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STUDENTS' MATHEMATICAL LITERACY IN SOLVING PROBLEMS SYSTEM OF EQUATION OF THREE VARIABLES

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Abstract

The main focus in this study aims to analyze the mathematical literacy skills of students at senior high school in solving problems involving the system of linear equations of three variables. The researcher took a qualitative descriptive method. The research subjects were 34 students from class X8. Problem sheets and interviews were the main data collection methods in this study. Researchers reduced data, presented data, and drew conclusions to handle data using a triangulation approach. The indicators of mathematical literacy skills studied were 1) Communication; 2) Mathematization; 3) Strategies in problem solving; 4) Use of language and symbolic operations; formal and technical; 5) Reasoning and argumentation skills. The findings of this study revealed that only one indicator, the communication indicator, was mastered by students in the low mathematical literacy category. Three indicators, namely communication indicators, problem solving techniques and mathematical communication indicators, can be mastered by students with medium mathematical literacy. Students with high mathematical literacy were able to understand and use each sign correctly. Students at SMA Negeri 1 Slogohimo have an average percentage of low mathematical literacy ability of 21%, medium mathematical literacy ability of 18%, and high mathematical literacy ability of 61%.

Keywords: literacy, linear equations of three variables, mathematics

1. Introduction

Mathematics is a means to think rationally; mathematics can also be seen as a science that investigates relationships between patterns, forms, and arrangements, and is useful in many other fields of study (Yasmita, 2018). In essence, math is frequently taught in schools for a variety of reasons, including to enable pupils to measure, subtract, compute, and to apply mathematical principles to their everyday life. Understanding concepts using mathematical models, such as mathematical statements, equations, graphs, diagrams, and charts, is a skill that may be developed through mathematics (Afriansyah et al, 2021).

The purpose of mathematics in schools is not only to optimize students' calculation skills, but also to maximize the logic of adjusting problems and students' critical reasoning abilities in solving these problems, not in the form of ordinary problems, just by substituting numbers into formulas, this is in the form of problems in everyday life. This mathematical skill is called mathematical literacy, individuals who have high mathematical literacy not only understand mathematics but can also be used in solving daily problems (Farida et al., 2021). In addition to using approaches and concepts, mathematical literacy also requires knowledge, underlying abilities, and the capacity to apply that knowledge in practical situations. Someone who understands mathematics can analyze data, clarify information, solve practical problems, graph or describe mathematics, reason mathematically, and convey mathematical ideas (Yanti et al., 2022).

Mathematical literacy is closely related to a person's capacity to solve problems and use their personal mathematical knowledge. Simply put, mathematical literacy is the ability to use mathematics in everyday activities. Based on the OECD (2017), mathematical literacy is a person's skills in formulating, using or implementing mathematics in a number of contexts. Mathematical literacy proves individual skills in utilizing knowledge and abilities, not just mastering it theoretically. Mathematical literacy is closely related to mathematical modeling, namely, skills in formulating mathematical models, utilizing knowledge and skills in solving models, and applying or evaluating the results (Stacey &; Turner, 2015). Mathmatical literacy is the skill in understanding, formulating, mastering, and applying logic to answer mathematical problems in everyday life (Yanisa et al., 2022).

High-level abilities are referred to as mathematical literacy. This aligns with PISA's main survey, which emphasizes reading, math, and science literacy. In today's competitive world, students must be proficient in mathematical literacy in order to compete with other countries (Oki et al., 2021). By having mathematical literacy, a person can form opinions based on consistent mathematical attitudes. The purpose of PISA, according to the OECD in (Apriandi et al., 2019), is to assess students' knowledge and skills in different types of literacy, including mathematical literacy, at the age of 15. The existence of PISA is to improve the improvement of the education system in Indonesia in order to maximize learning so that if the objectives of PISA cannot be implemented to the maximum extent possible, it will have an impact on the education system in Indonesia.

According to Sumardi & Aslami, (2022), students with medium, low, and high mathematical abilities, all show different levels of literacy competence. Students with moderate mathematical ability can learn the subject matter better than students with low mathematical ability. Compared with students with low and medium mathematical ability, students with high mathematical skills also understand the principles of problem solving more deeply. Meanwhile, according to Kurniawan & Khotimah (2022) Four indicators - indicators of communication, mathematization, representation, and problem-solving strategies - can be understood by students with moderate levels of mathematical literacy. The six markers of literacy can be met by students with a high level of literacy. In contrast, students with low literacy levels can only understand communication indicators.

