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Analysis of Mathematical Connection and Communication Skills in Flat-Sided Solid Geometry Material Based on the Mathematical Skills of Grade VIII Students at SMP Negeri 12 Palu

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ABSTRACT

Mathematics is an important subject that emphasizes mastery of concepts, communication, and mathematical connections. Mathematical connection skills enable students to relate concepts to one another, to other fields of science, and to everyday life, while mathematical communication skills facilitate the delivery of mathematical ideas verbally, in writing, and visually. This study aims to analyze students' mathematical connection and communication skills in solving flat-sided solid problems based on their mathematical ability levels. The research used a descriptive qualitative approach with three students from SMP Negeri 12 Palu as subjects, each representing high, medium, and low ability levels. Data were collected through written tests and semi-structured interviews, then analyzed using the Miles and Huberman model through the stages of condensation, presentation, and conclusion drawing and data verification. The results showed that high-ability students were able to understand, connect, and communicate flat-sided shape concepts completely and systematically. Medium-ability students demonstrated sufficient understanding, although there were deficiencies in the consistent use of symbols and drawing conclusions. Low-ability students experienced difficulties in connecting concepts, solving problems, and conveying ideas accurately.

1. Introduction

Mathematics is a compulsory subject at every level of education and plays an important role because it is used in various fields of science. Mathematics is understood as a science that studies abstract structures and relationships between concepts, so that mastery of concepts is key in mathematics learning (Kusmanto,

2021). The objectives of mathematics learning include understanding concepts, reasoning, mathematical communication, and an attitude of appreciating the usefulness of mathematics in everyday life (Yulian et al., 2020). In the Merdeka Curriculum, mathematics learning aims to help students develop several skills (Aprillia, 2025). The birth of the Merdeka curriculum is essentially an effort to improve the quality of education in Indonesia (Zahira, 2020).

Understanding mathematical concepts cannot be separated from mathematical connection and communication skills. Mathematical connection skills are the ability to relate mathematical concepts to each other, to other fields, and to real life (Lestari, 2022). However, several studies show that students' mathematical connection skills are still relatively low, both in connecting concepts, materials, and real-life contexts (Syahputri & Hidayati, 2022; Rohmah & Warmi, 2021). In addition, mathematical communication skills are also important because mathematics functions as a language and social activity in learning (Lestari, 2023). Mathematical communication helps students present ideas in the form of symbols, equations, or tables (Yanti et al., 2019). However, research shows that students still have difficulty understanding and communicating mathematical problems (Suhenda, 2023). Therefore, the selection of material that is close to everyday life, such as flat-sided shapes, is expected to improve students' mathematical connection and communication skills.

Analysis is a process of thinking or investigation carried out by observing, analyzing, sorting, and grouping an object or event to determine the actual situation and the causes of problems that occur (Magdalena et al., 2020; Anggraini, 2020; Meilida, 2022). Mathematical connection skills originate from the concept of Mathematical Connection developed by NCTM and have become the standard in mathematics learning in schools (Wulandari, 2023). This ability emphasizes the interrelationship between mathematical concepts and operations, because every concept in mathematics is interconnected in a complete system. Making connections is key to building mathematical understanding, and understanding mathematics means being able to link various related concepts (Lestari et al., 2025; Syadevi, 2025).

Mathematical communication is the ability to convey mathematical ideas obtained from the thinking process in solving mathematical problems (Bahtiar, 2020). This ability is evident when students are able to analyze and evaluate other people's mathematical strategies and use mathematical language appropriately to express their ideas (Suhenda, 2023). Mathematical communication is also understood as the process of conveying mathematical information through various learning media to improve students' mathematical abilities (Kartika, 2013), and includes the ability to read, write, listen, interpret, and evaluate mathematical ideas, symbols, terms, and information (Muharom, 2013).

Thus, mathematical communication skills can be defined as the ability of students to express mathematical ideas orally, in writing, or visually using mathematical symbols, terms, and structures, as well as to understand, interpret, and evaluate mathematical ideas appropriately. Indicators of mathematical communication skills

include the ability to connect real objects, pictures, and diagrams to mathematical ideas; explain mathematical ideas and relationships verbally and in writing; express everyday events in mathematical language; discussing and writing about mathematics; reading and responding to written mathematical representations; and constructing conjectures, arguments, definitions, and generalizations (Utari in Yani, 2016). In line with this, the NCTM states that indicators of mathematical communication include the ability to express mathematical ideas, use mathematical symbols and structures to model problems, and understand and evaluate mathematical ideas orally and in writing (Maulyda, 2020).

