

ANALYSIS OF STUDENTS' MATHEMATICAL LITERACY BASED ON THE LEVEL OF PROBLEM SOLVING ABILITY OF HOTS PROBLEMS

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ABSTRACT

This research aims to analyze students' mathematical literacy based on their level of problem solving ability on HOTS (Higher Order Thinking Skills) questions. Mathematical literacy is the ability that students must have to solve problems in learning mathematics in various contexts, one of which is HOTS type questions. The research method used is qualitative descriptive research. The sample for this research consisted of class VIII students at MTs Ichyaul Islam. Data was collected through mathematical literacy tests and HOTS questions relevant to the material on Systems of Linear Equations in Two Variables. The research results show that there is a relationship between students' mathematical literacy and their level of problem solving ability on HOTS questions. Students who have strong mathematical literacy tend to have higher problem solving abilities on HOTS questions. Students with high HOTS problem solving abilities are able to answer questions with high level thinking and are able to apply mathematical concepts in depth.

Keywords: mathematical literacy, problem solving ability, HOTS

1. Introduction

Indonesia is currently experiencing rapid development, especially in the education sector. This success is underpinned by a combination of workforce skills and ongoing technological advances. Technological advances and continuously developing knowledge are the main keys in improving the quality of learning methods in schools (Gellerstedt et al., 2018). This technological development also has a significant impact on the quality of education in Indonesia, especially in the field of mathematics. Mathematics has a very important role so that all levels of education in Indonesia require students to study mathematics (Husna et al., 2019). Mathematics is often considered an abstract science, but learning mathematics becomes easier when the concepts are related to everyday life.

Mathematics is a lesson that starts from simple concepts to provide an understanding of more complex and closely related concepts (Afriyanti et al., 2018). According to the National Education Standards Agency (Ministry of National Education, 2006), all students at the secondary level must develop three very important aspects of skills, namely a strong understanding of concepts, the ability to think logically and communicate, and the ability to solve problems. Mathematics and problem

solving abilities are two things that cannot be separated (Pradani & Nafi'an, 2019). Therefore, all of these skills are considered a must, meaning that every student at all levels of education must have these abilities (Arfany & Faradiba, 2022).

Problem solving skills are a very important aspect to develop in students, because this allows them to take the right decisions and find solutions in facing various problems (Aripin et al., 2021). Students need to develop their own abilities in solving the problems they encounter (Dian Sari & Faradiba, 2022). The solution to success in problem solving is that students must be actively involved in critical thinking, including analysis, exploration, communication and effective decision making. Problem solving ability is one of the main competencies that students must have. However, in reality many students still face obstacles in their mathematical problem solving abilities. One of the causes is the lack of variation in the learning methods used by teachers. Most teachers only rely on the lecture method in delivering material, then provide exercises in textbooks without providing sufficient motivation to students (Kurniawati et al., 2020). This has a negative impact on students' motivation in learning mathematics.

Learning mathematics has a very close relationship with mastering mathematical literacy

skills (Ananda & Wandini, 2022). Mathematical literacy refers to the use of mathematical abilities and skills in the process of finding solutions. This literacy ability is closely related to the ability to think mathematically in applying concepts, procedures and facts to solve problems (Janah et al., 2019). This problem can be solved by utilizing the knowledge that has been learned (Indrawati, 2020). Mastery of high-level thinking skills in decision making always requires skills in solving problems.

Mathematical literacy is a competency that students must have because it includes important aspects that enable them to develop ideas, build and apply mathematical concepts, use reasoning to generate ideas, and communicate effectively to explain solutions to certain problems (Widdah & Faradiba, 2022). The high level of mathematical literacy in students encourages them to communicate and interpret various problems in everyday life (Rismen et al., 2022). Students who are able to face these various problems will be able to adapt to current developments. Apart from that, in facing the challenges of increasingly competitive problems, students need to hone their mathematical literacy skills so they can compete with other countries (Masfufah & Afriansyah, 2021).

