Jurnal MATH-UMB.EDU
Vol 13, (3), 2026

JUNIOR HIGH SCHOOL STUDENTS' CRITICAL THINKING SKILLS IN LEARNING PRISM CONCEPTS

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Received:18-02-2026 Revised: 27-06-2026 Accepted:04-07-2026 Published:06-07-2026

Abstract

This study aims to describe and analyze junior high school students' critical thinking skills in learning prism concepts. A descriptive quantitative research design was employed, involving 109 students from three junior high schools in Palembang. Data were collected using a critical thinking skills test consisting of contextual mathematical problems developed based on Facione's critical thinking indicators, interpretation, analysis, evaluation, and inference. The data were analyzed descriptively through the stages of data reduction, data display, and conclusion drawing. The findings reveal that the overall level of students' critical thinking skills in prism concept is categorized as low, with a mean score of 1,83. Among the indicators, interpretation obtained the highest score, whereas inference showed the lowest performance. In terms of gender differences, male students tended to perform better in the interpretation indicator, while female students demonstrated stronger abilities in analysis and evaluation. Nevertheless, both male and female students exhibited weaknesses in drawing valid conclusions and constructing logical mathematical arguments. These results suggest that mathematics instruction remains predominantly procedure-oriented and has not adequately fostered higher-order thinking skills. Therefore, mathematics learning should emphasize reasoning-based instruction, classroom discussion, and contextual problem-solving activities to comprehensively enhance students' critical thinking skills.

Keywords: critical thinking skills, prism, junior high school students

INTRODUCTION

Education is a fundamental pillar in developing an enlightened society, as articulated in the Preamble of the 1945 Constitution of the Republic of Indonesia. National education aims to develop learners' potential so that they become individuals who are faithful, ethical, knowledgeable, and equipped with skills relevant to contemporary demands (Ministry of Education, Culture, Research, and Technology, 2022). In the context of the 21st century and digital transformation, education systems are also expected to produce human resources who are adaptive, creative, and capable of higher-order thinking (OECD, 2018; World Economic Forum, 2023).

In the era of globalization and the Fourth Industrial Revolution, higher-order thinking skills (HOTS) have become essential competencies for individuals, particularly critical thinking skills (Brookhart, 2010; Ennis, 2018; Facione, 2015; Pratiwi et al., 2022). Critical thinking is widely recognized as a core 21st-century skill that plays a crucial role in enabling learners to address complex problems in both academic settings and real-life situations (Paul & Elder, 2019; OECD, 2024).

Within the context of mathematics education, critical thinking is one of the primary learning objectives (Krulik & Rudnick, 1992). Mathematics learning should not merely emphasize computational skills but also require students to analyze information, connect concepts, and draw logical and systematic conclusions (Hendriana & Soemarmo, 2017; Fisher, 2011). Through critical thinking, students are expected to understand abstract concepts, solve problems in a structured manner, and develop rational decision-making skills (Lai, 2011; Halpern, 2014; Lestari & Yudhanegara, 2016).

One mathematical domain with strong potential to foster critical thinking skills is geometry, particularly topics related to polyhedra such as prism concept. Prisms are three-dimensional shapes closely associated with everyday life, including roof structures, food packaging, and multi-story buildings. Learning prism concept does not solely focus on calculating surface area and volume but also requires spatial reasoning, three-dimensional visualization, and the ability to integrate multiple mathematical concepts (Hershkowitz, 1990; Maričić & Špijunović, 2015). Therefore, prism concept offers substantial opportunities to optimally develop students' critical thinking skills.

However, the reality of mathematics instruction at the junior high school level still indicates a strong emphasis on formula transmission and routine problem-solving exercises (NCTM, 2000). Students are often encouraged to memorize formulas without a deep conceptual understanding, resulting in underdeveloped critical thinking skills (Siswono, 2008; OECD, 2024). This condition negatively affects students' ability to solve contextual or non-routine problems that require advanced reasoning and analytical skills.

Based on interviews with mathematics teachers at SMP Negeri 31 Palembang, SMP Muhammadiyah 3 Palembang, and MTs Thawalib Palembang, it was found that, in the previous academic year, many students experienced difficulties in identifying the elements of three-dimensional shapes, modelling problems into mathematical forms, and drawing logical conclusions. Previous descriptive studies have also reported that junior high school students' spatial reasoning ability in geometry tends to be at a low to moderate level, with most students facing challenges in mentally visualizing and manipulating spatial objects (Astuti et al., 2016).

In this regard, teachers play a pivotal role in fostering students' critical thinking skills. Teachers are not only transmitters of knowledge but also facilitators who are responsible for creating challenging, interactive, and meaningful learning environments (Marzano & Kendall, 2007; Raley & Preyer, 2012). Through the implementation of problem-based learning, inquiry-based instruction, and contextual approaches, students can be trained to formulate questions, compare alternative solutions, evaluate outcomes, and generalize mathematical concepts (Eggen & Kauchak, 2012). In teaching prism concepts, teachers may present contextual problems that encourage students to analyze three-dimensional shapes, estimate volumes, and design solutions in a creative and rational manner.