Mathematical connection skills are very important for students to have in solving problems in mathematics learning (Anggraini, 2025). Basically, each student has different abilities in solving math problems. Through mathematical connections, students' insight into mathematics will broaden, which will indirectly enable them to recognize and use the relationships between mathematical concepts, and they will be able to understand interrelated mathematical concepts and build on each other's concepts to produce everything that is interrelated (Putri, 2024). Mathematical connection skills must be developed in students as a skill in the problem-solving process.

Mathematical connection skills and mathematical communication skills complement each other in improving students' understanding. Mathematical communication skills are students' ability to communicate mathematical ideas verbally and in writing. In mathematics learning, students must have communication skills. These skills are evident in how students convey mathematical ideas, both verbally and in writing, as well as their ability to understand and accept other people's mathematical ideas carefully, analyze them to sharpen their understanding, and be able to draw conclusions and communicate them. The goal is for students to be able to solve problems from various contexts and achieve learning outcomes in the classroom.

Based on the basic competencies in flat-sided shapes, the focus of this study is on the surface area and volume of prisms. A prism is a shape bounded by two parallel planes and several other planes that intersect along parallel lines. A prism is a shape that has a pair of identical and parallel sides and perpendicular edges that are parallel to each other. The purpose of this study is to determine the extent of students' ability to connect and communicate mathematical material, especially on flat-sided shapes, based on their level of mathematical ability.

2. Methodology

This study used a qualitative approach with a descriptive research type. This approach was chosen because the study aimed to describe in depth the students' mathematical connection and communication abilities in solving flat-sided solid figures based on the mathematical abilities of students at SMP Negeri 12 Palu. The research was conducted at SMP Negeri 12 Palu, located in Layana Indah Village, Palu City, Central Sulawesi, in the odd semester of the 2025/2026 academic year.

The research subjects were determined based on the results of the initial test of students' mathematical abilities. From the test results, one student with high, medium, and low mathematical abilities was selected, resulting in a total of three research subjects. The grouping of students' mathematical ability levels was based on the criteria proposed by Arikunto in Maulyda (2020), namely students with scores of $70 \leq x < 100$ were categorized as high, $50 \leq x < 70$ as medium, and $0 \leq x < 50$ as low, as shown in Table 1.

Table1. Subject Grouping Criteria

No	Interval	Student Ability Level
1	$70 \leq x < 100$	High
2.	$50 \leq x < 70$	Medium
3.	$0 \leq x < 50$	Low

The instruments used in this study included a preliminary mathematics test, test sheets, and interviews. The preliminary mathematics test was used to measure students' initial mastery of basic flat-sided shape concepts and served as the basis for grouping research subjects. The test sheets consisted of written tests with descriptive questions on flat-sided shapes designed to reveal students' mathematical connection and communication abilities. In addition, semi-structured interviews were conducted with research subjects representing each ability category. During the interview stage, students were asked to verbally explain the process of understanding and solving the questions they had previously worked on.

Data collection was conducted through written tests and semi-structured interviews. Written tests were given to research subjects to obtain data on students' mathematical connection and communication skills in solving flat-sided geometric problems. Interviews were then used to explore more in-depth information related to students' thought processes and to confirm the results of the written tests. Before use, the test questions were first validated through content validity testing by mathematics experts to ensure the suitability of the instruments for the research objectives.

The credibility of the data in this study was maintained through the member check technique. Data credibility refers to the level of confidence in the data obtained, namely the conformity between the data reported by the researcher and the actual conditions in the field (Barokah et al., 2021). Member checks were carried out by rechecking the test and interview results with the research subjects to ensure that the data obtained was in accordance with the students' intentions and experiences. Data analysis in this study refers to the Miles and Huberman model, which includes three stages, namely data condensation, data presentation, and conclusion drawing and verification (Wanto, 2018). Data condensation is carried out by selecting, focusing, and simplifying the test and interview data in accordance with the research focus. Next, the data was presented in the form of descriptive descriptions and tables to make it easier to understand. The final stage was drawing conclusions and verification, which was carried out based on the data from the students' tests and interviews in solving flat-sided shape problems.

3. Result and Discussion

Research Results

The subjects in this study were selected by administering a mathematics ability test in class VIIIB at SMP N 12 Palu. The test was conducted in class VIIIB on Tuesday, November 11, 2025, with 19 students participating for 90 minutes with the permission of the subject teacher. This test aimed to group students' mathematical abilities into three groups, namely students with high, medium, and low mathematical abilities. Data on subjects with high, medium, and low abilities are presented in the following table.