Systems of linear equations with three variables are the subject of a mathematical concept known as SPLTV. This material is considered quite difficult to teach at the high school level of grade X. Story questions are often used to show the difficulty of this material because most of the example questions are taken from real life. Story problems are used to engage students' imagination and assist them in relating lessons to real-world situations. The use of this story problem makes the material of the three-variable linear equation system more difficult (Dewi & Kartini, 2021). According to Kuswanti & Nusantara (2018), common mistakes that students make include failing to get important information from problems, making mistakes when doing calculations, and making wrong mathematical models. Therefore, a basis for carrying out research has been established, the purpose of which is to analyze

students' mathematical literacy abilities when they solve problems involving three-variable linear equation systems at SMA Negeri 1 Slogohimo.

2. Method

This study applies qualitative descriptive research with data validity tests using the triangulation method, namely reducing data, presenting data, and conclusion-making procedures. The implementation of this research was at SMA Negeri 1 Slogohimo with class X8 as the single subject. A total of 34 students took the test . Two descriptive problems created using mathematical literacy indicators are used as research instruments, where questions are given and answered within a predetermined and set period of time. Researchers used five basic abilities that can be used to measure students' mathematical literacy skills based on the mathematical literacy measure according to OECD (2017), namely 1) Communication; 2) Mathematization; 3) Strategies in problem solving; 4) Use of language and symbolic operations; formal and technical; 5) Reasoning and argumentation skills. The author chose five of the seven PISA indicators because from observing students in working on story problems, it was found that students still had difficulties referring to these five indicators, so the researcher was interested in examining this by giving story problems by linking the system of linear equations of three variables.

The results of the study were analyzed using the standard deviation formula which can be seen in Table 1 below:

Table 1. Categories Mathematical literacy ability

Value Limit	Category
a < ($\bar{x}$ – 1 SD)	Low
($\bar{x}$ – 1 SD) ≤ a < ($\bar{x}$ +1 SD)	Keep
($\bar{x}$ + 1SD) ≤ a	Tall

Source: Sumardi & Aslami, (2022)

$$SD = \sqrt{\frac{\sum a^2}{N} - (\frac{\sum a}{N})^2}$$

Where:
Student Grade : a
Average : x̄
Number of Students : N
Standard Deviations : Elementary School

After processing, the three categories of mathematical literacy identified from the data in table 1 were scored as shown in Table 2 below.

Table 2. The results of processing data on the value of the mathematical literacy ability category

Value Limit	Category	Sum Student	Percentage
SG < 53	Low	7	21%
53≤SG < 78	Keep	6	18%
78≤SG	Tall	21	61%

SG: Student grade

This study will select three subjects with three categories of mathematical literacy skills to be interviewed as reinforcement of the analysis results. To maintain the confidentiality of the data, the data subject will use initials. The list of selected research subjects is presented in Table 3.

Table 3. List of Research Subjects

Category of mathematical literacy skills	Research Subjects
Low	SR_1
Keep	SS_1
Tall	ST_1

3. Results and Discussion

3.1. Results

Research on students' ability to solve problems using SPLTV on three materials selected based on low, medium, and high categories as listed in Table 4.

Table 4. List of Research Subjects

No	Mathematical Literacy Ability Indicator	SR_1		SS_1		ST_1	
		Number Problem					
		1	2	1	2	1	2
1	Communication	√	√	√	√	√	√
2	Mathematization	-	-	√	√	√	√
3	Strategies in Problem Solving		-	√	√	√	√
4	Use of language and symbolic operations; formal and technical;	-	-	√	-	√	√
5	Reasoning and Argumentation Skills		-	-	-	√	√

Analysis of the Work Results of Question Number 1

ST_1 student subjects meet all five indicators of mathematical literacy ability: indicators of communication, mathematics, strategies in problem solving, language use and symbolic operations; formal and technical, reasoning and argumentation skills. ST_1 students can answer and give accurate explanations. SS_1 students can achieve four indicators of mathematical literacy ability, namely the ability to rewrite material in problems, the ability to present examples correctly

and accurately, the ability to rewrite equations into mathematical models from the information obtained, the ability to apply problem-solving techniques, the ability to use calculation operations, and the ability to use mathematical language. However, indicators of the ability to reason and argue, are still a challenge for SS_1 students. Communication indicators are the only signs that SR 1 students may master. The results of SR 1 students' work on question number 1 are shown in Figure 1 below:

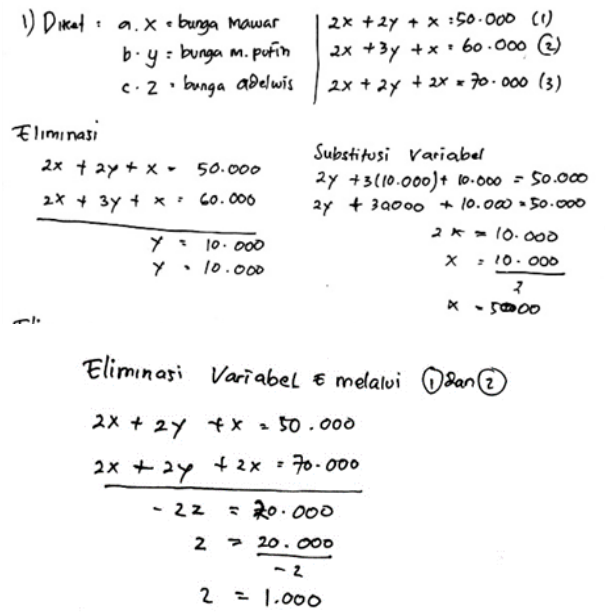

Figure 1. Result of work number 1 by SR1 students

The work of SR 1 students shows that students cannot turn the problem into a mathematical model equation, this is evidenced by the work of SR_1 subjects who enter examples into mathematical models represented by variables "x", "y", and "z". However, when writing the linear equation, SR_1 students write the example in the form of variables that are not quite right, namely by writing the variables into "x", "y", and "x". As shown from the results of the student's work above, when students write mathematical model equations incorrectly, the next step of work will also be wrong. SR_1 stated during student interviews with the topic that writing down mathematical equations was still confusing while doing.

P :try to explain how you generalized the problem."

SR_1 :I was still confused ma'am, so I entered the equation like that, it seems I also wrote the wrong symbol.".

Analysis of the Work Results of Question Number 2

Based on this, ST_1 students met the criteria of the five indicators of mathematical literacy which include indicators of communication, mathematics, problem solving strategies, language use, and formal, technical operations, as well as symbolic ability, reasoning, and argumentation. ST_1 successfully solved problem number 2 accurately and thoroughly. When interviewed, ST_1 students were able to explain coherently and correctly. SR_1 students have achieved two indicators of mathematical literacy ability, namely communication indicators and mathematical indicators. However, three other indicators, namely problem-solving strategies, the use of symbolic and linguistic operations in technical and formal contexts, and reasoning and argumentation skills, have not been met. Three indicators of communication, mathematization, and problem-solving techniques-mastered by SS_1. Two other indicators, namely indicators of the use of mathematical language, indicators of the use of mathematical processes, and indicators of reasoning and argumentation abilities, have not been mastered by SS_1. The following figure 2 shows the results of SS 1 students' work on question 2:

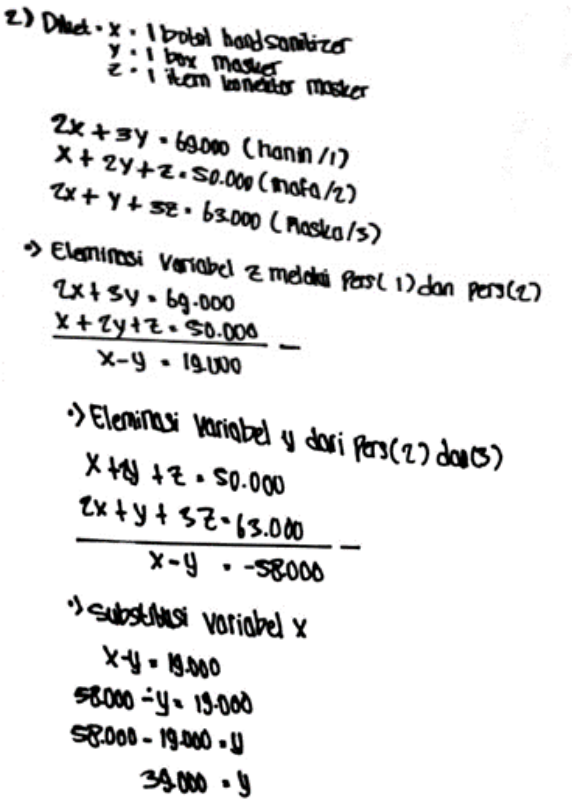

Figure 2. Work on number 2 by SS_1 students

Figure 2 shows that SS 1 students want to eliminate variable "z" through equations 1 and 2 even though equation 1 does not contain variable "z". At the time of the interview SS_1 students could not pin down what was written on the answer sheet. SS_1 students said that they could not do it because

they were confused by the known equations, even though they knew the steps to solve them, they were unable to solve them. Thus, it has an impact on indicators of reasoning and argumentation ability.

