas of each of its face (Sukestiyarno & Rahmawati, 2019).

Research on students' ability to understand geometric shapes in geometry problems was conducted by Indrayany & Lestari (2019) who analyzed the difficulties faced by junior high school students in solving geometry problems and the underlying factors, based on the van Hiele theory. Their findings revealed that students struggled with visualization-level thinking. In their data collection, the researchers used test items containing combined plane figures. The study employed low-difficulty test instruments, resulting in a relatively brief analysis. Additionally, due to the limited geographic scope of the subjects, the researchers selected participants from other regions to examine similar abilities relevant to their research goals.

Further research by Mariah (2024) found that students had difficulty solving HOTS problems related to polyhedra due to a lack of conceptual understanding. The study also showed that students who successfully solved HOTS problems tended to use drawings during the problem-solving process. However, the research had limitations, including one test item (question number one) that did not adequately reflect HOTS criteria, making the analysis of HOTS problem-solving incomplete.

Lastly, research on geometric intuition was conducted by Mutammam et al. (2023), inspired by Fujita et al. (2020). This study focused on task design incorporating components that are also used in the present research as instruments to assess students' ability to mentally create and manipulate geometric figures.

Research on the ability to create and manipulate images, one of the components of geometric intuition, is still relatively new in Indonesia. This topic has become a trend in China, where studies on geometric intuition have gained traction. For example, Zhou & Yang (2023), in their work Research on Geometric Intuition of Junior High School Students in China, discuss educational efforts to enhance geometric intuition through literature review. Similarly, Lin & Chen (2021), in Deepening the Understanding of Mathematics with Geometric Intuition, explore the components of geometric intuition that can be applied in the development of instructional media.

Although this topic is frequently discussed in China, research literacy on geometric intuition remains limited. Subsequent observations revealed that students tend to struggle with HOTS (Higher Order Thinking Skills) problems related to cuboids, as their understanding is often limited to calculating surface area and volume.

Based on this background and previous studies, it is evident that beyond conceptual understanding, students also need the ability to visualize shapes when solving geometry problems. Therefore, this study aims to describe students' geometric intuition, particularly their ability to create and manipulate geometric images when solving HOTS problems involving cuboids.

Methods

This study employs a qualitative approach with a descriptive research design. Qualitative research refers to studies that produce analytical procedures without using statistical methods or other forms of quantification (Kusumastuti & Khoiron, 2019). The research process began with preliminary activities, including selecting the research site and obtaining permission from SMPN 1 Tempeh, Lumajang, with a total of 29 eighth-grade students as subjects.

Next, the researchers developed instruments consisting of three HOTS (Higher Order Thinking Skills) test items focused on cuboid material, along with an interview guide. The following are the three HOTS test items related to cuboids.

1. A wooden block has dimensions of length (x+1) cm, width x cm, height twice its length, and a base diagonal of (x+2) cm. Determine the maximum number of wooden blocks that can fit into a box whose length, width, and height are twice the dimensions of the wooden block.
2. A father builds a lantern frame shaped like a cuboid, without vertical edges and with two pairs of space diagonals. Determine the length of iron needed to construct the lantern frame if the ratio of its length to width is 4:3, the perimeter of the base is 42 cm, and the height is equal to (length + width) - 1.
3. The cuboid ABCD EFGH has length, width, and height ratios of 4:3:12, and the perimeter of the base is 28 cm. Determine the length of segment CI, which represents the height of triangle ACG.

The instrument was validated by three experts: two Mathematics Education lecturers from the University of Jember and one mathematics teacher from SMPN 1 Tempeh. Once the instrument was deemed valid, the study proceeded to the data collection phase. This phase began with administering a written HOTS (Higher Order Thinking Skills) test consisting of three items to the students.

The test results were then scored based on indicators derived from the description of the component "creating and manipulating geometric figures in the mind" (Mutammam et al., 2023). This component is believed to stimulate students' imagination and creativity in problem-solving, particularly in analyzing geometric shapes, thereby allowing for diverse thinking approaches. From this description, two key indicators were formulated: (1) guessing shapes based on students' imagination, and (2) creating new geometric figures.