Table 2. Research Subjects

No	Student Code	Student Initial Ability Category Score According to Question Number				Total Score	Student Initial Ability Achievement Score Value	Category
		No. 1	No. 2	No. 3	No. 4			
1	SNP	5	5	5	3	18	90	Height
2	A	3	3	4	2	12	60	Moderate
3	MA	1	1	3	0	5	25	Low

The code for the interview transcript consists of the first two digits indicating the research subjects, namely SNP, S, and MA, and researcher NM. The last two digits indicate the sequence of questions and answers in the interview. The written test instrument for flat- sided spatial figures can be seen in the following table.

Table 3. Written Test Instrument for Flat-Sided Three-Dimensional Shapes

Answer the following questions correctly
Amanda wants to give a gift to her friend who is celebrating her birthday. She wants to buy candy to fill a triangular prism-shaped gift box as shown in the following picture



The gift box has a triangular base with a length of 10 cm and a slanted side length of 13 cm, and the length of the gift box is 15 cm. Each candy has a volume of 2 cm^3 , if the price of one pack of candy is Rp. 9,000 and each pack contains 50 candies, how much will Amanda have to spend to buy enough candy to fill the gift box?

Data Presentation and Drawing Conclusions for High Ability Subjects (SNP)

The written results of SNP in understanding mathematical ideas in writing are presented in Figure 4.1.

1. Diketahui: - Panjang alas 10 cm dan panjang sisi miring 13 cm,
 - Panjang kado serta tersebut 15 cm. setiap satu bungkus permen adalah Rp. 9.000 dan setiap bungkus berisi 50 permen dan memiliki volume 2 cm³?
 - kado berbentuk prisma segitiga.

Ditanyakan: - berapa total biaya yang harus dikeluarkan amanda untuk membeli permen yang cukup untuk mengisi kado tersebut sampai penuh?

SNP01

SNP02

Figure 1. SNP in Understanding Mathematical Ideas

From the results of the SNP above, it can be seen that SNP is able to write down the known information [SNP01] and the questions asked [SNP02] in the given problem correctly and completely. Based on the results of the interview conducted with SNP, it can be seen that SNP can explain the known information completely, such as the shape of the gift, the length of the base and the slanted side of the triangle, the length of the gift [SNP08], and information about the candy, such as the contents of each pack of candy, the price of each pack of candy, and the volume of each piece of candy [SNP12]. In addition, SNP was also able to explain the information asked on the answer sheet, which was to find the total cost Amanda had to spend to buy enough candy to fill the gift box [SNP18]. Thus, it can be concluded that SNP is good at understanding mathematical ideas both in writing and orally.

Presentation of Data and Drawing Conclusions SNP in Using Mathematical Terms, Symbols, and Structures to Solve Mathematical Problems

The results of SNP's written test in using mathematical terms, symbols, and structures to solve mathematical problems are presented in Figure 2.

Penyelesaian: luas - alas



$$t = \sqrt{13^2 - 10^2}$$

$$= \sqrt{169 - 100}$$

$$= \sqrt{69}$$

$$= 12 \text{ cm}$$

$$\text{luas} = \frac{1}{2} \times \text{alas} \times t$$

$$= \frac{1}{2} \times 10 \times 12$$

$$= \frac{1}{2} \times 120$$

$$= 60 \text{ cm}^2$$

Volume Prisma =

$$V = \text{luas alas} \times \text{panjang prisma}$$

$$= 60 \times 15$$

$$= 900 \text{ cm}^3$$

Jumlah permen didalam kado

$$= 900 \div 2$$

$$= 450 \text{ cm}^3$$

Figure 1. SNP in Using Mathematical Terms, Symbols, and Structures to Solve Mathematical Problems

From the results of SNP's work, it can be seen that SNP is able to use mathematical terms, symbols, and structures, namely L = area, a = base, t = height [SNP01], v = volume [SNP02], cm = unit of length [SNP03], cm^2 = unit of area [SNP04], cm^3 = unit of volume [SNP05]. Based on the results of interviews conducted with SNP, it can be seen that SNP is able to write and mention mathematical terms, symbols, and structures while also mentioning the meanings of these mathematical terms, symbols, and structures well. Thus, it can be concluded that SNP is proficient in using mathematical terms, symbols, and structures to solve mathematical problems.

Presentation of Data and Conclusions on SNP's Ability to Understand, Interpret, and Evaluate Mathematical Ideas in Writing and Speech

The results of the SNP written test in understanding, interpreting, and evaluating mathematical ideas are presented in Figure 3.

