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Students' Mathematical Literacy Ability in Solving Story Problems

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Abstract. The mathematical process is one part of mathematical literacy that students need to have in solving mathematical problems. Therefore, students who have good mathematical processing skills will find it easier to solve mathematical problems related to the real world. This article aims to determine students' mathematical literacy skills in solving story problems based on mathematical processes. The story problem in question is a math problem related to the real world. This research is a qualitative research with descriptive method. Data analysis techniques in this study consist of data collection, data reduction, display data, and verification. The subjects of this study were three students from the ninth grade in one of the junior high schools in Banyuwangi. Subjects were selected based on three considerations, namely academic ability, teacher recommendations, and students' willingness. The story questions given consist of two story questions about Quadrilateral material. The indicators of mathematical literacy ability used in this study include: (1) understanding the problem, (2) selecting knowledge, (3) outlining plans, (4) solving and reasoning, and (5) evaluating results in problem solving. The results showed that the mathematical literacy ability of the ninth graders in solving the story problems of the quadrilateral material had not met all the indicators of the mathematical literacy process. In addition, the results of the study also showed that students were not accustomed to writing down the information contained in the questions, and did not describe the completion plan clearly. From these results it is suggested that teachers train to involve the mathematical process in the learning process so that students are accustomed to solving problems related to the real world and can improve their mathematical literacy skills.

INTRODUCTION

Mathematics is one of the most important knowledge for students to learn. This is because mathematics is often used in everyday life. One of the uses of mathematics is used in the field of architecture, buying and selling, etc. In the Minister of Education and Culture Number 22 of 2016 it is stated that the objectives of learning mathematics are: (a) understanding mathematical concepts, describing how the interrelationships between mathematical concepts and applying concepts or logarithms in an efficient, flexible, accurate, and precise manner in solving problems, (b) reasoning patterns of the nature of mathematics, developing or manipulating mathematics in constructing arguments, formulating evidence, or describing mathematical arguments and statements, (c) solving mathematical problems which include the ability to understand problems, develop mathematical models of completion, complete mathematical models, and provide appropriate solutions, and (d)) communicate arguments or ideas with diagrams, tables, symbols, or other media in order to clarify problems or circumstances [8].

The objectives of learning mathematics described by the Minister of Education and Culture are in accordance with the abilities contained in mathematical literacy. Mathematical literacy is defined as students' capacity to formulate, employ and interpret mathematics in a variety of contexts. It includes reasoning mathematically and using mathematical concepts, procedures, facts and tools to describe, explain and predict phenomena [7]. Literacy in the context of mathematics is the power to use mathematical thinking in solving everyday problems to be better prepared to face life's challenges [14].

In solving mathematical literacy problems, the OECD has determined three mathematical literacy processes, including: a) Formulating situations mathematically; b) Apply concepts, facts, procedures and mathematical reasoning; and c) Interpret, use and evaluate mathematical results [6].

Mathematical literacy skills are needed by students in connecting the mathematics they learn in class with real-world problem situations [15]. De Lange states that mathematics in schools is focused on the material section, while mathematical literacy is focused on how to use mathematics in real life [3]. Someone who has good mathematical literacy skills must have sensitivity to mathematical concepts that are relevant to the problems they face [2].

The process of mathematical literacy is the domain of mathematical literacy [6]. However, based on several studies, students have not been able to fully apply the mathematical literacy process in solving mathematical problems . The results of research conducted by Wati, et al (2019), showed that students' mathematical literacy skills were not maximal in fulfilling the mathematical process, namely identifying mathematical aspects of a real-life problem context and identifying known variables; define mathematical models and simplify problems; designing and implementing strategies to find solutions; determine facts, procedures, algorithms and mathematical models when searching for solutions; reflect, describe and determine mathematical results; interpret mathematical results and evaluate mathematical solutions into real-life contexts [10]. In addition, Nur and Kiki (2021) also stated in their research that there are still students who have not met all the indicators of the mathematical literacy process in solving PISA questions [16].