The scoring process awarded one point for each indicator met by the student. After scoring, the data were analyzed by categorizing the test results into three levels: low, medium, and high. Next, interviews were conducted using a structured guide containing questions related to the component of mentally creating and manipulating geometric figures. The indicators used in the interviews were also based on Mutammam et al. (2023). The first indicator, guessing shapes based on students' imagination, aimed to explore how students determine the form of three-dimensional objects from various perspectives, such as geometric properties or combinations of other solid shapes. The second indicator, creating new figures, was intended to understand students' thought processes in analyzing possible new shapes based on the problem descriptions, in order to find alternative solutions.

Interviews continued until data saturation was reached, resulting in a sample of 10 students. Finally, three subjects, one from each performance category, were analyzed in depth, and conclusions were drawn.

Results

Based on the data collected from the HOTS problem-solving test, the results of the analysis are presented in Table 1.

Table 1. Analysis Levels of HOTS Problem-Solving Test Results

Interval	Frequency	Percentage (%)	Category
$0\% \leq P < 34\%$	16	55%	Low
$34\% \leq P < 67\%$	11	38%	Medium
$67\% \leq P \leq 100\%$	2	7%	High
Total	29	100%	

The HOTS test was scored using a validated scoring rubric. The data revealed that the majority of students fell into the low-performance category. Subsequently, interviews were conducted until data saturation was reached, involving four students from the low category, three from the medium category, and two from the high category.

From these interviews, three subjects were selected who provided clear and detailed responses. These subjects were then analyzed further and conclusions were drawn. The subjects were coded as S1 (Subject 1), S2 (Subject 2), and S3 (Subject 3). The list of interview subjects is presented in Table 2.

Table 2. List of Interview Subjects

No.	Pseudonym	Category	Subject Code	Test Percentage
1.	DSR	Low	S1	31%
2.	FA	Medium	S2	63%
3.	FT	High	S3	77%

Interview data were obtained from these three students, each representing one performance category. The interviews followed a structured guide and included responses from each subject. Below is the analysis of each subject's level of geometric intuition.

Based on S1's response to problem number 1, the subject was able to draw a cuboid and label its edge measurements. However, the subject did not illustrate other possible three-dimensional shapes that could be formed into a cuboid. Therefore, S1 met the indicator of "guessing shapes based on student imagination." S1's solution to problem number 1 is shown in Figure 1. The figure and interview excerpts are coded according to the indicators: Indicator 1 (M1) and Indicator 2 (M2).

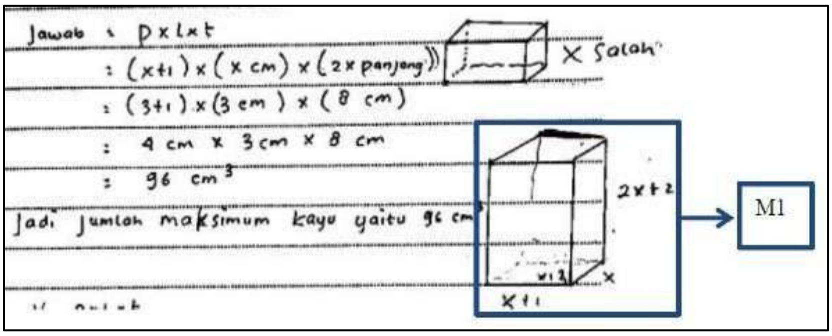


Figure 1. Solution to Problem Number 1 by S1

Translation of Figure 1:
Answer: length × width × height
= (x+1) × (x cm) × (2x length) ╳ Wrong
= (3+1) × (3 cm) × (8 cm)
= 4 cm × 3 cm × 8 cm
= 96 cm³
Therefore, the maximum amount of wood is 96 cm³.

