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Exploration of Students' Abilities in Solving Mathematical Literacy Problems on Geometry Material Using Polya's Steps

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Abstract

Students face challenges in understanding the minimum competency assessment (AKM) mathematical literacy questions, as they struggle to interpret and solve the problems effectively. This difficulty stems from their low comprehension of the questions and limited problem-solving skills, particularly when confronted with questions differing from the examples provided by the teacher. This study investigates students' abilities to solve AKM mathematical literacy questions using Polya's problem-solving steps. The research is descriptive with a qualitative approach, involving a population of all Grade VIII students at SMP 21 Bengkulu City during the 2023/2024 academic year. The sample consisted of 30 students from class VIII.3 and 30 from class VIII.6. Data collection included test and non-test (interview) methods, utilizing AKM-based test instruments and Polya step-guided problem-solving tasks. Results indicated that 44 students (73.33%) demonstrated low ability, 11 students (18.33%) showed medium ability, and only 5 students (8.33%) exhibited high ability in solving AKM literacy questions. Overall, students' problem-solving skills were categorized as low, with notable difficulties in planning, executing, and reviewing solutions to mathematical problems.

Keywords: Assessment, Mathematical Literacy, Minimum Competency Problem-Solving

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INTRODUCTION

Mathematics is vital in all aspects of life, especially in education. Mathematics can be used to solve problems in everyday life (Hendi, Caswita & Haenilah, 2020). Mathematics lessons are at every level of education, from Elementary School, Middle School, and High School. One of the goals of mathematics lessons in schools is to equip students with several competencies, including logical, analytical, systematic, critical, and creative thinking skills, collaboration skills (Daryanto & Raharjo, 2012), and problem-solving (Susanta et al., 2020).

Mathematical literacy is a person's ability to formulate, apply, and interpret mathematics in various contexts. It involves reasoning and using mathematical concepts, procedures, facts, and tools to describe, explain, and relate them to everyday life (Astuti, 2018). Mathematical literacy skills relate to how individuals can apply knowledge in everyday real-world problems to feel the benefits directly (Indrawati, 2020). So, mathematical literacy can make it easier for students to learn more about the role of mathematics in everyday life.

Indonesia's PISA score achievement since it first participated in 2000 to 2022, the 2022 PISA score is among the lowest, especially the mathematics score of 379, below the international average score of 494 (Febindayanti et al, 2024). Based on these data, it is concluded that the mathematical literacy skills of Indonesian students are still very low. This is in line with previous research stating that students with good mathematical literacy skills can analyze, communicate, solve, and interpret reasonable mathematical solutions (Astuti, 2018).

Based on the results of the interview with the VIII grade teacher of SMP number 21 Kota Bengkulu conducted in April 2024, students' lack of problem-solving ability was seen when working on practice questions that examples the teacher gave accompanied. Because students only memorized examples of questions and could not explain the steps to solve the questions they had written. This makes it difficult for students to determine the formula to be used in the questions, and students find it challenging to find the steps to solve them.

Arithmetic skills in the minimum student ability assessment and problem-solving illustrate that both are related. Arithmetic skills in the minimum ability assessment aim to train students in reasoning, responsiveness, and creativity and hone their ability to solve problems through questions given in the form of questions. Students with high arithmetic skills will be proficient in solving mathematical problems clearly, so the mathematics learning process benefits students.

This research was conducted at the junior high school level to test students' mathematical problem-solving abilities related to solving minimum-ability assessment questions in the hope that it can help find solutions to improve students' abilities. Based on the results of interviews with several grade VIII students who have taken the AKM’s problem at Junior high School Number 21, Bengkulu City, it was found that students still have difficulty reading long AKM questions and have not been able to answer the questions given clearly because of the low ability of students to understand the problems presented, connect concepts and understanding, and have not been able to find appropriate strategies in solving AKM questions. Considering the existing issues, especially those related to problem-solving abilities in solving AKM's problems, it is necessary to analyze students' problem-solving skills first so that the solutions provided are appropriate, effective, and efficient.