In the current curriculum in Indonesia, mathematical literacy is one of the aspects assessed in the Minimum Competency Assessment which is part of the National Assessment benchmark [9]. Therefore, every student must have good mathematical literacy skills. However, the facts on the ground show that students' mathematical literacy skills in Indonesia are still low. This is shown by the results of the PISA (Program for International Student Assessment) in 2018, where Indonesia's score is still below the average PISA test score [7].

Several studies also show that students in Indonesia still have low mathematical literacy skills. One of these studies was conducted by Mahiuddin, et al. The results of his research indicate that students' mathematical literacy skills are still low, where students are still weak in formulating. and planning strategies to solve a problem [4]. In addition, the results of research conducted by Munfaikhatin & Irmawaty in 2020 also showed that students' mathematical literacy skills in completing PISA space and shape content were still very low. Most students are still not able to use mathematical operations correctly, and have not been able to use their mathematical abilities to solve the given mathematical problems[5].

Based on this description, researchers are interested in further researching the process of students' mathematical literacy in solving mathematical problems, especially for students in Banyuwangi. This research was conducted because there is no research related to the ability of students in Banyuwangi in solving mathematical problems related to the mathematical process. From the results of this study, it is expected to add data related to the ability of students' mathematical literacy processes in Indonesia. From this data, it can be used as a reference in improving students' mathematical literacy skills, especially the ability to process mathematics which is one of the domains of mathematical literacy.

RESEARCH METHOD

This research is a qualitative research with descriptive method which aims to describe students' mathematical literacy skills in solving story problems. The research was conducted in one of the junior high schools in Banyuwangi Regency. The material used in this research is quadrilateral material. The subjects of this study were three students in the ninth grade. Subject selection was carried out based on three criteria, namely (1) prospective subjects had studied quadrilateral material (2) mathematics teacher information about good mathematical communication skills to facilitate digging up information during the interview process, and (3) students' willingness to become research subjects.

The instrument used in this study was a two-point question about the material in a quadrilateral. The story problem in question is a math problem related to real-world problems. The questions given are taken from research on the development of mathematical literacy test questions by Alam (2016) and Saukiyah, et al (2017) which have received previous validation [1][12].

The indicators of mathematical literacy ability used to measure students' mathematical literacy skills are: (1) understanding the problem, (2) choosing knowledge, (3) outlining plans, (4) solving and reasoning, and (5) evaluating results [15]. This indicator is an indicator used by Sumirattana (2017) in his research to determine the mathematical literacy ability of high school students.

Data collection techniques were carried out by using quadrilateral material description questions and free interviews to determine students' mathematical literacy abilities. Free interviews in question are interviews conducted without making interview guidelines beforehand so that researchers are free to ask questions to research subjects according to the topic under study. Qualitative data analysis used in this study using data analysis techniques according

to Milles and Huberman. The steps of the qualitative data analysis technique include of data collection, data reduction, data display, and conclution (drawing/verifying). the flow of the steps of the data analysis technique is presented in Figure 1.
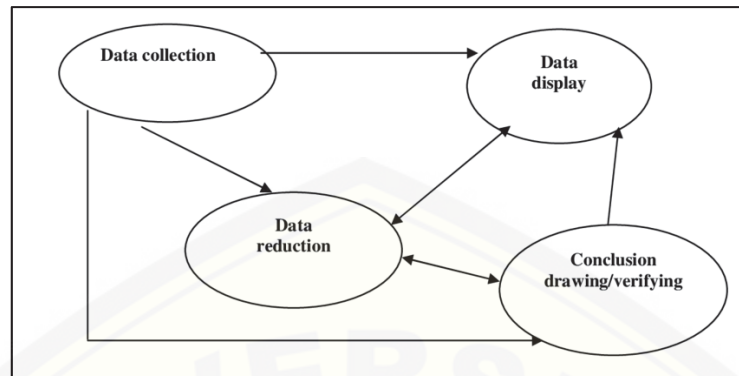
FIGURE 1. Chart of the steps of data analysis techniques according to Milles and Huberman

Based on this explanation, the data analyzed in this study were students' answers in completing the two description questions given and the results of student interviews. Analysis of interview data is used to obtain additional data that is more accurate about mathematical literacy skills in solving quadrilateral material questions. The presentation of the results of data analysis in this study contains a description of the mathematical literacy abilities of ninth graders in solving quadrilateral material problems based on predetermined indicators.