In mathematics education, HOTS problem solving is an important aspect in developing students' mathematical literacy (Saraswati & Agustika, 2020). HOTS questions refer to questions that involve high-level thinking, such as analyzing, evaluating, and creating mathematical solutions. The level of problem solving ability for HOTS questions generally consists of several categories, such as levels of knowledge, understanding, application, analysis, synthesis and evaluation (Herman et al., 2022). Each of these levels describes the level of students' ability to solve increasingly complex mathematical problems. This analysis provides an overview of students' abilities individually and as a whole in solving HOTS problems.

Thus, analysis of students' mathematical literacy based on their level of problem solving ability on HOTS questions is an effective tool for describing students' abilities to understand and apply mathematical concepts in more depth (Aisyah et al., 2021). This analysis helps educators in designing effective teaching strategies and providing constructive feedback to students to improve their mathematical problem solving abilities.

2. Research Methods

This research uses a qualitative method with a descriptive approach. The main aim of this research is to analyze the mathematical literacy abilities of students with various levels of problem solving abilities, namely high, medium and low. Data was obtained from two main sources, namely test questions and interview results (as primary data), as well as documentation (as secondary data). The research subjects consisted of three class VIII students, and the selection of subjects was not carried out randomly, but instead used a purposive sampling technique. This research follows the stages according to Miles and Huberman which include data collection, data reduction, data presentation, and drawing conclusions (Muchlas & Slameto, 2008).

Data collection

Initially, data was collected before data analysis was carried out. This research was carried out at MTs Ichyaul Islam. The first stage, the research began by giving a mathematical problem solving test to all class VIII students to determine the research subject. Furthermore, the research continued by giving mathematical literacy tests to students who had different levels of problem solving abilities, namely high, medium and low.

The steps taken by the researcher to collect data were as follows: (1) carrying out a test to measure students' problem solving abilities which was given to all class VIII students. The test questions used in this case are multiple choice questions; (2) Students are grouped according to their level of ability to solve the problem. Student with a score of $85 \leq s \leq 100$ is considered a high level, score $70 \leq s < 85$ is classified as medium level, and $0 \leq s < 70$ is considered low level; (3) Determine one Random students from each level of problem solving ability as research objects, and continued by giving mathematical literacy test questions; (4) Conduct interviews with each subject.

Data reduction

Data reduction refers to the process of simplifying data that has been collected by selecting information and grouping it into a broader framework (Rijali, 2019). In the context of this research, the data reduction process involves selecting information that is relevant for research purposes. The next step is to re-evaluate the data repeatedly, ensuring that the data

produced is in accordance with the research objectives. The data processed in the reduction stage includes all information related to aspects of mathematical literacy.

Data Presentation

Presenting data is a step after the information has been compiled, then formulating conclusions that can be used as a basis for taking further action (Rijali, 2019). Data is presented in a concise and easy to understand manner. Data obtained through working on mathematical literacy test questions by students with different levels of problem solving ability, is then analyzed as information. Mathematical literacy ability is measured using indicators obtained from the OECD (OECD, 2013), as listed in Table 1 below.

Table 1. Indicators for Assessing Mathematical Literacy Abilities

Indicators of Mathematical Literacy Ability	Activities Activities
Formulate various problem situations mathematically	Identifying mathematical aspects in problems found in real context situations and identifying important variables.
	Linking problems into mathematical language.
	Understand various problems using mathematical concepts, facts or procedures.
Apply concepts, facts, procedures and mathematical reasoning	devise a plan to find a mathematical solution.
	using mathematical tools and technology to help get the right solution.
	apply facts, rules, algorithms and mathematical structures.
Interpret, and evaluate results	reinterpret the mathematical results that have been obtained into real problems.
	evaluate contextual reasons for mathematical solutions to real problems.
	understand the reality in the field regarding the results and calculations of procedures or mathematical models and how the application of the solutions obtained is appropriate to the problem context.

Drawing Conclusions

The final step in the data analysis process is drawing conclusions. This conclusion is reached

by verifying the data that has been collected and interpreting it so as to produce significant understanding (Rijali, 2019). This final stage aims to respond to questions or problems that have been expressed by researchers.

3. Results and Discussion

After completing the problem solving test, the researcher chose three students as the focus of the research at each level. Then, students are asked to complete a mathematical literacy test and take part in an interview process. The selection of these three students was based on the scores they obtained, these results can be seen in table 2 below.