Based on the description of the problem above, it is necessary to conduct a focused study to find out students' abilities in detail so that teachers can determine each student's level of thinking ability. After knowing the students' thinking ability level in solving AKM problems, teachers can design learning strategies that can improve students' abilities. So that an analysis of Students' Ability in Solving AKM Problems - Mathematical Literacy of Geometry Material Using Polya's steps is carried out

METHOD

1. Design Research

The type of research used in this study is descriptive research with a qualitative approach. According to Arikunto (2010), the descriptive method is a study that aims to investigate conditions, situations, events, and others, the results of which are presented in the form of descriptions and spoken or written words (Silitonga, 2021).

2. Research Procedures

The initial step in this study is to determine the research instrument, namely compiling a grid of questions with geometry material and writing questions as descriptive questions with Polya's step solution. Furthermore, an expert validity test will discuss content validity, question suitability, and question readability. After conducting expert validity, the validated instrument is revised based on expert input and suggestions. Then, the revised question instrument is given to students to take a problem-solving ability test using AKM mathematical literacy questions. Furthermore, the scores obtained by students are grouped according to the level of problem-solving ability, namely high, medium, and low abilities. Then, 4 subjects were taken from each student's ability to do an interview test; after the interview test, the results obtained by students were described to determine students' ability to solve AKM literacy questions using Polya's steps.

3. Research Instrument

Research instruments are measuring tools to measure natural and social phenomena that are research variables being studied (Sugiyono, 2019). Research instruments are tools used to collect data in a study to answer problems (Lestari & Yudhanegara, 2017). The instruments in this study are divided into text and non-text instruments. The text instruments used in this study are AKM mathematical literacy questions for junior high school mathematics using Polya steps. In contrast, the non-text instruments used in this study are interview guidelines.

4. Data Colection

The data collection methods used to obtain research data are as follows:

a. Test method

Tests are questions that collect data on students' cognitive abilities before or after the direct learning process. These tests are generally given during formative or summative assessments that reveal students' cognitive aspects or assess the results of daily, mid-term, and final tests. The form can be essays, multiple choice, matching, false-false, or short-answer answers (Arif, 2016). The test questions used in this study were AKM questions that were descriptive, consisting of 6 problem-solving questions.

b. Non-test

Interviews are used as data collection techniques when researchers want to conduct preliminary studies to find problems that need to be studied and when researchers want to know things from respondents in more depth (Sugiyono, 2016). Interviews are a non-telephone evaluation tool carried out through conversations and questions and answers, either directly or indirectly, with students. Interviews can be conducted in a structured or unstructured manner, face-to-face or by telephone. Interviews are a form of non-verbal evaluation tool carried out through conversation, questions, and answers, either directly or indirectly, with students (Arifin, 2016).

5. Data Analysis

The criteria for classifying mathematical problem-solving abilities are as follows.

Table 1. Classification of Scores of Problem Solving Ability Tests

Interval	category
$80 \leq X \leq 100$	High
$60 \leq X < 80$	Medium
$0 \leq X < 60$	Low

(Mawardi et al., 2022)

RESULTS AND DISCUSSION

The average result of mathematical problem-solving ability achievement, followed by 60 students with the total value obtained was 2946.93 with an average of 49.11. The results of the students' mathematical problem-solving ability scores have a high variance because they range from 17.71 to 83.33. The classification of students' mathematical problem-solving ability is to find out the range of students' abilities, including high, medium, and low criteria. The following are the results of the classification criteria for students' mathematical problem-solving ability scores:

Table.2 Recapitulation of Student Achievement Categories

Criteria	Students	Percatage
Low	44	73,33%
Medium	11	18,33%
High	5	8,33%

Based on Table 2, we can see the results of the mathematical problem-solving ability of grade VIII students of Junior high School number 21, Bengkulu City; the highest score is in the low criteria, with a score of 73.33%. This shows that students have been unable to carry out Polya's four steps. Overall, the level of mastery of the material of grade VIII students of Junior high School number 21, Bengkulu City, is still relatively low.