RESULT AND DISCUSSION

This research was conducted with the research subjects, namely the first student (S1), the second student (S2), and the third student (S3) who were ninth grade students. The data from the three students represent the students' ability to solve the given problem. This is because there are some of the same answers from the results of student work, so the researchers reduced the same data and obtained three different answers that could be used as subjects for analyzing students' literacy skills based on the mathematical process in solving mathematical problems. The story questions are given in Figure 2.
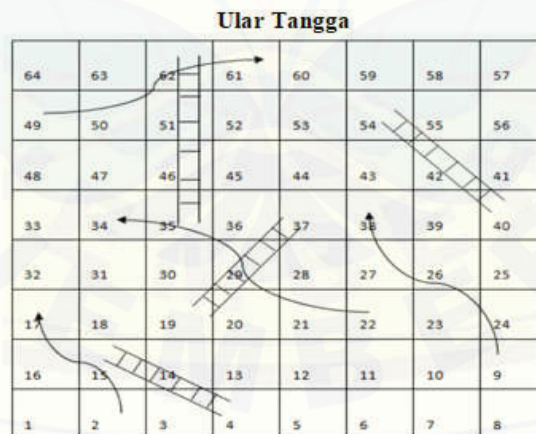
In the game of snakes and ladders, the game starts from square number 1 and moves to finish in square number 64 with the movement of the pawns according to the dice obtained in the toss. If we start with the number 1, what is the area covered by the pawn when the dice that is rolled shows a dice of 4 and each game square has a side of 3 cm?

(a)

Mr. Yazid wants to replace the floor of his 10 cm x 6 cm house with tiles. If one square meter requires 10 tiles, then how many tiles are needed to replace the floor of his house? Please include your reasons!

(b)

FIGURE 2. (a) The first story problem,
(b) The second story problem

The Analysis Results of First Student (S1)

Based on the student' answers to first question, it can be seen that students have not written down what is known in the problem completely. Students also have not written down what is asked in the question. Student planning is also not clearly visible because students do not write down the formula used in solving the problem. Students also did not write down the description of the calculations they did. From the results of the interview as shown on Figure 3(b), the area of the pawn discussed by the students is the area traversed by the pawn. Here students can already know what is being asked in the question, but they are wrong in providing an explanation. Based on the results of the interviews it is also seen that students have not been able to provide appropriate solutions and reasoning in solving problems. students misinterpret the length of the side of the box with the area of the box. In addition, students do not yet understand how to count the squares passed by the pawns based on the throwing of the dice. Based on this explanation, the first student's mathematical literacy ability in completing has not met all the indicators of mathematical literacy.

(a)

G : "What is asked in the question?"
S1 : "Large pawn area"
G : "How do you find the area?"
S1 : "by multiplying 4 times 3"
G : "why find the area traversed by the pawn by counting 4 times 3?"
S1 : "because the pawn goes 4 squares and one square 3 cm"
G : "How do you know a pawn runs 4 squares?"
S1 : "because the dice show the number 4"

(b)

FIGURE 3. (a) student's answer to the first question,
(b) Excerpt from the first student interview for the first question

Based on students' answers to the second question, it appears that students have not written down what they know and what was asked in the question. Students also have not written a plan to solve the problem. From the results of interviews as shown on Figure 4(b), it is known that students have not been able to understand the problem properly. This is indicated by the students still not mentioning the information contained in the questions. In addition, students have not been able to make appropriate problem solving and reasoning. Based on this explanation, the first student's mathematical literacy ability in solving the second question did not meet all the indicators of mathematical literacy.