Table 2. Research Subjects

No.	Code	Score	Level of Problem Solving Ability
1.	S1	95	Tall
2.	S2	80	Currently
3.	S3	65	Low

The mathematical literacy test carried out by students is a HOTS question about Linear Equations in Two Variables. One of these questions can be seen as follows:

Ayah menghabiskan uang sebesar Rp 205.000 untuk membeli 2 jenis buah dengan berat keseluruhan 7 kg. Jika harga 1 kg buah apel adalah Rp 40.000 dan harga 1 kg buah jeruk adalah 25.000, maka berapa kg buah jeruk yang dibeli ayah?

Figure 1. HOTS Questions about Linear Equations in Two Variables

Undergraduate Mathematics Literacy Results with High Level Problem Solving Ability

$$\begin{array}{l}
 \text{Misal : apel} = x \\
 \text{jeruk} = y \\
 x + y = 7 \\
 40.000x + 25.000y = 205.000 \\
 \text{ditanya : berapa kg buah jeruk yang dibeli ayah?} \\
 \text{Gunakan metode eliminasi untuk mencari } y \\
 x + y = 7 \quad | \times 40.000 \\
 40.000x + 25.000y = 205.000 \quad | \times 1 \\
 \hline
 40.000x + 40.000y = 280.000 \\
 40.000x + 25.000y = 205.000 \quad - \\
 \hline
 15.000y = 75.000 \\
 y = \frac{75.000}{15.000} \\
 y = 5 \\
 \text{Jadi, banyaknya buah jeruk yang dibeli Ayah} \\
 \text{adalah 5 kg.}
 \end{array}$$

Figure 2. Results of the Mathematics Literacy Ability Test at S1

Based on Figure 2, S1 successfully completed the questions and had all components of mathematical literacy skills. Subject S1 wrote clearly what was known and asked which was an indicator of communication. Formulating mathematical sentences with the variables 'x' and 'y' as examples is a manifestation of students' mathematical abilities. From the results of the written test, the solution strategy used by S1 was elimination using operations and symbolic language as well as technical language. After taking the test, students are interviewed to provide information about the problem. The results of interviews conducted at S1 are as follows:

S1 : Based on the question, it is known that there are two fruits, namely apples and oranges. For example, let's say an apple with variable x and an orange with variable y. This aims to make writing shorter. Then to answer the question, I used the elimination method to find y. Finally the answer was obtained that the number of oranges my father bought was 5 kg.

Based on interviews with undergraduates, researchers concluded that the indicators of mathematical literacy skills were met well. S1 subjects can make logical statements according to the interpretation of the results of problem solving into the context of the problem. Finally, S1 evaluates all steps in problem solving.

Undergraduate Mathematics Literacy Results with Medium Level Problem Solving Ability

$$\begin{array}{l}
 \text{Misal : Apel} = x \\
 \text{Jeruk} = y \\
 x + y = 7 \\
 40.000x + 25.000y = 205.000 \\
 \text{Ditanya : Buah jeruk yg dibeli ayah} \\
 \text{berapa kg?} \\
 \text{Jawab :} \\
 x + y = 7 \quad | \times 40.000 \\
 40.000x + 25.000y = 205.000 \quad | \times 1 \\
 \hline
 40.000x + 40.000y = 280.000 \\
 40.000x + 25.000y = 205.000 \quad - \\
 \hline
 15.000y = 75.000 \\
 y = \frac{75.000}{15.000} = 5
 \end{array}$$

Figure 3. Results of the Mathematical Literacy Ability Test in S2

Based on Figure 3, S2 succeeded in solving the problem. However, S2 does not yet have all components of mathematical literacy abilities. Subject S2 wrote clearly what was known and asked which was an indicator of communication. S2 subjects can write down things they know and ask as indicators of communication. Mathematical abilities are demonstrated by formulating mathematical sentences from story problems using the variables 'x' and 'y' as an example. In choosing a strategy, subject S2 applies elimination. However, the use of technical language does not appear in the problem solving step. Apart from that, S2 is also lacking in providing conclusions on these answers. After taking the test, students are interviewed to provide information about the problem. The results of interviews conducted at S2 are as follows:

S2 : The first step I took in working on the problem was to give an example of an apple being an x variable and an orange being a y variable. This aims to make it easier to work on the questions. Then I wrote down what was asked and finally I used the elimination method to find y (oranges). The result obtained is 5.