Students take a problem-solving ability test of six questions based on Polya's problem-solving steps. When viewed from the final scores obtained by students for the six questions in each Polya step, the consequences of students' levels of mathematical problem-solving ability can be seen in the following table:

Table.3 tudent Preliminary Examination Results at Each Stage

Student Ability Level		Stage Polya			
		KPMM 1	KPMM 2	KPMM 3	KPMM 4
High	N	6	2	5	1
	%	10	3	8	2
Medium	N	15	28	8	7

	%	25	47	13	12
Low	N	39	30	47	52
	%	65	30	78	87

Based on table 3, shows that student's achievement in the level of problem-solving ability at the stage of understanding the problem (KPMM 1) students with low criteria have the highest achievement, which is 65%. This can be interpreted as the average grade VIII student still not yet capable enough to understand the problem, such as students' understanding of what is known from the problem. Furthermore, regarding the ability to plan a solution (KPMM 2), students with medium criteria have the highest achievement, which is 47%. The average student is already capable enough to make a solution plan, and students are quite capable of explaining the main problem. The ability to solve problems (KPMM 3) of grade VIII students with low criteria has the highest percentage of 78%. This can be interpreted as the fact that, on average, students have not been able to solve the problems presented, so students pay less attention to the correct solution steps and are less careful in carrying out arithmetic operations, so they do not find the correct final answer. Furthermore, the re-checking stage (KPMM 4) with low criteria is at the highest percentage of 87%. This can be interpreted as the fact that many students still have not carried out the re-checking stage and have not been able to draw conclusions from solving the problems.

In this section, the research data is presented, namely students' ability to solve AKM literacy questions on junior high school geometry material using Polya's steps.

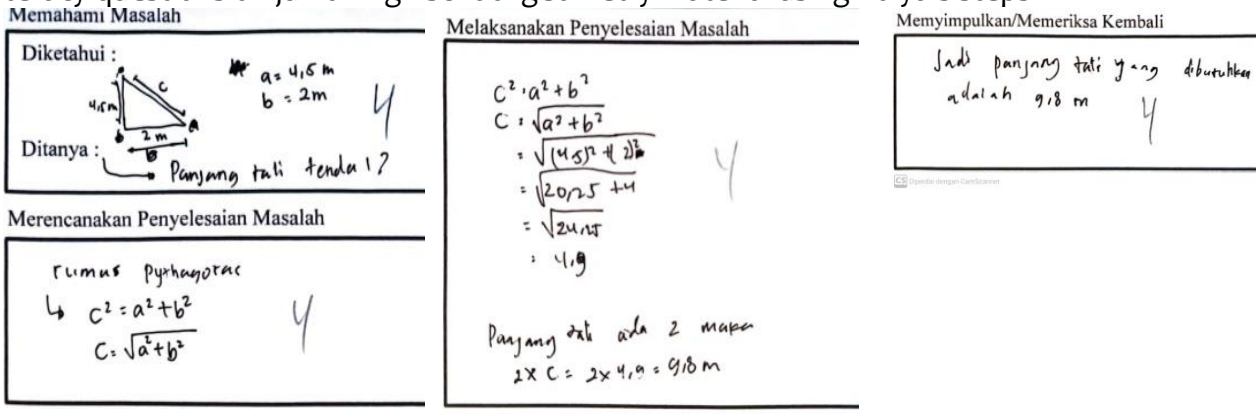

Figure 1. Results of students' work in the high category

At the stage of understanding the problem, AA has correctly written what is known and what is asked of the problem. Namely, AA wrote the known height and base of the base, while for what was asked, Subject AA wrote the length of the rope of base 1. Furthermore, at the stage of planning the solution to the problem, AA could write the mathematical rules (formulas) used, namely the Pythagorean formula. At the stage of solving the problem, AA wrote the correct procedure, and at the stage of re-checking, AA wrote back the calculation results that had been obtained correctly.

Based on the results of the problem-solving ability test above, it is predicted that AA can demonstrate mathematical literacy skills based on the indicators of mathematical literacy skills, namely the first indicator AA can formulate real problems when understanding questions about the length of a rope, and for the second indicator AA can use mathematics in solving problems by applying the Pythagorean formula to calculate the length of the rope. Furthermore, for the third literacy ability indicator, after AA obtains the

length of one rope, AA can interpret the solution by realizing that what is being asked is the length of the pair of ropes in the eighth section, so AA multiplies the result by two to get the final answer. At the final stage, namely the fourth literacy understanding indicator, AA can evaluate the solution by rechecking the calculations and ensuring the results are correct.