| G : "What information is contained in the question?" |
| S1 : "house floor measuring 10 m x 6 m" |
| G : "Then what is asked in the question?" |
| S1 : "what is asked in the question is the number of tiles" |
| G : "How do you calculate the number of tiles needed?" |
| S1 : "with 10 times 6" |
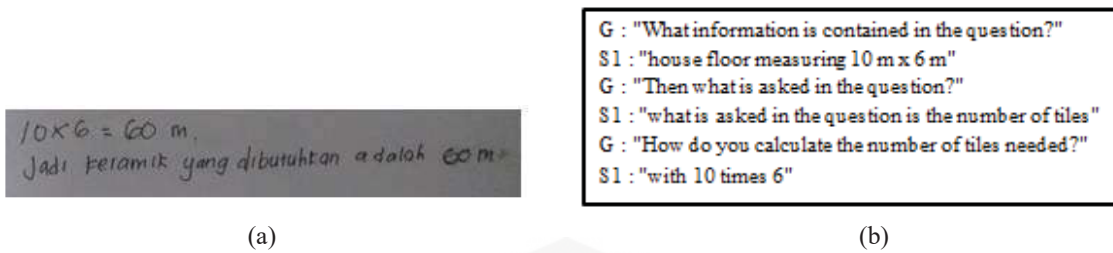
(a)   (b)

FIGURE 4. (a) student's answer to the second question,
(b) Excerpt from the first student interview for the second question

The conclusion of the analysis of the first student's mathematical literacy ability in solving story problems is presented in Table 1.

TABLE 1. Analysis of the First Student's Mathematical Literacy Ability in solving story problems

Mathematical Literacy Questions	Indicator of Mathematical Literacy ability					Conclusion
	1	2	3	4	5	
1	-	-	-	-	-	-
2	-	-	-	-	-	-

The Analysis Results of Second Student (S2)

Based on the student' answers to first question, it can be seen that students have not written down what is known and asked in the question. From the students' answers, it was seen that students were able to choose the right knowledge in solving problems. However, students have not been able to describe the completion plan well. This is because after calculating the area, students do not write down what information is being calculated. From the results of the interview as shown on Figure 5(b), can be known that students can understand the problem in the question. However, it is not written down. In addition, students are also able to choose the right knowledge and describe plans well. This can be seen from the students' answers in explaining how students will calculate the large of the area that the pawns pass. However, in their calculations, the students made a mistake in determining the number of squares that the pawns would pass through. Based on this explanation, the second student's mathematical literacy ability in solving the first problem has met the mathematical literacy indicators (1), (2), and (3), but has not met the indicators (4) and (5).

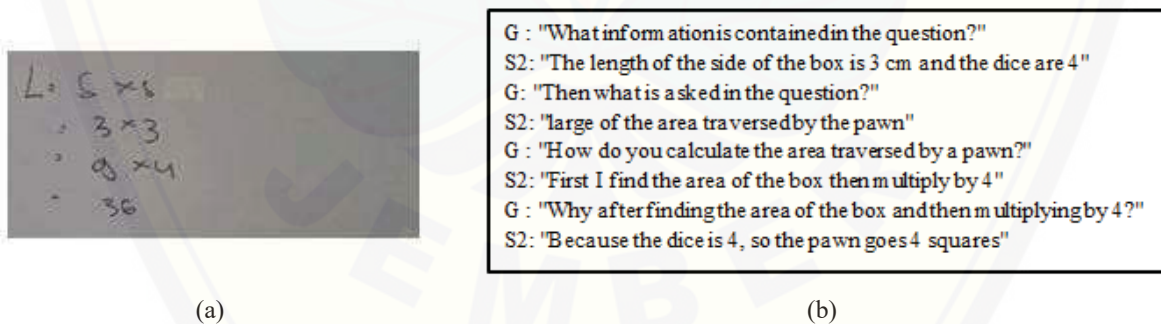| G : "What information is contained in the question?" |
| S2: "The length of the side of the box is 3 cm and the dice are 4" |
| G : "Then what is asked in the question?" |
| S2: "large of the area traversed by the pawn" |
| G : "How do you calculate the area traversed by a pawn?" |
| S2: "First I find the area of the box then multiply by 4" |
| G : "Why after finding the area of the box and then multiplying by 4?" |
| S2: "Because the dice is 4, so the pawn goes 4 squares" |

(a)   (b)