The urgency of this study lies in the need to analyze junior high school students' critical thinking skills in learning prism concepts. A comprehensive understanding of students' critical thinking levels can serve as a foundation for teachers and schools in designing more effective, innovative, and learner-centered instructional strategies. Furthermore, this study is expected to contribute both theoretically and empirically to the field of mathematics education, particularly in relation to the development of critical thinking skills through three-dimensional geometry learning. Thus, the findings of this study are not only relevant to improving the quality of mathematics instruction in schools but also support the achievement of national education goals oriented toward the development of critical, creative, and adaptive human resources in response to ongoing societal changes.

METHOD

This study adopted a descriptive quantitative design aimed at examining and interpreting empirical data as they naturally occur, with an emphasis on capturing the meaning of the observed phenomena. The main focus was to provide a comprehensive description of junior high school students' critical thinking skills in mathematics learning, particularly within the context of prism concepts.

This study was conducted from March to June 2024, involving 109 students: 56 from SMP Negeri 31 Palembang, an A-accredited school; 27 from SMP Muhammadiyah 3 Palembang, a B-accredited school; and 26 from MTs Thawalib Palembang, a C-accredited school. The participants were selected through purposive sampling based on specific considerations, particularly school accreditation and the students' ability to provide data relevant to the research objectives. The inclusion of schools with different accreditation levels was intended to ensure fair and balanced representation.

Data were collected using a critical thinking test consisting of contextual problems on prism concepts. The instrument was developed with reference to Facione's (2015) critical thinking indicators, covering four aspects: interpretation, which refers to understanding and interpreting information; analysis, involving the ability to break down and connect ideas; evaluation, which concerns assessing the logic and accuracy of arguments; and inference, related to drawing rational, evidence-based conclusions. Prior to its use, the test was validated by two lecturers from Universitas PGRI Palembang and declared valid. It was subsequently examined in terms of validity, reliability, difficulty level, and discriminating power to ensure the quality and feasibility of the items. The results of these four analyses indicated that the instrument was appropriate for use in the study.

Student responses were rated using a five-point Likert scale (1–5). Descriptive analysis was applied through three sequential stages: data reduction, data presentation, and conclusion formulation. This analytical procedure enabled the development of a comprehensive profile of students' critical thinking skills based on their test performance.

RESULTS

Critical Thinking Ability Test Results

After the completion of instruction on prism concepts, a test was administered to assess students' mathematical critical thinking skills related to the topic. Based on the analysis of students' responses, the profile of their mathematical critical thinking abilities is presented in Table 1.

Table 1. The Results of Students' Mathematical Critical Thinking Skills

School	Gender	Number of Students	Interpretation	Analysis	Evaluation	Inference	Total
SMP Negeri 31 Palembang	Male	30	3,43	2,08	0,86	0,16	1,63
	Female	26	3,08	2,01	0,41	0,07	1,39
Sub Total		56	3,26	2,05	0,64	0,12	1,51
SMP Muhammadiyah 3 Palembang	Male	13	2,12	1,82	1,47	0,44	1,46
	Female	14	2,84	2,24	1,69	0,73	1,88
SubTotal		27	2,48	2,03	1,58	0,59	1,67
MTs Thawalib Sriwijaya Palembang	Male	18	2,71	2,51	2,31	0,91	2,11
	Female	8	2,44	3,38	2,94	1,31	2,52
Sub Total		26	2,58	2,95	2,63	1,11	2,32
Total		109	2,77	2,34	1,61	0,60	1,83

Based on Table 1, an overview of junior high school students' mathematical critical thinking ability on prism concepts was obtained through four main indicators: interpretation, analysis, evaluation, and inference. Overall, the average critical thinking score of students from the three schools was 1,83 on a 1–5 Likert scale. This score indicates that students' critical thinking ability remained in the low category, particularly in the evaluation and inference indicators, which recorded the lowest scores compared with the other aspects.

At SMP Negeri 31 Palembang, students obtained an average total score of 1,51, which falls into the low category. The highest score was found in the interpretation indicator, at 3,26, indicating that students were fairly able to understand and interpret problems related to prisms. However, their performance in analysis (2,05), evaluation (0,64), and inference (0,12) remained very low. This suggests that students tended to understand only the initial information in the problem, without being able to process it into logical reasoning or accurate conclusions. In terms of gender, interpretation was also the dominant indicator, while inference had the lowest score. Male students, however, showed higher critical thinking ability across all indicators.

At SMP Muhammadiyah 3 Palembang, students' critical thinking ability was also relatively low, with an average score of 1,67. Interpretation obtained the highest score (2,48), whereas inference remained low (0,59). Female students performed better than male students across all indicators, particularly in analysis (2,24) and evaluation (1,69). This finding indicates that female students were more careful in analysing problems and evaluating the information obtained.

Meanwhile, students at MTs Thawalib Sriwijaya Palembang showed better results than those at the other two schools, with an average total score of 2,32, placing them in the moderate category. This result reflects an improvement in students' critical thinking ability, especially in analysis (2,95) and evaluation (2,63). Female students in this school also achieved higher scores than male students, with an average total score of 2,52 compared with 2,11 for male students. This indicates that female students were more proficient in assessing, comparing, and drawing logical conclusions from the mathematical problems given.

Overall, when compared across indicators, the highest score in all schools was found in interpretation (2,77), indicating that most students were able to understand and identify basic information in prism-related problems. However, the scores for analysis (2,34), evaluation (1,61), and inference (0,60) suggest that students still experienced difficulties in connecting information, evaluating solutions, and drawing conclusions based on logical reasoning. Therefore, students' critical thinking ability can be concluded to remain focused on understanding problems through interpretation, while the analytical and reflective aspects that characterize mathematical critical thinking have not yet developed optimally.