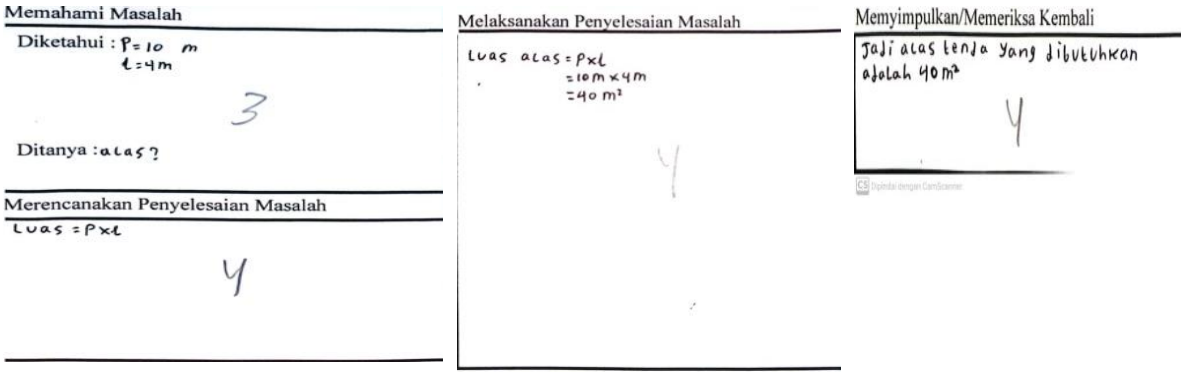

Figure 2. Results of students' work in the moderate category (Subject FR)

At the stage of understanding the problem, FR has not been able to correctly write what is known and what is asked from the problem. Furthermore, at the stage of planning the solution of the problem, FR has been able to write the mathematical rules (formulas) used, namely the formula for the area of a long triangle; then, at the stage of solving the problem, FR writes the correct procedure, and at the stage of rechecking rechecking, FR writes back the calculation results that have been obtained correctly. So, based on the results of the problem-solving ability test above, it is predicted that FR can demonstrate mathematical literacy skills based on the indicators of mathematical literacy skills, namely the first indicator FR can formulate real problems when understanding questions about the area of the base of a triangle in the form of a long triangle. Still, FR does not provide a more straightforward explanation, namely the length of the triangle and the base, while FR only writes p l and base. For the second indicator, FR can use mathematics to solve problems by applying the formula for the area of a long triangle to calculate the location of the triangle's base. Next, for the third literacy ability indicator, FR can interpret the solution by realizing that what is being asked is a base that is a triangle of length so that FR finds the area of the triangle. In the last stage, the fourth literacy understanding indicator, FR can evaluate the solution by rechecking the calculations and ensuring the results are correct.

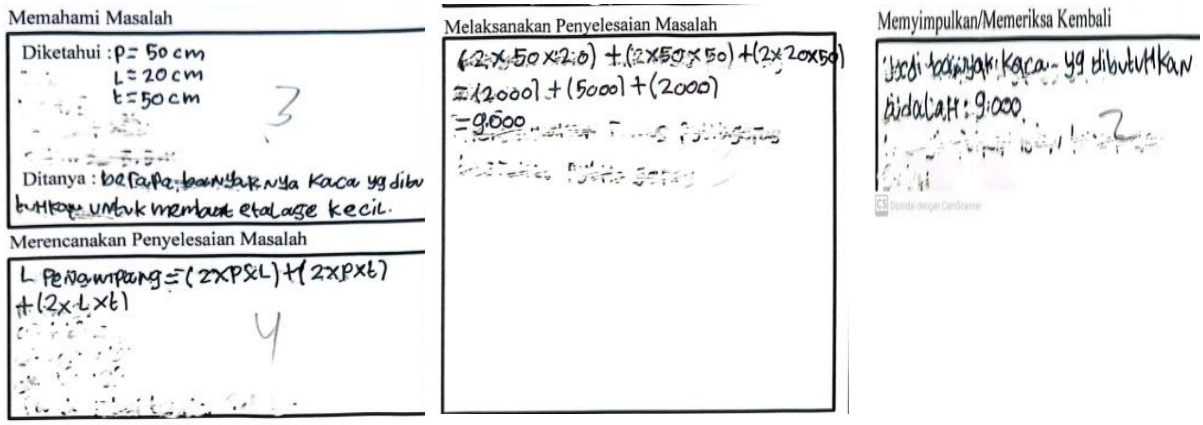

Figure 3. Results of low-category students' work (subject LAK)