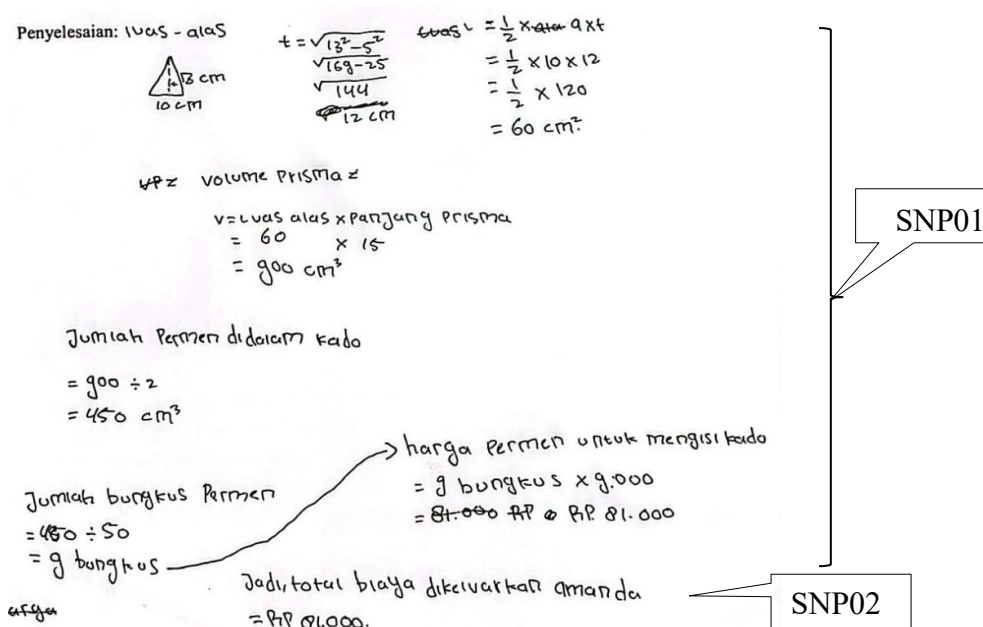


Figure 2. SNP in Understanding, Interpreting, and Evaluating Mathematical Ideas in Writing.

From the results of SNP's work above, it can be seen that SNP can answer questions and understand them. SNP is able to write down the strategy and steps to solve the given problem correctly and completely, namely, first calculating the area of the base, second calculating the volume of the prism, third calculating the number of candies, and finally calculating the total cost incurred by Amanda [SNP01]. SNP is also able to write a conclusion at the end of the solution based on the information asked previously [SNP02]. Based on the results of data presentation and conclusion drawing on mathematical connection indicators, subjects with high abilities (SNP) showed good mathematical connection abilities. SNP was able to relate various mathematical concepts in solving flat-sided solid problems. In solving problems, SNP connects the Pythagorean theorem with subtraction and root operations to determine the height of a triangle, then relates it to the concept of triangle area and

fraction multiplication operations to determine the base area. Next, SNP uses the concept of base area and multiplication operations to calculate the volume of a triangular prism. In addition to linking mathematical concepts, SNP is also able to connect mathematical concepts with other fields, particularly economics. SNP uses the concept of solid volume, division, and multiplication to determine the number of candies in a gift, the number of candy wrappers, and the total cost that must be spent. This shows that SNP is able to apply mathematical concepts contextually outside the field of mathematics.

SNP also demonstrated a strong ability to relate mathematical concepts to everyday life. The concept of flat-sided shapes was used appropriately to solve real-world problems, namely calculating the contents of a gift box and the cost of filling it. The concepts of volume, division, and multiplication were used sequentially and logically to arrive at the correct final conclusion. Thus, it can be concluded that subjects with high ability have a good ability to relate mathematical concepts to other mathematical concepts, to other fields, and to the context of everyday life.

Presentation of Data and Drawing of Conclusions for Subjects with Average Ability (A)

Subject A's written results in understanding mathematical ideas are presented in Figure 4.