Analysis of Students' Solution

To gain a deeper understanding of students' mathematical critical thinking ability, the researcher also analysed their responses to each item in the critical thinking test. This analysis was conducted to determine the extent to which students were able to interpret information, analyse relationships among concepts, evaluate solution steps, and draw conclusions or inferences based on the problem context in prism concepts.

Figure 1 presents a sample response from a male student at SMP Negeri 31 Palembang, illustrating the process of determining the surface area of a prism situated within a real-life context, such as a rectangular prism–shaped swimming pool.

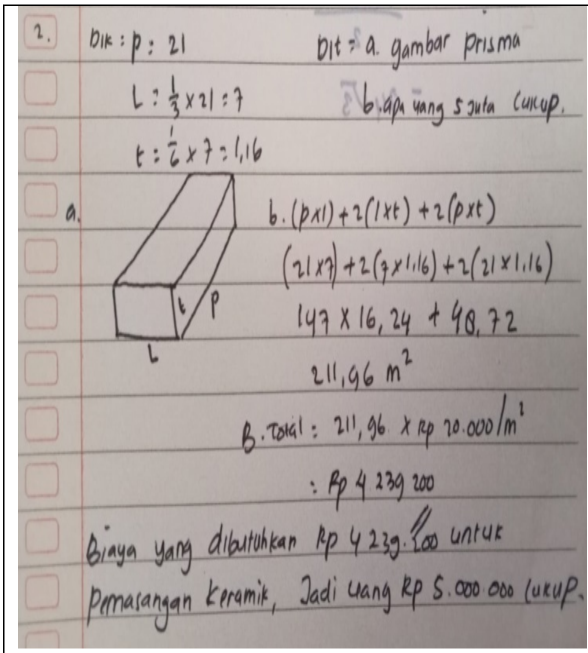
Based on the male student's response presented in Figure 1, performance on the task involving prism surface area and the calculation of tiling costs reflects a relatively strong level of mathematical critical thinking. This performance aligns with the critical thinking indicators proposed by Facione (2015) and Ennis (2011), which encompass interpretation, analysis, evaluation, and inference.

With regard to interpretation, the student demonstrated an adequate understanding of the problem by identifying the given information, determining side dimensions through proportional reasoning, and constructing a visual representation of the prism to clarify the problem context. According to Facione (2015), interpretation involves comprehending meaning, recognizing essential elements of information, and transforming them into representations that support problem solving. This finding indicates that the student possessed a solid initial level of critical thinking, as contextual information was successfully translated into a workable mathematical form.

In terms of analysis, the student correctly applied the surface area formula, performed calculations systematically, and obtained an accurate result of 211,96 m^2, reflecting sound conceptual understanding. Ennis (2011) defines analysis as the ability to identify relationships among concepts and to examine the logical structure of arguments or solution steps. In this case, the student effectively connected the concept of prism surface area to the computation of tiling costs in a coherent mathematical manner.

Regarding evaluation, the student reviewed the obtained result by comparing the total cost with the available budget and provided a rational justification for the final decision. Facione (2015) explains that evaluation entails assessing the credibility of outcomes, examining the consistency of reasoning, and considering alternative solutions. By reassessing the results and justifying the conclusion, the student demonstrated reflective thinking throughout the problem-solving process.

Furthermore, in the inference dimension, the student was able to draw a logical conclusion by calculating the total cost of IDR 4,239,200 and determining that the available budget of IDR 5,000,000 was sufficient. Paul and Elder (2019) describe inference as the capacity to formulate conclusions based on evidence and rational arguments. This outcome suggests that the student was not merely executing procedural calculations but was also capable of linking mathematical results to real-life contexts, particularly in evaluating financial feasibility.