Based on interviews with S2, researchers concluded that indicators of mathematical literacy ability were not met well. S2 subjects can make logical statements according to the interpretation of the results of problem solving into the context of the problem. This can be seen in making examples and writing down what is asked. However, S2 does not have the ability to

use technical language in solving problems and providing conclusions.

Undergraduate Mathematics Literacy Results with Low Level Problem Solving Ability

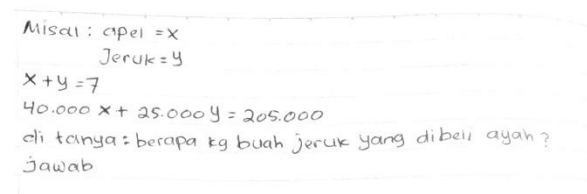


Figure 4. Results of the Mathematical Literacy Ability Test in S3

Based on Figure 4, it proves that S3 was not successful in solving the problem. S3 subjects only have communication skills by finding out what is known and asking questions. S3 subjects can write down what they know using the variables 'x' and 'y' as an example. During the interview, S3 admitted that he had difficulty continuing to the next stage because the questions given were too difficult to understand. The results of interviews conducted at S3 are as follows:

S3 : *I made an example of an apple being an x variable and an orange being a y variable. Then I wrote down what was asked according to the question. But, I had difficulty answering the questions. The questions given were too difficult. I'm confused about using the elimination or substitution method.*

Based on interviews with S3, researchers concluded that indicators of mathematical literacy ability were not met properly. S3 subjects can do examples using variables and write down what is asked. However, S3 found it difficult to solve the questions so that subject S3 did not answer the problems in the questions. The results of tests and interviews conducted by researchers on the three subjects above regarding mathematical literacy skills regarding HOTS-based SPLDV (Two Variable Linear Equation System) material can be seen in table 3 below.

Table 3. Mathematical Literacy Ability Test Results

No.	Mathematical Literacy Ability	S1	S2	S3
1.	Communication	√	√	√
2.	Mathematization	√	√	√
3.	Choosing	√	√	-

Strategy to Solve Problems				
4.	Using Operation and Symbol Language, Formal Language and Engineering Language	√	-	-
5.	Giving Reasons and Conclusions	√	-	-
Categorization Description		ST	S	R

Categorization Description:

ST : Very high

Q : Tall

S : Currently

R : Low

SR : Very low

The mathematical literacy skills of HOTS-based SPLDV material include five components of mathematical literacy with categorization. The five components of ability are categorized into a very high category (ST) if the student has all five components. High category (T) if students have the ability to use operations and symbol language components. Medium category (S) if students have the ability to use strategy components. Low ability (R) if students have abilities up to the mathematical component. Very low category (SR) if students only have a maximum of communication skills components. If students do not have any of the five components, their mathematical literacy abilities will be in the very low category.

From the results of interviews with MTs Ichyaul Islam mathematics teachers, it was stated that students still have low ability in solving HOTS questions because they are not used to it. This statement is in line with research (Hadi et al., 2018) which stated that students had difficulty working on HOTS questions because they were not used to it. Additionally, research (Abdullah et al., 2015) also stated that the majority of students could not solve HOTS questions. This may be because the questions presented are not like the questions they often encounter. This statement is also related to research (Kane et al., 2016) which states the importance of HOTS-based mathematics learning so that high-level thinking abilities can develop so that critical and creative attitudes are created when having to solve real-life problems that arise in everyday life.

4. Conclusions

Based on the results of HOTS-based SPLDV test questions and interviews, only communication and mathematics skills were dominant among all subjects. Meanwhile, strategies for solving problems, using operations and symbolic language, formal language and technical language, as well as giving reasons and conclusions are abilities that not many students have. The conditions above show that the mathematical literacy skills of MTs Ichyaul Islam students are still very low. This is because students are not used to HOTS-based story questions so they experience difficulties when tested.

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