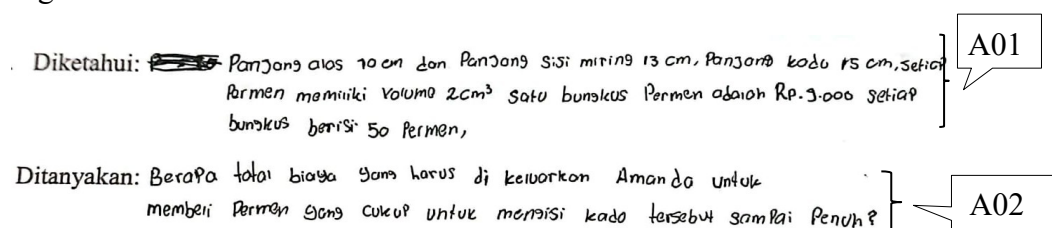


Figure 4. A in Understanding Mathematical Ideas Well in Writing

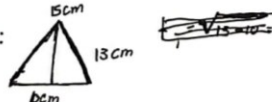
From the results of A's work above, it can be seen that A is able to write down the known and asked information in the given problem correctly. However, A did not write down one piece of known information, namely the shape of the gift. Based on the interview conducted with A, A was able to explain the known information, such as the length of the base and the slanted side of the triangle, the length of the gift, the volume of each piece of candy, the price of each pack of candy, and the contents of each pack of candy [A04]. A is also able to explain the information asked for on the answer sheet, namely the total cost Amanda must spend to buy enough candy to fill the gift box. However, A does not mention or explain one more piece of known information, namely the shape of the gift box. Thus, it can be concluded that A is quite capable of understanding mathematical ideas both verbally and in writing.

Presentation of Data and Drawing Conclusions A in Using Mathematical Terms, Symbols, and Structures to Solve Mathematical Problems

From A's work, it can be seen that A uses several mathematical terms, symbols, and structures, namely T = height [A01], L = area, a = base, t = height [A02], and v =

volume [A03]. However, A did not write the units for the height of the triangle, which is "cm," the units for the area of the triangle, which is "cm²," and the units for the volume of the prism, which is "cm³." The results of A's written test in using mathematical terms, symbols, and structures to solve mathematical problems are presented in Figure 5.

Penyelesaian:



A01

$$T = \sqrt{13^2 - 5^2}$$

$$= \sqrt{169 - 25}$$

$$= \sqrt{144}$$

$$= 12$$

A02

$$L = \frac{1}{2} \times a \times t$$

$$= \frac{1}{2} \times 10 \times 12$$

$$= 60$$

A03

$$V = L \times \text{Panjang Prisma}$$

$$= 60 \times 15$$

$$= 900$$

$$\text{Jumlah Permen} = 900 : 2$$

$$= 450$$

$$\text{banyak bungkus Permen} = 450 : 50$$

$$= 9$$

$$\text{banyak total biaya yg dikeluarkan} = 9 \times 9000$$

$$= 81000$$

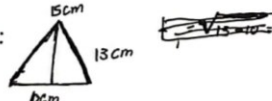
Figure 3. A in Using Mathematical Terms, Symbols, and Structures to Solve Mathematical Problems

Based on the results of the interview conducted with A, it can be seen that A is able to write and mention several mathematical terms, symbols, and structures while also mentioning the meaning of the symbols. However, there are several symbols that A does not use, namely cm = unit of length [A20], cm² = unit of area [A28], and cm³ = unit of volume [A30]. Thus, it can be concluded that A is quite capable of using mathematical terms, symbols, and structures to solve mathematical problems.

Presentation of Data and Drawing Conclusions A in Understanding, Interpreting, and Evaluating Mathematical Ideas in Writing and Speech

The results of A's written test in understanding, interpreting, and evaluating mathematical ideas are presented in Figure 6.

Penyelesaian:



A01

$$T = \sqrt{13^2 - 5^2}$$

$$= \sqrt{169 - 25}$$

$$= \sqrt{144}$$

$$= 12$$

A02

$$L = \frac{1}{2} \times a \times t$$

$$= \frac{1}{2} \times 10 \times 12$$

$$= 60$$

A03

$$V = L \times \text{Panjang Prisma}$$

$$= 60 \times 15$$

$$= 900$$

$$\text{Jumlah Permen} = 900 : 2$$

$$= 450$$

$$\text{banyak bungkus Permen} = 450 : 50$$

$$= 9$$

$$\text{banyak total biaya yg dikeluarkan} = 9 \times 9000$$

$$= 81000$$

Figure 4. A in Understanding, Interpreting, and Evaluating Mathematical Ideas in Writing

From the results of A's work above, it can be seen that A can answer questions and understand them, A is able to write down the strategy and steps to solve the given problem correctly. However, A did not write down and explain the conclusion at the end of the solution based on the information asked previously. From the interview results, it can be seen that A understands and is able to explain the strategy in finding the total cost incurred by Amanda to fill the gift box to the brim. A can explain the steps to solve the problem, namely, first calculating the area of the base [A12], second calculating the volume of the prism [A30], third calculating the number of candies [A32], and finally calculating the total cost incurred by Amanda [A40]. However, A did not explain the conclusion at the end of the solution based on the information asked previously. Thus, it can be concluded that A is quite good at understanding, interpreting, and evaluating mathematical ideas in writing and orally.