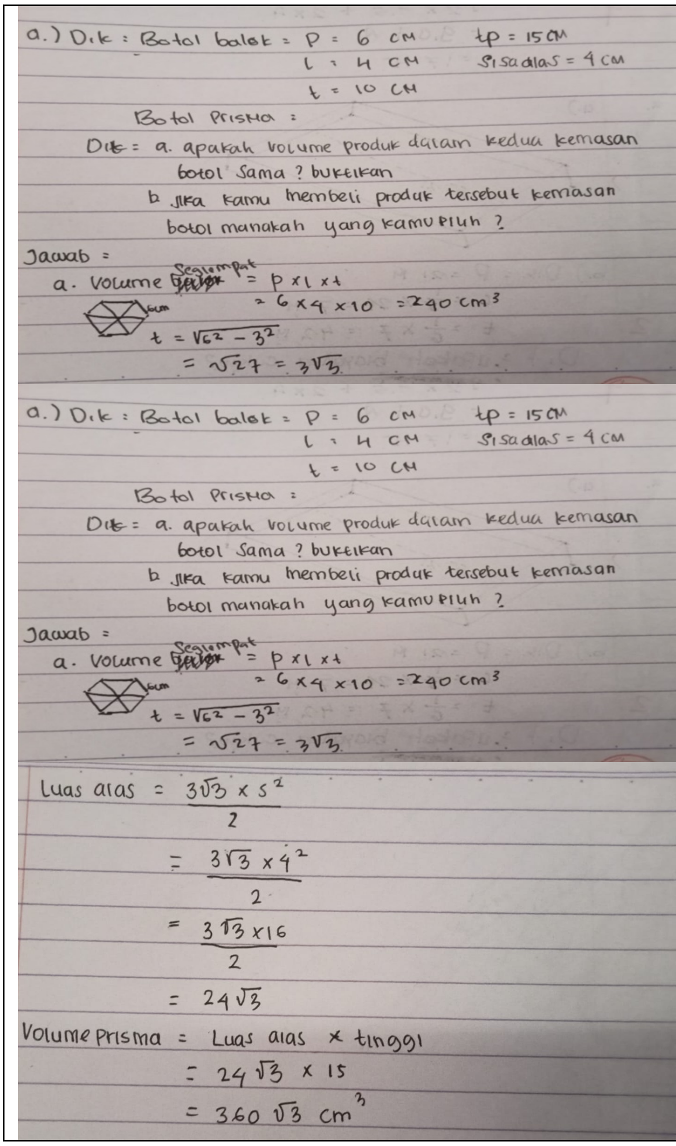


Translation:
Given:
p = 21
L = 1/3 × 21 = 7
t = 1/6 × 7 = 1,16
Asked:
a. draw the prism
b. determine whether the available money is sufficient
Solution:
a. (drawing of a prism with labels p and L)
b. (p × L) + 2(L × t) + 2(p × t)
(21 × 7) + 2(7 × 1,6) + 2(21 × 1,6)
147 + 16,24 + 48,72
211,96 m^2
Cost = total area × IDR 20,000/m^2
= IDR 4,239,200
The cost required for installing the tiles is IDR 4,239,200; therefore, the available money of IDR 5,000,000 is sufficient.

Figure 1. The First Student's Response

Overall, based on the critical thinking indicators outlined by Facione (2015) and Ennis (2011), the male student in this context exhibited critical thinking skills at a high level. This classification is supported by the student's ability to accurately interpret information, analyze data logically, generate appropriate inferences, and evaluate outcomes in a rational and contextualized manner.

The following section presents an analytical description of a female student's response from SMP Negeri 31 Palembang when solving a problem related to determining prism volume within a real-life context.



Translation:
Rectangular prism bottle:
p = 6 cm
l = 4 cm
t = 10 cm
Prism bottle:
tp = 15 cm
base side length = 4 cm
Asked:
a. Is the volume of the product in both bottles the same? Explain.
b. If you were to buy the product, which bottle would you choose?
Solution:
a. Volume of the rectangular prism
$= p \times l \times t$
$= 6 \times 4 \times 10$
$= 240\ cm^3$
Height of the triangular base
$t = \sqrt{(2^2 - 3^2)}$
$= \sqrt{(27)}$
$= 3\sqrt{3}$
Area of the base
$= (3\sqrt{3} \times s^2) / 2$
$= (3\sqrt{3} \times 4^2) / 2$
$= (3\sqrt{3} \times 16) / 2$
$= 24\sqrt{3}$
Volume of the prism
= base area × height
$= 24\sqrt{3} \times 15$
$= 360\sqrt{3}\ cm^3$

Figure 2. The Second Student’s Response

Based on the female student’s response shown in Figure 2, it can be concluded that her mathematical critical thinking skills fall within a moderately adequate level, particularly in the dimensions of interpretation and analysis. However, performance in evaluation was limited, and no evidence of inferential ability was observed.

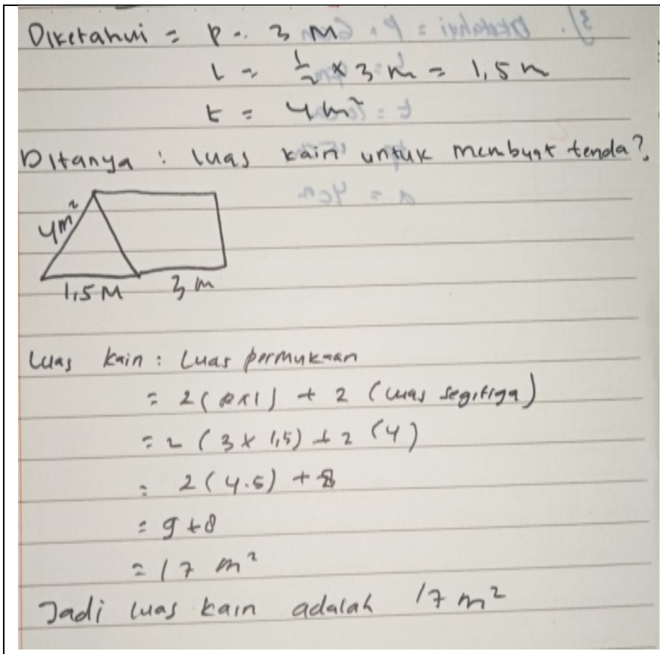
At the interpretation stage, the student demonstrated an ability to recognize essential information presented in the problem, such as identifying the length, width, and height of the prism, as well as understanding whether the task required the calculation of volume or surface area. This competence reflects the student’s capacity to interpret the meaning of a problem and to distinguish relevant information needed for its solution. Facione (2011) defines interpretation as the ability to comprehend and express meaning derived from experiences, situations, data, or statements. Accordingly, this female student exhibited an adequate initial level of critical thinking through accurate comprehension and identification of mathematical elements.