Figure 2 shows the subject's response to problem number 2, where the student drew a cuboid and did not illustrate any other possible three-dimensional shapes. Therefore, S1 met the indicator of "guessing shapes based on student imagination." The solution to problem number 2 by S1 is shown in Figure 2.

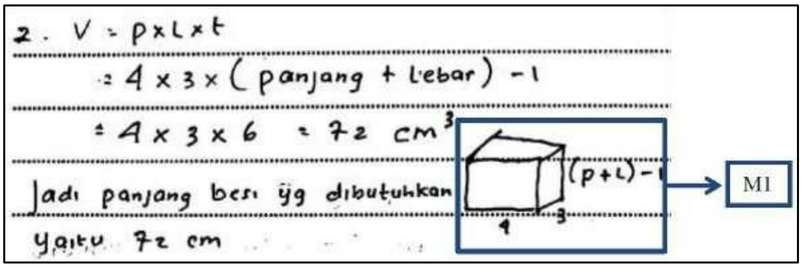


Figure 2. Solution to Problem Number 2 by S1

Translation of Figure 2:
Volume = length × width × height
= 4 × 3 × (length + width) – 1
= 4 × 3 × 6 = 72 cm³
Therefore, the length of iron required is 72 cm.

Figure 3 shows the subject's response to problem number 3, where the student drew a cuboid based on the information provided in the problem. No other three-dimensional shapes were illustrated by the subject. Therefore, the subject met the indicator of "guessing shapes based on student imagination." The solution to problem number 3 by S1 is shown in Figure 3.

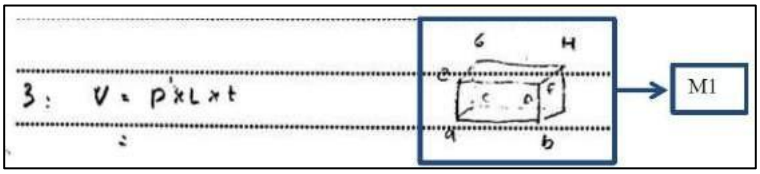


Figure 3. Solution to Problem Number 3 by S1

Translation of Figure 3:
Volume = length × width × height

Below is an excerpt from the interview conducted by the researcher with S1 for the problem number 1.

M1 : Based on problem number 1, what three-dimensional shape did you imagine?
S1 : A cuboid.
M2 : In your opinion, what other three-dimensional shapes are formed in the image?
S1 : None.
M2 : Why do you think that?
S1 : Because the problem only describes it that way, and I drew according to the question.

Based on problem number 1, S1 was able to identify the shape as a cuboid. However, the subject did not consider any other possible shapes. Therefore, the subject met the indicator of "guessing shapes based on student imagination."

Below is an excerpt from the interview conducted by the researcher with S1 for the problem number 2.

M1 : Based on problem number 2, what three-dimensional shape did you imagine?
S1 : A cuboid.
M2 : In your opinion, what other three-dimensional shapes are formed in the image?
S1 : None.
M2 : Why do you think that?
S1 : Same as before, because of the way the question is written.

Based on problem number 2, S1 recognized that the problem involved a cuboid. The subject did not consider other possible shapes, thus meeting the indicator of "guessing shapes based on student imagination."

Below is an excerpt from the interview conducted by the researcher with S1 for the problem number 3.

M1 : Based on problem number 3, what three-dimensional shape did you imagine?

S1 : A cuboid.
M2 : In your opinion, what other three-dimensional shapes are formed in the image?
S1 : It seems there aren't any, based on the question.

Based on problem number 3, S1 was able to identify that the problem presented involved a cuboid and believed that no other shapes were formed. Therefore, the subject met the indicator of "guessing shapes based on student imagination." The analysis of test responses and interview data shows that S1 fulfilled one indicator across all three problems, namely, guessing shapes based on imagination. The results of this analysis are presented in Table 3.