3.2. Discussion

Students with low mathematical literacy ability

Students with low literacy ability are only able to understand one indicator, according to the results of student work in Indicator No. 1. Only the information part in the problem can be recognized and rewritten by students with low levels of mathematical literacy. Students have difficulty in generalizing and modeling into linear equations, finding appropriate problem-solving methods, appropriately using mathematical symbol operations and mathematical language, and understanding reasoning and arguments when they analyze difficulties.

According to research by Nurutami et al. (2018), students who have low mathematical literacy skills are only able to pass the first step, which is to identify the problems contained in the problem. Students with low mathematical literacy ability can understand and rewrite the contents of problem number 2, and make them into examples and convert them into mathematical model equations. In line with this, Andari & Setianingsih (2021), stated that students with low levels of mathematical literacy can only recognize the mathematical components of a problem, convert them into variable forms (models and symbols), and apply solving methods to a problem, but are unable to apply mathematical literacy skills to other problems (Nurutami et al., 2018; Andari & Setianingsih, 2021).

Students with moderate mathematical literacy ability

Based on the findings of interviews and responses to the questions, students with intermediate mathematical literacy abilities have not achieved all measures of mathematical literacy. The ability to detect and rewrite information in issues, transform them into mathematical models and equations, create problem-solving techniques, and apply language and mathematical operations are all talents that students with moderate literacy skills possess. However, they cannot draw conclusions from the solution of the problem. Based on the results of Yulia et al.'s research, (2021) that difficulties can be solved by students with moderate abilities by mentioning what is understood in the problem, modeling mathematics, solving problems with formulas, and carrying out procedures correctly. Students with moderate literacy ability can achieve three indicators in question number 2, namely the ability to identify the information contained in the problem, the ability to write problems into variables and convert them into linear equations, and the ability to design problem-solving strategies, but have not been able to master other indicators (Yulia et al., 2021).

In line with Andari & Setianingsih (2021) Students with a moderate level of mathematical literacy are only able to recognize variables and mathematical components of a problem, translate information into mathematical language according to variables (models and symbols), and practice strategies in solving problems (Andari & Setianingsih, 2021).

Students with high mathematical literacy ability

According to this study, students who have a high level of mathematical literacy can demonstrate five indicators: communication, mathematics, problem-solving strategies, use of language and symbols, formal and technical procedures, reasoning skills, and arguments. In agreement with this, Murtiyasa et al., (2020) stated that students who have high mathematical literacy skills can achieve mathematical literacy indicators with evidence of being able to solve each problem correctly and precisely, besides that students also understand the steps of working on the information known in the problem. In line with Yulia et al., (2021) highly capable students can execute procedures well, deal with complex situations, use their reasoning to solve problems, work effectively, and interpret various presentations before relating them to the real world. They can also solve routine problems, interpret problems, and solve them with formulas.

Students' mathematical literacy ability is more dominant in communication ability indicators, in other words that communication indicators are most mastered by students with low, medium, and high mathematical literacy skills (Rusmining, 2017) Meanwhile, research conducted by Setiani et al. (2018) proves that students who have high mathematical literacy skills are more effective in describing problems in models so that they can easily design methods to overcome mathematical literacy challenges. Students with low mathematical literacy may identify problems but cannot solve them. Although students with moderate mathematical literacy are able to understand the core of the problem, students with moderate mathematical literacy have difficulty in communicating their ideas using mathematical symbols.

4. Conclusion

Analysis of the data in this study resulted in the conclusion that the communication indicator was the only one of the five characteristics that could be met by students with low mathematical literacy, while the other four indicators were not met. Students with moderate mathematical literacy tend to master three indicators, namely communication indicators, mathematics, and strategy indicators to solve problems, but less optimally on two other indicators, namely indicators of language use and mathematical symbolic operations and indicators of the ability to reason and argue (give conclusions). Students with high mathematical literacy ability can meet five indicators, including indicators of communication, mathematics, strategies in solving problems, use of language and symbolic operations, formal and technical skills, reasoning and argumentation.

The average number of students who belong to low math literacy ability at SMA Negeri 1 Slogohimo is 21%, the average percentage of students who belong to medium math literacy ability is 18%, and the percentage of students who belong to high math literacy ability is 61%. This shows that typical grade X8 students at SMA Negeri 1 Slogohimo are included in the group of high literacy skills.

The hope is that this article can be a guideline for a number of subsequent studies that examine students' mathematical literacy. For further research, it is recommended to focus more on efforts to maximize teachers' mathematical literacy skills, so that teachers and educators can have balanced mathematical literacy skills.

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