In the analysis phase, the student was able to decompose the problem into systematic steps, including selecting appropriate formulas, performing calculations correctly, and linking relevant mathematical concepts to the given context. The surface area formula was applied accurately, and numerical values were computed correctly. This performance indicates a reasonably developed analytical ability in connecting information and explaining relationships among concepts. According to Ennis (2011), analysis involves identifying relationships among statements, reasons, and conclusions within an argument. In this context, the student's capacity to isolate key information and apply suitable mathematical procedures serves as evidence of emerging analytical competence.

Nevertheless, the response did not demonstrate evaluation or inference. Although all calculations were carried out correctly, the student's work remained procedural and did not extend to conceptual reflection on the obtained results. No attempt was made to assess the reasonableness of the solution, nor was there an explanation of the final outcome in relation to the problem context. The absence of evaluative and inferential processes indicates that the student has not yet developed reflective reasoning required to connect computational results with broader contextual meaning or decision making.

Thus, the lack of evaluation and inference in the female student's response suggests that her critical thinking skills have not yet been fully integrated. The problem-solving process remained at an algorithmic level, without synthesizing results into a more comprehensive understanding of the situation. Facione (2011) emphasizes that ideal critical thinking involves the integration of interpretation, analysis, evaluation, and inference within a coherent reflective process.

The following section presents an analysis of a male student's response from SMP Muhammadiyah 3 Palembang when solving a problem related to determining the area of fabric required to construct a tent, as illustrated in Figure 3.


Diketahui : p = 3 m
l = 1/2 × 3 m = 1,5 m
t = 4 m
Ditanya : luas kain untuk membuat tenda?
4m
1,5 M
3 m
Luas kain : Luas permukaan
= 2 (p × l) + 2 (luas segitiga)
= 2 (3 × 1,5) + 2 (4)
= 2 (4,5) + 8
= 9 + 8
= 17 m²
Jadi luas kain adalah 17 m²

Translation:
Given:
p = 3 m
l = 5 m
h = √(3² + 4²) = 5 m
Asked:
The area of fabric required to make the tent
(illustration of a tent-shaped prism with dimensions 4 m, 1,5 m, and 3 m)
Area of fabric:
= surface area
= 2 (p × l) + 2 (area of triangle)
= 2 (3 × 1.5) + 2 (4)
= 9 + 8
= 17 m²
Therefore, the required fabric area is 17 m².

Figure 3. The Third Student's Response

Based on Figure 3, the male student's critical thinking performance in solving a triangular prism problem demonstrates the presence of all four indicators, interpretation, analysis, evaluation, and inference, although the level of proficiency differs across stages. At the interpretation stage, the student was able to comprehend fundamental information, including the dimensions of the geometric figure and the contextual background of the problem. This finding is consistent with previous studies indicating that interpretation serves as a foundational component of critical thinking that influences the overall problem-solving process (Anggraini, et al, 2022).

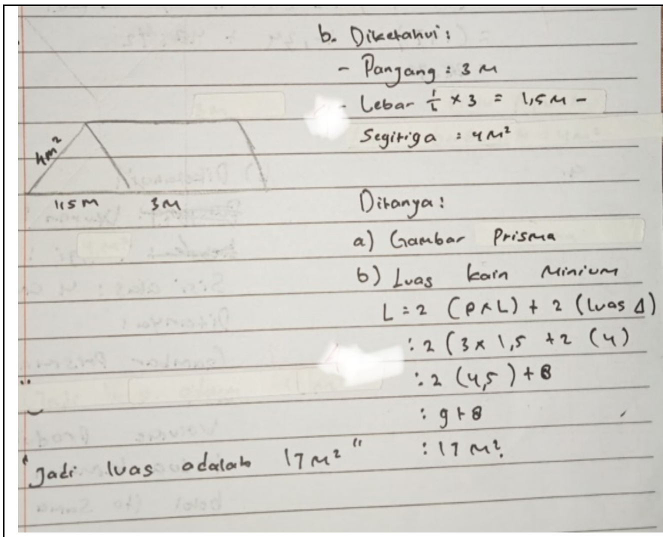
During the analysis phase, the student successfully decomposed the three-dimensional object into simpler two-dimensional shapes, namely two rectangles and two triangles, while correctly identifying that the bottom rectangular face did not need to be included in the calculation. This approach aligns with the view that mathematical analytical ability involves breaking down complex problems into more manageable components (Ariawan et al., 2022).

However, in the evaluation stage, the student tended to concentrate on verifying numerical computations rather than reassessing the appropriateness of the applied geometric concepts. Although computational accuracy was maintained, conceptual evaluation, an essential aspect of enhancing the quality of critical thinking, was not sufficiently demonstrated. This indicates that the evaluative process was only partially developed.

With respect to inference, the student was able to derive a final conclusion regarding the required area of fabric. Nevertheless, this conclusion lacked strong mathematical justification. This condition is consistent with findings from classroom-based research showing that while realistic mathematics instruction can significantly improve students' critical thinking abilities, inferential reasoning remains a persistent challenge (Sutarni & Gatiningsih, 2022).

Overall, these findings suggest that the student has developed a reasonably adequate foundational level of critical thinking. However, further reinforcement is necessary, particularly in conceptual evaluation and the construction of well-supported arguments during conclusion formulation, to ensure more comprehensive and rigorous problem-solving outcomes.

The following section presents an analysis of a female student's response from SMP Muhammadiyah 3 Palembang when solving a problem related to determining the area of fabric required to construct a tent, as illustrated in Figure 4.