At the stage of understanding the problem, LAK can correctly write what is known and what is asked of the problem. Furthermore, at the stage of planning the solution to the problem, LAK could write the mathematical rules (formulas) used, namely the formula for the area of the blank surface. At the stage of solving the problem, MSP wrote the correct procedure, but MSP did not include the units, and at the stage of re-checking, MSP was able to re-write the calculation results that had been obtained correctly even though they did not include the units.

Based on the results of the problem-solving ability test above, it is predicted that ALK can demonstrate mathematical literacy skills based on the indicators of mathematical literacy skills, namely the first indicator LAK can formulate real problems when understanding questions about the surface area of a blank, and for the second indicator LAK can use mathematics in solving problems by applying the formula for the surface area of a blank. Furthermore, for the third literacy ability indicator, LAK can interpret solutions by calculating the amount of glass needed using the formula for the surface area of a blank. Still, here, LAK does not include the unit of area, namely m ^ 2. In the final stage, namely the fourth literacy understanding indicator, LAK can evaluate the solution by rechecking the calculations and ensuring the results are correct. Still, LAK does not include the units here.

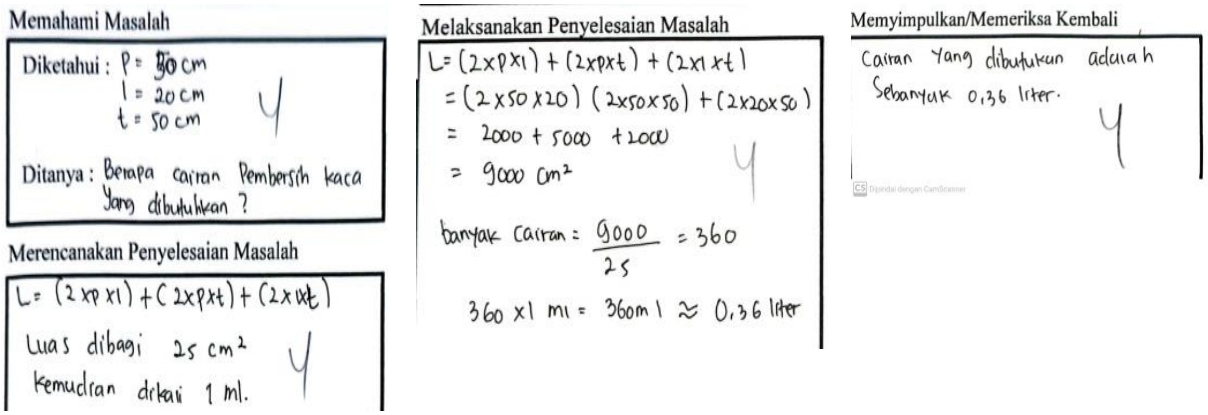

Figure 4. Results of the work of high-category students (student N)

When understanding the problem, N can correctly write down what is known and what is asked from the problem. Furthermore, in planning the solution to the problem, N could write down the mathematical rules (formulas) used, namely the formula for the area of a blank surface. To solve the problem, N writes down the correct procedure, and at the stage of checking again, N writes back the calculation results that have been obtained correctly.

So based on the results of the problem-solving ability test above, it is predicted that N can demonstrate mathematical literacy skills based on the indicators of mathematical literacy skills, namely the first indicator N can formulate real problems when understanding questions about the surface area of small glass cells where small glass cells are in the form of a blank to calculate the amount of cleaning fluid, and for the second indicator N can use mathematics in solving problems by applying the formula for the surface area of the blank and finding the amount of glass cleaning fluid needed. Next, for the third literacy ability indicator, N can interpret the solution by realizing that what is being asked is the amount of glass cleaning fluid needed to clean small database cells. In the last stage, the fourth literacy understanding indicator, N can evaluate the solution by rechecking the calculations and ensuring the results are correct.