Table 3. Data Analysis of S1

Component of Geometric Intuition	Indicator	Problem Number		
		1	2	3
Creating and manipulating geometric figures in the mind	Guessing shapes based on student imagination	✓	✓	✓
	Creating new shapes	-	-	-

Based on S2's response to problem number 1, the subject drew a cuboid and did not illustrate any other shapes. Therefore, the subject met the indicator of guessing shapes based on student imagination. S2's solution to problem number 1 is shown in Figure 4.

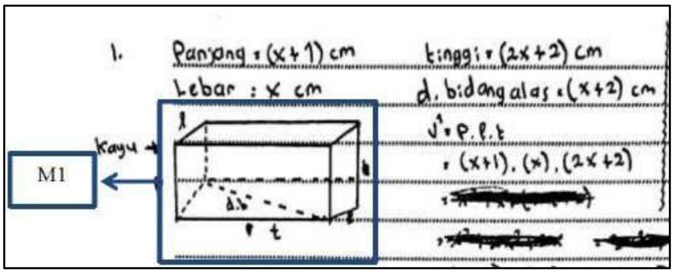
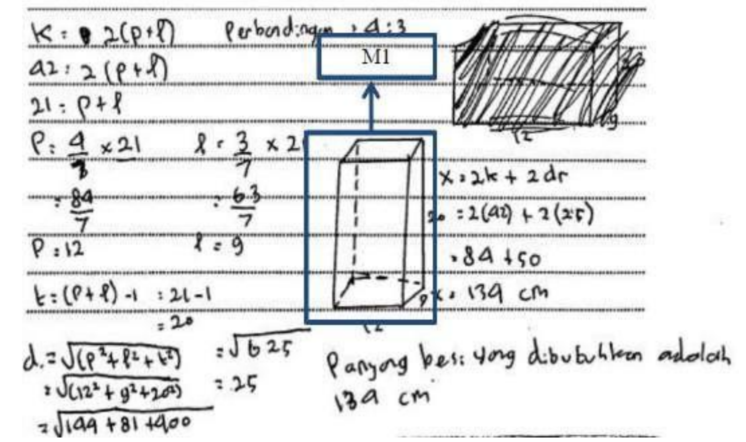


Figure 4. Solution to Problem Number 1 by S2

Translation of Figure 4:
Length = (x+1) cm
Width = x cm
Height = (2x+2) cm
Diagonal of Base side = (x+2) cm
V = L × W × H
= (x+1) × (x) × (2x+2)

Figure 5 shows the subject's response to problem number 2, where the student successfully drew a cuboid and did not include any other shapes. Therefore, the subject met the indicator of "guessing shapes based on student imagination." The solution to problem number 2 by S2 is shown in Figure 5.



Translate:
The ratio is 4:3
The required length of iron is 134 cm

Figure 5. Solution to Problem Number 2 by S2

Figure 6 shows the subject's response to problem number 3, where the student drew a cuboid and did not include any other three-dimensional shapes. Based on this, the subject met the indicator of "guessing the shape based on student imagination." The solution to problem number 3 by S2 is shown in Figure 6.

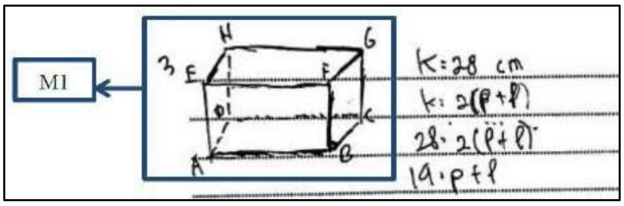


Figure 6. Solution to Problem Number 3 by S2

Below is an excerpt from the interview conducted by the researcher with S2 for the problem number 1.

M1 : Based on problem number 1, what three-dimensional shape did you think of?
S2 : A cuboid.
M2 : In your opinion, what three-dimensional shapes are formed in the image?
S2 : There is a triangular prism, because if two prisms are combined, they form a cuboid.

Based on problem number 1, S2 was able to identify the cuboid shape using the given information. S2 believed that another shape, a triangular prism, was present, and that combining two of these would result in a cuboid. Based on this, the subject met all the indicators.