Subject A, who has moderate ability, shows good ability in relating one mathematical concept to another. A is able to use the Pythagorean theorem to determine the height of a triangle by involving subtraction and root operations, then relating it to the concept of triangle area and fraction multiplication operations to determine the base area. Next, A uses the concept of base area and multiplication operations to calculate the volume of a triangular prism. This shows that A has been able to integrate several mathematical concepts in solving problems. In addition, A is also able to relate mathematical concepts to other fields, particularly economics. A uses division to determine the number of candies and the number of candy wrappers, as well as multiplication to calculate the total cost required. The application of these concepts shows that A can accurately relate mathematics to contexts outside of mathematics.

A also demonstrated a good ability to relate mathematical concepts to everyday life. The concept of flat-sided shapes was used to solve contextual problems, namely calculating the number of candies and the total cost of filling the gift box. A is able to use the concepts of prism volume, division, and multiplication sequentially to obtain the correct final result. Thus, it can be concluded that subjects with moderate abilities have good mathematical connection skills, both in linking mathematical concepts, connecting them to other fields, and to everyday contexts.

Data Presentation and Conclusions for Subjects with Low Ability (MA)

From the results of MA's work, it can be seen that MA wrote down the information that was known [MA01]. However, there was one piece of incorrect information, namely that MA stated that a gift was triangular in shape when it should have been a triangular prism. MA was able to write down the information that was asked [MA02]. Based on the results of the interview conducted with MA, it can be seen that MA can explain the known information, such as the length of the base, the sloping side of the triangle, and the length of the gift [MA04], as well as information about the candy, such as the contents of each pack of candy, the price of each pack of candy, and the volume of each piece of candy [MA08]. The written results of MA in understanding mathematical ideas are presented in Figure 7.

Diketahui: - sebuah kado berbentuk segitiga memiliki panjang alas 10 cm
 - dan panjang sisi miringnya 13 cm
 - serta panjang kado adalah 15 cm
 - dan setiap permen memiliki 2 cm³
 - jika harga 1 bungkus permen adalah Rp 9.000 dan setiap bungkus berisi 50 permen

Ditanyakan: - berapa total biaya yang harus dikeluarkan Amanda untuk membeli permen yang cukup untuk mengisi kado tersebut sampai penuh

MA03

MA01

MA02

Figure 5. MA in Understanding Mathematical Ideas

In addition, MA was also able to explain the information requested on the answer sheet, which was to find the total cost Amanda would have to spend to buy enough candy to fill the gift box [MA12]. However, MA mentioned one piece of incorrect information, namely that the gift box was triangular [MA04], when it should have been a triangular prism. Thus, it can be concluded that MA is quite good at understanding mathematical ideas both in writing and orally.

Presentation of Data and Drawing Conclusions in Using Mathematical Terms, Symbols, and Structures to Solve Mathematical Problems

The results of the MA written test in using mathematical terms, symbols, and structures to solve mathematical problems are presented in Figure 8.

MA01

$$\text{luas segitiga} = \frac{1}{2} \times \text{alas} \times \text{tinggi}$$

$$= \frac{1}{2} \times 10 \times 12$$

$$= 60$$

$$\text{luas alas} = \frac{1}{2} \times \text{alas} \times \text{tinggi}$$

$$= \frac{1}{2} \times 10 \times 12$$

$$= 60$$

$$\text{tinggi sama dengan} = \sqrt{13^2 - 5^2}$$

$$= \sqrt{169 - 25}$$

$$= \sqrt{144}$$

$$= 12$$

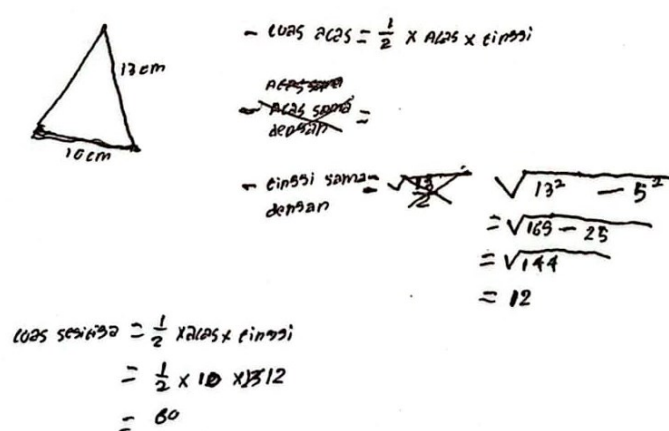
Figure 6. MA in Using Mathematical Terms, Symbols, and Structures to Solve Mathematical Problems