Translation:
b. Given:
Length = 3 m, Width = 5 m,
Height = $\sqrt{(3^2 + 4^2)}$ = 5 m
Area of the triangle = 4 m^2
Asked:
a) Draw the prism
b) Determine the minimum required fabric area
Fabric area:
L = 2 (p × l) + 2 (area of triangle)
= 2 (3 × 1.5) + 2 (4)
= 2 (4.5) + 8 = 9 + 8 = 17 m^2
Therefore, the fabric area is 17 m^2.

Figure 4. The Fourth Student's Response

Based on Figure 4, the female student's critical thinking performance in solving a triangular prism problem indicates an adequate understanding of the basic problem-solving steps; however, several shortcomings remain with respect to conceptual accuracy. In the interpretation dimension, the student was able to comprehend essential information presented in the task by identifying the length, width, and area of the triangular base, followed by constructing a simple representation of the prism. This understanding suggests that the student successfully grasped the initial meaning of the geometric representation. Such a finding is consistent with the critical thinking framework proposed by scholars such as Facione (2015), who emphasizes that interpretation, the ability to understand fundamental information, constitutes the initial stage of critical thinking before progressing to analysis and evaluation.

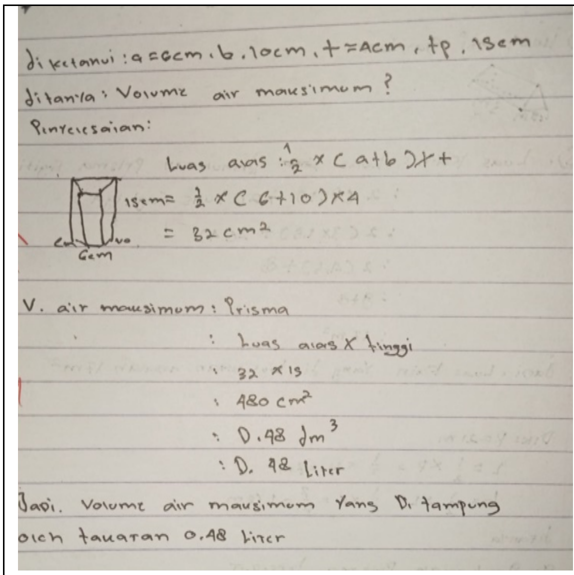
Regarding analysis, the student demonstrated the ability to decompose the prism into its constituent surface components, including rectangular and triangular regions, and to formulate a surface area expression based on the structure of the solid. This process aligns with the critical thinking framework, which characterizes analytical ability as the skill to break down complex problems into simpler and relevant components within a mathematical context.

Nevertheless, at the evaluation stage, the student appeared to focus primarily on numerical verification without reassessing whether the applied formula was conceptually appropriate or whether all relevant surfaces had been correctly included. For instance, although the surface area formula was written, inaccuracies remained in determining which faces should be calculated and which should be excluded. This indicates a limitation in conceptual evaluation rather than computational execution.

In the inference aspect, the student was able to arrive at a final conclusion regarding the required fabric area, namely 17 m^2. However, this conclusion was not accompanied by a coherent mathematical justification explaining the rationale behind formula selection and procedural decisions. In mathematical reasoning studies, strong inferential ability is characterized by the capacity to construct well-founded justifications that support derived conclusions (Inglis et al., 2017; Pedemonte & Balacheff, 2016).

Therefore, although this female student demonstrated basic critical thinking ability, further reinforcement is required, particularly in conceptual evaluation and inferential argumentation, to ensure that the problem-solving process becomes more accurate and mathematically meaningful.

The following section presents an analysis of a male student's response from MTs Thawalib Sriwijaya Palembang when solving a problem related to determining the maximum volume of water that can be contained in a prism, as shown in Figure 5.



Given:
$a = 6$ cm; $b = 10$ cm; $t = 4$ cm; $tp = 15$ cm
Asked:
What is the maximum volume of water?
Solution:
Base area:
$= \frac{1}{2} \times (a + b) \times t$
$= \frac{1}{2} \times (6 + 10) \times 4$
$= 32\ cm^2$
Maximum water volume (prism):
= base area × height
$= 32 \times 15$
$= 480\ cm^3$
$= 0{,}48\ dm^3$
= 0,48 liters
Therefore, the maximum volume of water that can be contained is 0,48 liters.

Figure 5. The Fifth Student's Response

Based on Figure 5, the male student's response to the problem concerning the maximum volume of water in a prism-shaped container indicates the presence of several aspects of critical thinking, although conceptual inaccuracies remain in the computational process. In the interpretation dimension, the student demonstrated an understanding of the basic information provided in the task, including the base side lengths (a = 6 cm, b = 10 cm), the height of the triangular face (t = 4 cm), and the height of the prism (tp = 15 cm). The student also identified the solid as a hexagonal prism and produced a simple sketch. This performance suggests an ability to grasp the initial meaning of the given information.

With respect to analysis, the student did not decompose the problem into appropriate systematic steps. Ideally, the hexagonal base should have been divided into six congruent triangles. Instead, the student directly calculated the base area using the formula ½ × (a + b) × t and subsequently multiplied the result by the prism height to obtain the volume. A conceptual error occurred when the student added two sides of the triangular base (6 cm + 10 cm) as a single base length, whereas only one base side should have been used. This misunderstanding resulted in inaccurate values for both the base area and the volume.