Below is an excerpt from the interview conducted by the researcher with S2 for the problem number 2.

M1 : Based on problem number 2, what three-dimensional shape did you think of?
S2 : A cuboid.
M2 : In your opinion, what three-dimensional shapes are formed in the image?

S2 : Same as before, there is a triangular prism.

Based on problem number 2, S2 was able to identify the cuboid shape using the given information. S2 believed that another shape, a triangular prism, was present, but this assumption turned out to be incorrect. Nevertheless, the subject met the indicator of guessing the shape based on student imagination.

Below is an excerpt from the interview conducted by the researcher with S2 for the problem number 3.

M1 : Based on problem number 3, what three-dimensional shape did you think of?
S2 : A cuboid.
M2 : In your opinion, what three-dimensional shapes are formed in the image?
S2 : None.
M2 : Why do you think that?
S2 : It seems that there are no other shapes in the problem.

Based on problem number 3, S2 was able to recognize that the problem involved a cuboid. The subject did not consider any other shapes, thus meeting the indicator of guessing the shape based on student imagination. Based on the analysis of S2's test answers and interview responses, the results show that S2 met the indicator of guessing the shape based on student imagination in each problem, and met the indicator of creating a new shape in one problem. The analysis results are presented in Table 4.

Table 4. Data Analysis of S2

Component of Geometric Intuition	**Indicator**	**Problem Number**		
		1	**2**	**3**
Creating and manipulating geometric figures mentally	Guessing the shape based on student imagination	✓	✓	✓
	Creating a new shape	✓	-	-

Based on S3's response to problem number 1, the subject drew a cuboid and did not include any other shapes. Therefore, the subject met the indicator of guessing the shape based on student imagination. The solution to problem number 1 by S3 can be seen in Figure 7.

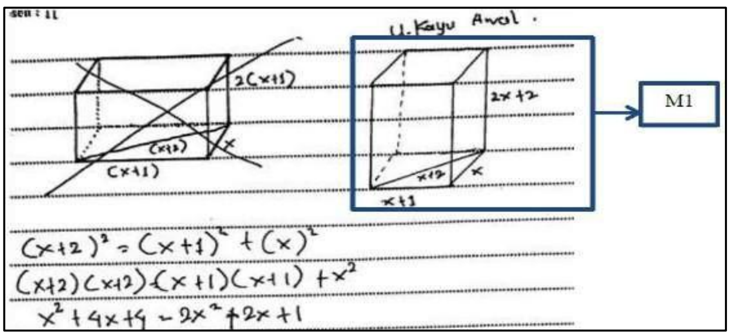


Figure 7. Solution to Question 1 by Subject S3

Figure 8 shows the answer to Question 2, where the subject drew a rectangular prism and did not include any other three-dimensional shapes. Based on this, the subject meets the indicator of guessing the image based on the student's imagination. The solution to Question 2 by Subject S3 can be seen in Figure 8.

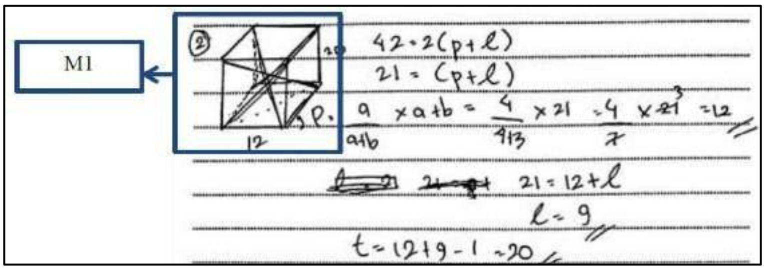


Figure 8. Solution to Question 2 by Subject S3

Figure 9 shows the answer to Question 3, where the subject drew a rectangular prism along with another geometric shape—a pyramid. Therefore, the subject meets all indicators: guessing the image based on the student's imagination (M1) and creating a new shape (M2). The solution to Question 3 by Subject S3 can be seen in Figure 9.