From the results of MA's work, it can be seen that MA wrote one mathematical symbol, namely cm for the unit of length [MA01]. However, MA did not use mathematical terms, symbols, and structures to solve other mathematical problems, such as: the base, which can be symbolized by "a"; the height, which can be symbolized by "t"; and MA did not write the unit for the height of the triangle, which is "cm," and the unit for the area of the triangle, which is "cm²." Based on the results of the interview conducted with MA, it can be seen that MA did not

mention mathematical terms, symbols, and structures in solving mathematical problems, such as: the base, which can be symbolized by "a"; the height, which can be symbolized by "t"; and MA did not write the units at the end of his answers. Thus, it can be concluded that MA has poor ability in using mathematical terms, symbols, and structures to solve mathematical problems.

Presentation of Data and Drawing of Conclusions by MA in Understanding, Interpreting, and Evaluating Mathematical Ideas in Writing and Oral Communication

The results of MA's written test in understanding, interpreting, and evaluating mathematical ideas in writing and orally are presented in Figure 9.



Handwritten work showing a triangle with base 10 cm and side 13 cm. The student attempts to find the area using the formula $\text{luas segitiga} = \frac{1}{2} \times \text{alas} \times \text{tinggi}$. They use the Pythagorean theorem to find the height, but make a mistake in the calculation, resulting in 12 instead of the correct height of 12. The final area calculation is 60.

$$\begin{aligned} \text{luas segitiga} &= \frac{1}{2} \times \text{alas} \times \text{tinggi} \\ &= \frac{1}{2} \times 10 \times 12 \\ &= 60 \end{aligned}$$

Figure 7. MA in Understanding, Interpreting, and Evaluating Mathematical Ideas

From the results of the MA's work above, it can be seen that the MA cannot answer the question. From the work, the MA can only write the answer up to the stage of finding the area of the triangle. The MA's answer is incomplete because the MA is unable to find the volume of the gift box, so the MA cannot answer the question correctly and completely. The MA also did not write a conclusion at the end of the solution based on the information asked previously.

Low-ability subjects (MA) showed limited ability to relate mathematical concepts. MA were able to relate the Pythagorean theorem to subtraction and root forms to determine the height of a triangle, and use the concepts of triangle area and fraction multiplication to calculate the area of the base. However, MA made a mistake in understanding the object in the question by assuming that the gift was triangular in shape, rather than a triangular prism, and was therefore unable to continue the solution to determine the volume of the gift. This shows that MA's ability to relate mathematical concepts is still incomplete. In relating mathematical concepts to other fields, particularly economics, MA was unable to solve the problem to the final stage. 's inability to determine the volume of the gift box meant that MA was unable to continue the calculation to determine the number of candies and the total cost that had to be spent. This shows that MA is not yet able to relate the concept of flat-sided shapes to an economic context. In addition, MA is also unable to relate mathematical concepts to everyday life. MA is only able to complete calculations

to find the area of a triangle, but does not understand the further steps needed to completely solve contextual problems. Thus, it can be concluded that low-ability subjects have poor mathematical connection skills, both in linking mathematical concepts, connecting them to other fields, and to the context of everyday life.

Students' Communication and Mathematical Connection Skills in Solving Flat-Sided Solid Problems

This study aims to analyze students' communication and mathematical connection abilities in solving flat-sided solid geometry problems. The research subjects consisted of three groups based on mathematical ability, namely high-ability students (SNP), medium- ability students (A), and low-ability students (MA). The results of the analysis showed significant differences in ability among the three groups of students, both in terms of mathematical communication and mathematical connection. The following is a further discussion based on the indicators of each ability.

Mathematical Communication Ability

High-ability students (SNP) demonstrated good mathematical communication skills in all three indicators. In the first indicator, SNP were able to write down and explain the information known and asked correctly and completely. SNP tended to write down information using the same sentences as in the questions and were able to explain the information clearly verbally. This is in line with the opinion of Nadia et al. (2023), who stated that identifying the information given and the information needed helps students explain problems better. In the second indicator, SNP is able to use mathematical terms (such as L = area, a = base, t = height, v = volume) and symbols (cm , cm^2 , cm^3) appropriately. SNP is also able to explain the meaning of these terms and symbols, in accordance with Ahmad's (2019) findings that high-ability students are able to express mathematical concepts with appropriate symbols. The third indicator emphasizes students' ability to understand, interpret, and evaluate mathematical ideas. SNP wrote the steps to the solution systematically, starting from finding the base area, the volume of the prism, the number of candies, to the total cost spent by Amanda. Verbally, SNP was able to explain the strategy and conclusions correctly and completely. Thus, SNP has excellent mathematical communication skills.