FIGURE 5. (a) student's answer to the first question,
(b) Excerpt from the second student interview for the first question

Based on students' answers to the second question, It appears that students have not written down the information contained in the questions. From the students' answers, it was seen that students were able to choose the right knowledge in solving problems. However, students have not been able to describe the completion plan well. This is because after calculating the area, students do not write down what information is being calculated. From the results of interviews as shown on Figure 6(b), it is known that students can understand the problem in the question. However, it is not written down. In addition, students are also able to choose the right knowledge and describe plans well. This can be seen from the students' answers in explaining how students will calculate the number of ceramics needed. The

calculations made by students are also correct in determining the number of ceramics needed. However, students still have difficulty in writing down the reasons for the results. Based on this explanation, the mathematical literacy ability of master's degree students in solving the second question has met the indicators of mathematical literacy (1), (2), (3), and (4). However, it does not meet the indicator (5).

G : "What information is contained in the question?"
S2 : "floor size is 10 m x 6 m and one square meter requires 10 tiles"
G: "Then what is asked in the question?"
S2 : "a lot of tiles are needed to replace the floor of the house"
G : "How do you calculate the number of tiles needed?"
S2: "First I find the floor area, then multiply by 10"
G : "Why after finding the floor area and then multiplying by 10?"
S2 : "Hmm .. because one square meter requires 10 tiles"
G : "Why hasn't the reason been written yet?"
S2 : "Hm .. I'm confused Ma'am, how to write it"

(a)   (b)

FIGURE 6. (a) student's answer to the second question,
(b) Excerpt from the second student interview for the second question

The conclusion of the analysis of the second student's mathematical literacy ability in solving story problems is presented in Table 2.

TABLE 2. Analysis of the Second Student's Mathematical Literacy Ability in solving story problems

Mathematical Literacy Questions	Indicator of Mathematical Literacy ability					Conclusion
	1	2	3	4	5	
1	✓	✓	✓	-	-	1,2,3
2	✓	✓	✓	✓	-	1,2,3,4

The Analysis Results of Third Student (S3)

Based on the student' answers to first question, it can be seen that students write down what is known in the problem but is not complete. Students also have not written down what is asked in the question. Student planning is also not clearly visible, because students do not write down the formula used in solving the problem. Students also do not write down the description of the calculations they do. From the results of the interview as shown on Figure 7(b), student can know what is being asked in the question. Students have not been able to provide appropriate solutions and reasoning in solving problems. students misinterpret the length of the side of the box with the area of the box. In addition, students do not yet understand how to count the squares passed by the pawns based on the throwing of the dice. Based on the explanation, the third student's mathematical literacy ability in solving the first problem did not meet all the mathematical literacy indicators.
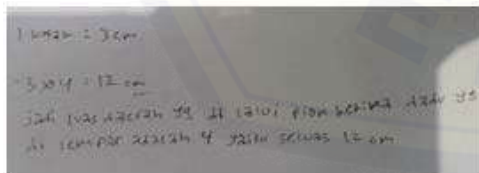
G : "What is asked in the question?"
S3 : "large of the box through which the pawns pass"
G : "How do you determine the large of the box through?"
S3 : "with 3 times 4"
G: "why do you find the area traversed by the pawn by counting 3 times 4?"
S3: "because one square is equal to 3 cm and the pawn runs 4 squares"
G : "How do you know that a pawn runs 4 squares?"
S3: "because the dice that is thrown shows a dice of 4"

(a)   (b)

FIGURE 7. (a) student's answer to the first question,
(b) Excerpt from the third student interview for the first question