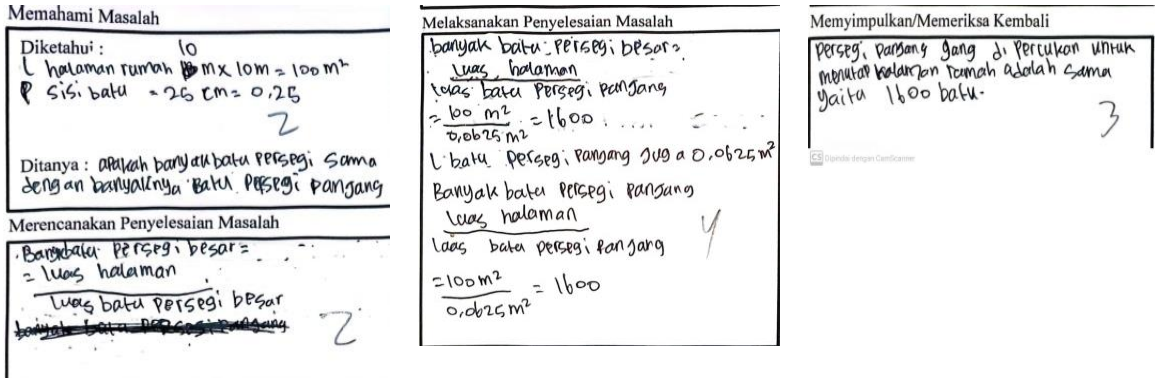

Figure 5. Results of students' work in the medium category (ACD subject)

At the stage of understanding the problem, ACD has been able to correctly write what is known and what is asked from the problem, but it is said that what is known is still incomplete. Furthermore, at the stage of planning the solution to the problem, ACD could write the mathematical rules (formulas) used, but it was still incomplete. ACD only includes the formula for calculating the long triangle, while the formula for calculating the long triangle is not included. Then, at the stage of solving the problem, ACD writes the correct procedure, and at the stage of rechecking, ACD writes back the calculation results that have been obtained correctly.

Based on the results of the problem-solving ability test above, it is predicted that ACD can demonstrate mathematical literacy skills based on the indicators of mathematical literacy skills, namely the first indicator ACD can formulate real problems when understanding questions about whether the number of straight lines is the same as the number of long lines, then for the second indicator ACD can use mathematics in solving problems by applying the formula to calculate the number of straight lines. Furthermore, ACD obtains the number of straight and long lines for the third literacy ability indicator. At the final stage, namely the fourth literacy understanding indicator, ACD can evaluate the solution by rechecking the calculations and ensuring the results are correct. However, it is still incomplete because ACD only includes the results of many long-term discussions.

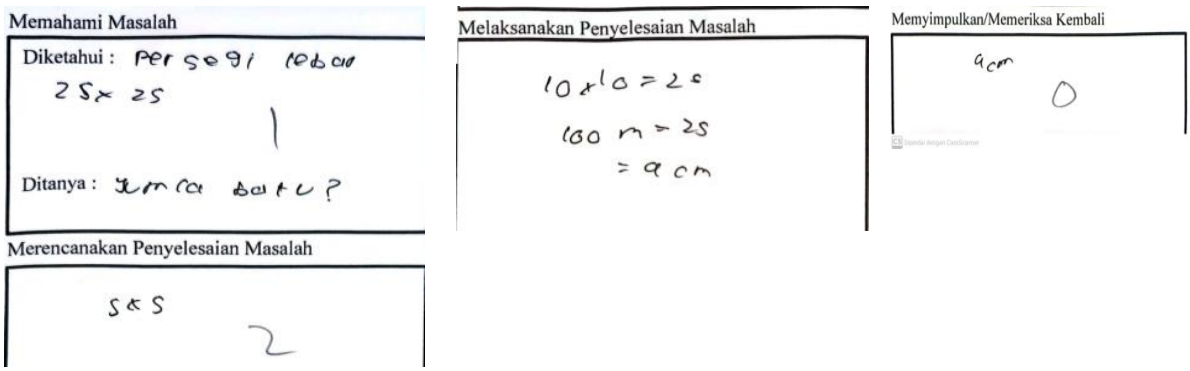

Figure 6. Results of students' work in the low category (Subject MNNA)