Students with moderate abilities (A) demonstrate fairly good mathematical communication skills. In the first indicator, A writes and explains the known information correctly, although one important piece of information about the shape of the gift is not mentioned. A is still able to explain the information asked, but does not include the shape of the gift. In the second indicator, A is able to use mathematical terms and symbols (), such as area, base, height, and volume, but does not write the units in each answer (cm , cm^2 , cm^3). A is able to mention several terms and symbols and explain their meanings, but is inconsistent in the use of units. The third indicator shows that A is able to write the strategy and steps of the solution correctly, but does not write the conclusion at the end of the solution. Verbally, A explains the steps of the solution correctly, but does not convey the conclusion

based on the information asked. This shows that A's mathematical communication skills are quite good, but there are still shortcomings in consistency and drawing conclusions.

Low-ability students (MA) demonstrate poor mathematical communication skills. In the first indicator, MA writes and explains the information, but there is a significant error, namely referring to the gift as a triangle, not a triangular prism. MA tends to copy the question and also verbally conveys incorrect information. In the second indicator, MA only writes the unit of length (cm) and does not mention other units. Verbally, MA did not use mathematical terms, symbols, or structures. The third indicator showed that MA was only able to write the solution up to the stage of finding the area of the triangle, was unable to find the volume or total cost, and did not write a conclusion. Verbally, MA's explanation only covered the area of the triangle and was incomplete. In conclusion, MA's mathematical communication skills were poor.

Mathematical Connection Ability

Mathematical connection skills include three indicators: connecting one mathematical concept to another, connecting mathematical concepts to other fields, and connecting mathematical concepts to everyday life. High-ability students (SNP) are able to connect one mathematical concept to another well. SNP uses the Pythagorean theorem to determine the height of a triangle and fraction multiplication to calculate the area of a prism base. SNP is also able to relate flat-sided shapes to economic operations, such as determining the number of candies in a gift and calculating the total cost. SNP's ability shows that he is able to connect mathematical concepts across fields and apply them in everyday life.

Students with moderate ability (A) are able to connect mathematical concepts well. A uses the Pythagorean theorem and the concept of triangle area to determine the height and base area of a prism. A is able to connect the concept of solid volume with division and multiplication operations in an economic context, and use these concepts to solve everyday problems. Although slightly simpler than SNP, A's mathematical connection skills are still good. Low-ability students (MA) demonstrate poor mathematical connection skills. MA is only able to relate the Pythagorean theorem to subtraction to determine the height of a triangle and multiplication of fractions to calculate the area of a triangle. MA is unable to use the concept of triangle area to find the volume of a prism and does not understand the steps to solve economic problems related to the number of candies and total cost. This indicates a limited understanding of concepts and difficulty in relating mathematical concepts to other fields or everyday life.

4. Conclusion

The results of the study show that students' mathematical connection and communication abilities differ based on their level of mathematical ability. High-ability students have good mathematical connection abilities. This can be seen from

their ability to relate various mathematical concepts, such as the Pythagorean theorem, subtraction and root forms, flat shape concepts, and flat-sided spatial shapes. In addition, high-ability students are also able to relate these concepts to everyday life and economics. This ability shows that students have a deep and structured understanding of concepts and are able to see the relevance of mathematics to real-life situations. Medium-ability students also demonstrate good mathematical connection skills, although not as complex as those of high-ability students. Students are able to relate several relevant mathematical concepts in solving flat-sided solid problems and connect them to everyday life and economics. However, the connections they make are still limited to certain concepts and are not yet fully consistent. This shows that students with average abilities have a basic understanding of the concepts but still need reinforcement in connecting various concepts comprehensively.

Unlike the previous two categories, low-ability students demonstrated poor mathematical connection skills. Students had difficulty connecting the concepts of flat shapes and flat-sided three-dimensional shapes, and were unable to connect mathematical concepts to other fields or everyday life. These difficulties indicate a weak grasp of basic concepts, which limits their ability to make mathematical connections. In terms of mathematical communication skills, high-ability students are able to write down and explain known and asked information completely, use mathematical symbols and terms appropriately, present the steps to a solution in a logical sequence, and draw correct conclusions. Students with moderate abilities have fairly good mathematical communication skills, but there are still shortcomings in the completeness of information, use of units, and writing conclusions. Meanwhile, students with low abilities have poor mathematical communication skills, characterized by errors in conveying information, limited use of mathematical symbols, and an inability to solve and conclude problem solutions correctly.

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