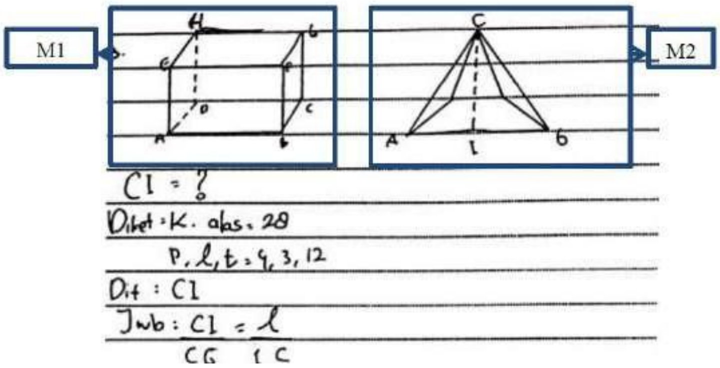


Figure 9. Solution to Question 3 by Subject S3

Translation of Figure 9:
Given = the perimeter of the base = 28
Length, widht, height = 4, 3, 12
Asked = CI

Below is an excerpt from the interview conducted by the researcher with Subject S3 for the problem number 1.

M1 : Based on Problem 1, what three-dimensional shape did you imagine?
S3 : A rectangular prism.
M2 : In your opinion, what shapes are formed in the image?
S3 : None.
M2 : Why do you think that?
S3 : Because the question clearly states that the shape is a rectangular prism

Based on Problem 1, S3 was able to identify that the problem presented involved a rectangular prism. The subject did not consider any other shapes, thus fulfilling the indicator of guessing the image based on student imagination.

Below is an excerpt from the interview conducted by the researcher with Subject S3 for the problem number 2.

M1 : Based on Problem 2, what three-dimensional shape did you imagine?
S3 : At first, I thought it was a rectangular prism, but after imagining it, I saw another shape.
M2 : What shapes do you think are formed in the image?
S3 : I forgot the name of the shape, but it looks like an hourglass with the top and bottom sides shaped like rectangles.

Based on Problem 2, S3 was able to guess the rectangular prism using the given information. S2 believed there was another shape, such as a square pyramid. Based on this, the subject fulfilled both indicators: guessing the image based on student imagination and creating a new shape.

Below is an excerpt from the interview conducted by the researcher with Subject S3 for the problem number 3.

M1 : Based on Problem 3, what three-dimensional shape did you imagine?
S3 : A rectangular prism.
M2 : What shapes do you think are formed in the image?
S3 : It looks like a pyramid because of the explanation involving ACG and (CI)

Based on Problem 3, S3 was able to guess the rectangular prism using the given information. S3 also believed there was another shape, a pyramid. Therefore, the subject fulfilled both indicators: guessing the image based on student imagination and creating a new shape.

Based on the analysis of test answers and interviews, S3 met the indicator of guessing the image based on student imagination in all problems, and the indicator of creating a new shape in two problems. The analysis results can be seen in Table 5.

Table 5. Data Analysis of Subject S3

Component of Geometric Intuition	**Indicator**	**Question Number**		
		1	**2**	**3**
Creating and manipulating geometric figures mentally	Guessing the image based on student imagination	✓	✓	✓
	Creating a new shape	-	✓	✓

Discussion

When solving Problem 1, Subject S1 used the description provided in the question and connected it with the image to help solve the problem. However, S1 did not consider creating any new shapes, as they focused solely on the explanation in the question. Therefore, S1 met only one indicator, guessing the image based on student imagination. The same applies to Problems 2 and 3, where S1 relied on the descriptions given in the questions and assumed that all shapes were rectangular prisms, without considering the possibility of new forms. Based on this, S1 falls into the low category.