Based on students' answers to the second question, It appears that Students write down what is known in the problem but is not complete. Students also have not written down what is asked in the question and have not written a plan to solve the given problem. From the results of interviews as shown on Figure 8(b), it is known that students know what is asked in the question. However, students have not been able to make appropriate problem solving and reasoning. Based on this explanation, the third student's mathematical literacy ability in solving the second question did not meet all the indicators of mathematical literacy
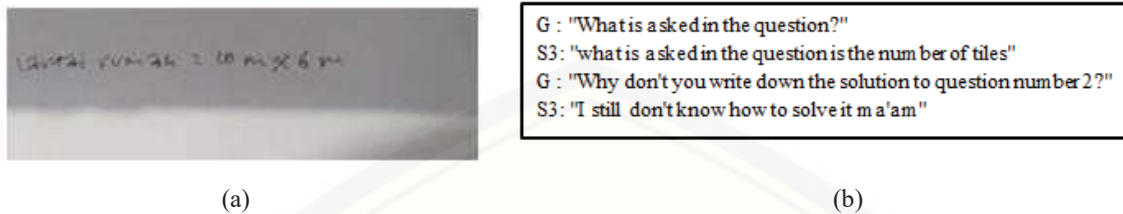

G : "What is asked in the question?"
S3: "what is asked in the question is the number of tiles"
G : "Why don't you write down the solution to question number 2?"
S3: "I still don't know how to solve it ma'am"

(a)   (b)

FIGURE 8. (a) student's answer to the second question,
(b) Excerpt from the third student interview for the second question

The conclusion of the analysis of the third student's mathematical literacy ability in solving story problems is presented in Table 3.

TABLE 3. Analysis of the Third Student's Mathematical Literacy Ability in solving story problems

Mathematical Literacy Questions	Indicator of Mathematical Literacy ability					Conclusion
	1	2	3	4	5	
1	-	-	-	-	-	-
2	-	-	-	-	-	-

Discussion

The subjects of this study were ninth grade students with heterogeneous intelligence levels. Based on the results of data analysis that has been carried out, several explanations related to students' mathematical literacy skills are presented based on mathematical processes. The results of the first student analysis include: (1) Students have not been able to fulfill the first indicator of the mathematical literacy process, namely understanding the problem. (2) Students have not met the second and third indicators, namely selecting knowledge and outlining plans. It is shown that students have not been able to choose and write a problem-solving plan correctly; (3) students have not met the fourth indicator, namely solving and giving reasons, this is because students have not been able to do the completion correctly; (4) Students have not met the fifth indicator, namely evaluating the results of the completion. It can be seen that students are still wrong in solving the questions given. The results of the analysis of the second student The second student in solving the problem, among others: (1) the student has met the first indicator, namely understanding the problem. This is indicated by the answers of students who have correctly explained the information and what is the problem with the questions; (2) Students have met the second and third indicators, where students are able to choose and write a completion plan well; (3) students still have not completely fulfilled the fourth and fifth indicators. This is because the second student is still unable to solve and give reasons regarding the results of the completion correctly, and students do not evaluate the results obtained. For the results of the analysis, the third student has similarities with the first student, where the third student also has not been able to fulfill all the indicators of mathematical literacy ability used related to the mathematical process.

CONCLUSION

There are five indicators of mathematical literacy ability in problem solving used in this research based on mathematical process, including: The first indicator is the ability to understand problems. In the first indicator, students must have the ability to write down the information contained in the questions. The information can be in the form of what is known and what is asked in the question. The second indicator is the ability to choose knowledge. In this indicator, students must have the ability to choose the right knowledge in solving problems in the questions. The third indicator is the ability to describe plans. In this indicator students must be able to write down what they will do in solving the problem. Outlining the plan can be done by writing down the steps of completion in a coherent and clear manner. The fourth indicator is the ability to solve and reason. In this indicator students must be able to solve problems

with the right work and results. This is shown from the exact calculation procedure. The fifth indicator is the ability to evaluate solutions. In this indicator students must have the ability to evaluate and re-check the results of student answers. This can also be shown from the conclusions and reasons for solving the problem correctly.

From the results of the research that has been described, it was shown that the mathematical literacy ability of ninth graders in completing stories of rectangular material had not been able to meet all the indicators of mathematical literacy that had been described previously. In addition, the results of the study also showed that students were not accustomed to writing down the information contained in the questions, and did not describe the completion plan clearly. Therefore, from the results of this study, it is necessary to follow up on research related to learning methods or models that can familiarize students with the mathematical process in solving mathematical problems, so can to improve their mathematical literacy skills.

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