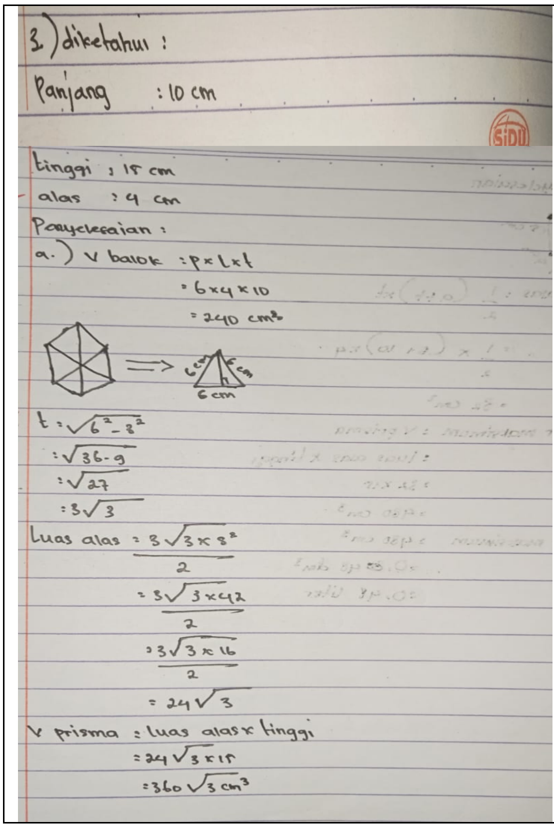
At the evaluation stage, the student merely verified the calculations procedurally without reassessing whether the selected formula was conceptually appropriate. This limitation is evident in the assumption that two sides of a triangle could be summed to form its base, which contradicts fundamental geometric principles. The inability to critically evaluate the applied concept ultimately led to an incorrect volume calculation.

In terms of inference, the student was able to state a final conclusion, namely that the maximum volume of water was 0,48 liters. Although this conclusion was consistent with the preceding computational steps, it was mathematically invalid because it was derived from an incorrect conceptual understanding of the base area. Consequently, the student demonstrated only a basic level of critical thinking, primarily at the interpretation stage, while requiring substantial reinforcement in procedural analysis, conceptual evaluation, and argument-based inference to ensure that problem-solving outcomes are mathematically valid and conceptually sound.

The following section presents an analysis of a female student's response from MTs Thawalib Sriwijaya Palembang when solving a problem related to determining the maximum volume of water that can be contained in a prism, as illustrated in Figure 6.

Based on Figure 6, the female student's response demonstrates a relatively strong level of mathematical critical thinking across several indicators, particularly interpretation, analysis, and evaluation, although the inference indicator was not clearly evident.

In the interpretation dimension, the student was able to identify essential information provided in the problem, such as lengths, heights, and base edges of the prism. This information was then translated into a visual representation through a sketch of the three-dimensional shape and the decomposition of the hexagonal base into several triangles. This ability aligns with Facione's (2015) view that interpretation involves understanding and assigning meaning to data, enabling learners to construct an initial mental representation of a problem.



Translation:
3. Given:
Length = 10 cm; Height = 15 cm; Base side = 6 cm
Solution:
a) Volume of the rectangular prism
$= p \times l \times t$
$= 6 \times 4 \times 10$
$= 240\ cm^3$
Height of the triangle:
$t = \sqrt{(6^2 - 3^2)}$
$= \sqrt{(36 - 9)}$
$= \sqrt{27}$
$= 3\sqrt{3}$
Base area:
$= (3\sqrt{3} \times s^2) / 2$
$= (3\sqrt{3} \times 4^2) / 2$
$= (3\sqrt{3} \times 16) / 2$
$= 24\sqrt{3}$
Volume of the prism:
= base area × height
$= 24\sqrt{3} \times 15$
$= 360\sqrt{3}\ cm^3$

Figure 6. The Sixth Student's Response

Regarding analysis, the student successfully decomposed the hexagonal structure into six triangular components, thereby simplifying the process of calculating the base area. The student also systematically applied formulas for triangle height and hexagon area. This finding is consistent with Tambychik and Meerah (2010), who state that mathematical analysis becomes apparent when students are able to organize information and construct solution steps based on logical relationships among concepts.

In the evaluation aspect, the student selected appropriate formulas to calculate the triangle height, base area, and prism volume, followed by checking the results and examining the coherence between solution steps. This evaluative process indicates the presence of metacognitive control during problem solving. As noted by Ennis (2011), evaluation is a crucial component of critical thinking because it involves assessing the accuracy and appropriateness of both information and procedures.

However, the inference indicator did not emerge clearly in the student's response. Ideally, inference would be evident when a student draws conclusions based on accumulated evidence and reasoning, for example, by explaining the mathematical rationale for selecting specific formulas, justifying the chosen method for calculating the prism, or formulating a concluding statement that logically connects initial information, procedures, and final results. In this case, the conclusion merely stated the final volume value of $360\sqrt{3}\ cm^3$ without providing evidence-based reasoning or mathematical justification. This observation is consistent with Lai's (2011) argument that inference entails not only stating results but also articulating logical reasons grounded in data and procedures.

Therefore, although the student demonstrated adequate interpretation, analysis, and evaluation skills, the absence of inferential reasoning suggests that this indicator has not yet been fully achieved and should become a key focus in subsequent instructional interventions aimed at strengthening students' critical thinking abilities.