There are similarities in how Subject S2 solved Problems 1 and 2. S2 used the descriptions provided in the questions and connected them with the images to help solve the problems. According to S2, the three-dimensional shapes in Problems 1 and 2 were combinations of triangular prisms, but the subject did not apply that analogy when solving the problems. Furthermore, the idea of a triangular prism combination in Problem 2 was inaccurate, as it did not align with the description given in the question. Then, S2 solved Problem 3 using the description provided in the question, without considering the possibility of other three-dimensional shapes being formed. Based on this, S2 falls into the medium category.

Next, the solution provided by Subject S3 for Problem 1 only met the first indicator, as the subject relied on the description given in the question. However, for Problems 2 and 3, S3 fulfilled all indicators. Initially, the subject used the description in the question to accurately draw a rectangular prism. Then, based on that description, the subject imagined another shape: in Problem 2, it was described as an hourglass with rectangular top and bottom sides, and in Problem 3, the subject envisioned a square pyramid. Based on this, the subject falls into the high category.

The researcher was able to analyze the ability to create and manipulate shapes mentally, which is one of the components of geometric intuition, by adapting the task design proposed by Mutammam et al. (2023). The researcher then categorized this ability into three levels: low, medium, and high. Students' ability to create and manipulate shapes in their minds tended to fall into the medium category. This is because students were able to form shapes based on known information, but when asked about other possible shapes, they were often unaware of them. Based on the conducted research, students in the high category tended to have a deeper understanding and were able to manipulate other emerging shapes. Students in the medium category were generally able to create shapes based on existing information but were less accurate in identifying new ones. Students in the low category were unable to guess or consider alternative shapes and could only draw figures based on the given information.

The study conducted by Indrayany & Lestari (2019) explains that students experienced confusion when solving problems due to the presence of shapes that matched the question. The subjects also tended to solve the problems based on concrete visual forms. This was because the questions presented contained images of combined two-dimensional shapes. In contrast, the current study presented the problems in narrative form, allowing students to first imagine the three-dimensional shapes based on the information provided. This led to variations in students' thinking when determining other possible shapes based on the problem. Both studies are interconnected, as their findings show that students also struggled to visualize shapes based on the question descriptions and to consider the possibility of other shapes that, when combined, could form a rectangular prism or a new shape altogether.

The questions used in this study are based on Higher Order Thinking Skills (HOTS). This is because identifying one of the components of geometric intuition requires instruments that can prompt students to analyze the problem. Therefore, the questions fall under the C4 category, which involves analysis. In a study conducted by Mariah (2024), students who were able to solve HOTS problems used visual representations in their solutions. This research employed HOTS-based problem-solving tests that were validated by three experts. It was found that when students are able to create and manipulate shapes, it helps them solve problems involving rectangular prisms more effectively and increases the likelihood of accurate answers—provided that the relevant geometric properties and concepts are applied correctly.

Conclusion

Based on the results of the data analysis, students used the information provided in the questions to determine the images that would help them solve the problems. However, students were too focused on the descriptions and visual representations, which led to a lack of consideration for new shapes and limited variation in problem-solving approaches. All three subjects met the indicator of guessing the image based on student imagination. Regarding the indicator of creating a new shape, S1 did not meet it, S2 met it only in Problem 1, and S3 met it in Problems 2 and 3. Based on these findings, S1 falls into the low category, S2 into the medium category, and S3 into the high category.

This research should serve as a valuable evaluation tool for teachers to assess students' ability to create and manipulate geometric images. Furthermore, it is hoped that this study can be used as a reference in developing learning media aimed at training students' skills in creating and manipulating geometric images in solving HOTS (Higher Order Thinking Skills) problems.

Declarations

Author Contribution	:	AIK: Conceptualization, Methodology, Investigation, Writing - Original Draft, Formal Analysis, Editing and Visualization. AS: Methodology, Writing - Review & Editing, Formal Analysis and Visualization. RA: Methodology, Writing-Review & Editing, Formal Analysis and Visualization. SS: Validation and Supervision. LNS: Validation and Supervision.
Funding Statement	:	No funding.
Conflict of Interest	:	The authors declare no conflict of interest.
Additional Information	:	No additional information is available for this paper.

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