Based on the results of the problem-solving ability test above, it is predicted that MNNA has not been able to demonstrate mathematical literacy skills based on the indicators of mathematical literacy skills, namely the first indicator MNNA cannot formulate real problems when understanding questions about the area of a triangle, then

for the second indicator, MNNA has not been able to use mathematics in solving problems by applying the area of a triangle formula. Furthermore, for the third literacy ability indicator, MNNA does not get a precise number of triangles. In the last stage, the fourth literacy understanding indicator, MNNA cannot evaluate the solution by rechecking its calculations.

When understanding the MNNA problem, Blelum could write down what was known and what was asked from the problem. Furthermore, in planning the solution to the MNNA problem, Blelum could write down the mathematical rules (formulas) used, namely the formula for the area of a triangle with Blelum. At the stage of solving the problem, MNNA wrote down the incorrect procedure, and at the stage of rechecking, the AMR did not write down the calculation results that had been obtained correctly.

Based on the results of the problem-solving ability test above, it is predicted that MNNA has not been able to demonstrate mathematical literacy skills based on the indicators of mathematical literacy skills, namely the first indicator MNNA cannot formulate real problems when understanding questions about the area of a triangle, then for the second indicator, MNNA has not been able to use mathematics in solving problems by applying the area of a triangle formula. Furthermore, for the third literacy ability indicator, MNNA does not get a precise number of triangles. In the last stage, the fourth literacy understanding indicator, MNNA cannot evaluate the solution by re-checking its calculations.

Based on the results of research and data analysis on the ability to solve AKM mathematical literacy problems using Polya's steps, it is known that mathematical literacy is one of the essential skills that students must have. According to NCTM, mathematical literacy has three abilities: problem-solving, formulating problems by applying mathematics and communicating (Salsabilla & Hidayati 2021). Mathematical literacy helps develop problem-solving skills, critical thinking, and good decision-making. Students need This important skill to face real-world challenges and provide a strong foundation for developing mathematical and logical thinking skills.

In this study, after analyzing students' problem-solving ability level, it can be seen that students' problem-solving ability is in the low category. The calculation of the proportion test shows that the average ability of students to solve AKM literacy questions using the Polya step of class VIII Junior High School number 21 Bengkulu City in the 2023/2024 academic year on AKM geometry material questions is 49.11. This can be seen from the results of the analysis of the problem-solving ability of class VIII students at Junior High School number 21 Bengkulu City, which showed that 8.33% of students had high ability, 18.33% had medium ability, and 73.33% had low ability. The ability to solve AKM mathematical literacy problems on junior high school geometry using Polya steps for grade VIII students of Junior High School number 21 Bengkulu City in the low category is labeled due to the lack of students' ability to carry out each stage of the mathematical literacy indicators and problem-solving. Meanwhile, research on the problem-solving abilities of prospective mathematics teachers found that most mathematics teachers possess mathematical problem-solving skills in the high category (Nopriana et.al, 2021). Another research reported that low problem-solving ability is evident as the majority of errors occur when attempting to identify the nature of the issue including geometry problems (Arifin & Bonyah, 2024).

CONCLUSION

Based on the results of the study and discussion on the ability to solve mathematical literacy AKM problems on junior high school geometry using Polya's steps on grade VIII students of Junior High School number 21 Bengkulu City in the 2023/2024 Academic Year, it was concluded that the ability to solve mathematical problems on AKM problems on geometry of grade VIII students of Junior High School number 21 Bengkulu City based on Polya's steps was 49.11% (low category). The distribution of the level of mathematical problem-solving ability in each stage is as follows: understanding the problem 54.58% (low category), planning the solution 56.73% (low category), implementing the solution plan 45.55% (low category) and looking back 39.93% (low category).

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