DISCUSSION

Mathematical Critical Thinking Skills Based on Gender

An analysis of mathematical critical thinking skills from a gender perspective reveals relatively consistent patterns across the three schools. At SMP Negeri 31 Palembang, the mean score for male students (1,63) was slightly higher than that for female students (1,39). This difference is reflected in Figure 1, where the male student demonstrated the ability to interpret initial information effectively by identifying the prism shape, determining side dimensions, and linking these elements to surface area calculations and tiling costs. The student was able to analyze the problem by identifying key components of the solid, resulting in a relatively complete solution. This finding supports Halpern's (2014) assertion that males often exhibit advantages in visual–spatial abilities, particularly in tasks involving mental rotation, although individual variation and environmental factors also play important roles.

Despite this advantage in interpretation and analysis, male students at SMP Negeri 31 Palembang frequently showed weaknesses in evaluation and inference. Many did not recheck their solution procedures and tended to complete tasks quickly without assessing the conceptual validity of the applied formulas. Facione (2015) explains that individuals who perform well in analysis but poorly in evaluation often produce numerically correct answers that lack conceptual grounding and logical justification. This pattern was evident in the findings, where male students performed computations accurately but failed to articulate mathematical reasoning.

In contrast, at SMP Muhammadiyah 3 Palembang, female students outperformed male students, with mean scores of 1,88 and 1,46, respectively. As illustrated in Figure 4, female students demonstrated more structured step-by-step analysis, including identifying prism components and attempting surface area calculations. Although errors and inaccuracies were still present, their reasoning processes appeared more systematic than those of male students shown in Figure 3, who relied primarily on formula application without sufficient analytical consideration. In this study, female students tended to engage in more thorough evaluation, consistent with findings that careful and structured approaches can enhance performance in certain critical thinking indicators (Hidayanti et al., 2020).

Gender differences were even more pronounced at MTs Thawalib Sriwijaya Palembang. Female students achieved a mean score of 2,52, considerably higher than the male mean score of 2,11. The female student's response in Figure 6 demonstrates strong critical thinking performance, including the ability to decompose a hexagonal shape into triangles, identify relationships among sides, and apply area formulas accurately. These skills reflect higher-level analytical competence as described by Facione (2015), who emphasizes identifying logical relationships within mathematical structures as a hallmark of critical thinking. Conversely, the male student in Figure 5 exhibited conceptual errors in determining the base area, indicating insufficient evaluative reasoning. As emphasized by Siswono (2008), evaluation is a crucial stage in critical thinking, and its absence often leads to persistent misconceptions.

Overall, the gender-based analysis suggests that female students tend to excel in intermediate to higher-level critical thinking skills, particularly analysis and evaluation, whereas male students show relative strength in interpretation. However, both groups exhibit substantial weaknesses in inference. Very few students were able to draw mathematical conclusions supported by evidence or articulate logical arguments. This finding reinforces Susanti et al.'s (2020) conclusion that mathematics instruction in Indonesia has not sufficiently habituated students to justify answers or construct mathematical arguments, leaving inferential reasoning as the weakest indicator.

Mathematical Critical Thinking Skills of All Students

Hasil Combined results from the three schools yielded an average mathematical critical thinking score of 1,83, categorized as low. Among the indicators, interpretation achieved the highest mean score (2,77), while inference was the lowest (0,60). This pattern indicates that junior high school students were generally able to comprehend initial information but struggled to evaluate procedures or draw conclusions based on mathematical evidence.

Responses in Figures 1–6 reveal a general tendency toward procedural understanding rather than conceptual understanding. Students were able to apply formulas but lacked insight into the underlying concepts and were unable to provide sound mathematical reasoning. This observation aligns with prior studies in mathematics education reporting students' difficulties in drawing logical conclusions and evaluating solutions due to limited mathematical reasoning skills (Susanti, Budi Waluya, & Rosyida, 2020).

The consistently low inference scores indicate that students rarely justify their answers logically. This pattern mirrors findings in mathematical argumentation research showing that students with lower mathematical proficiency often struggle to construct complete arguments consisting of claims, evidence, and reasoning (Lubis & Lubis, 2024). In this study, most students merely stated final results without articulating the rationale behind them.

Accordingly, the findings across all three schools suggest that mathematics instruction has not yet placed sufficient emphasis on developing higher-order critical thinking skills. To enhance students' performance, instructional approaches must shift from routine, algorithmic practices toward learning environments that emphasize reasoning, conceptual discussion, and mathematical proof.

CONCLUSION

Based on the analysis of students' mathematical critical thinking ability on prism concepts, students from the three schools were generally found to be in the low category. The highest score was obtained in the interpretation indicator, whereas evaluation and inference were the weakest aspects. MTs Thawalib Sriwijaya Palembang showed the best achievement, followed by SMP Muhammadiyah 3 Palembang and SMP Negeri 31 Palembang. These findings indicate that although students were able to understand the basic information presented in the problems, their ability to assess solution procedures and draw mathematical conclusions was still underdeveloped.

In terms of gender, female students demonstrated better critical thinking ability than male students. The most noticeable gap appeared in the analysis and inference indicators, suggesting that female students were more careful and better able to organize and communicate mathematical reasoning logically. Overall, students' critical thinking ability was still dominated by basic skills, such as interpretation, while higher-order thinking skills, including evaluation and inference, need further improvement.

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