

Analysis of Mathematical Literacy in Solving Fraction Arithmetic Operations

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Abstract: *Mathematical literacy is the ability of students to formulate, apply, and interpret mathematics in various real contexts. The aim of this study to describe mathematical literacy in solving fraction count operation questions based on grouping students' cognitive abilities into high, medium, and low categories. The subjects of this study were 24 students of grade V SDN Darungan 01 Lumajang. Data collection methods used were tests and interviews. This type of research used in this research is descriptive using a qualitative approach. The results showed that there were 4 students who were able to fulfill 2 components of mathematical literacy, namely formulating mathematical situations and interpreting the results of the solutions. While 15 students are able to fulfill 1 component of mathematical literacy, namely formulating mathematical situations. 5 Other students are able to fulfill one component of mathematical literacy, namely formulating mathematical situations.*

Keywords: Cognitive skills; mathematical literacy; fraction count operations

1. INTRODUCTION

Mathematical literacy in Indonesia ranks 63rd out of 72 countries with a score of 386 (OECD, 2016). The low level of mathematical literacy is due to the quality of education in Indonesia which is only oriented towards mastering theory and memorization so that students' reasoning abilities are less developed. Students in problem solving abilities are only given routine questions, in contrast to PISA questions which begin with daily problems, then from the problems students are asked to think freely using various ways of doing them, learn to provide reasons, and make conclusions. Knowledge of mathematical literacy needs to be possessed by teachers in order to design literacy-based learning in the hope that students can get used to working on literacy-laden questions and be able to solve math problems in everyday life. Hara (2017), explains that mathematical literacy is an individual's capacity to formulate, use, and interpret mathematics. Mathematical literacy in mathematics learning is a standard that must be mastered by students to improve mathematical competence because the mathematical concept that needs to be prioritized is mathematical literacy.

The modified mathematical literacy indicator from the PISA Framework (2012) can be seen in Table 1 as follows.

Mathematical Literacy Components	Mathematical Literacy Indicators
Formulate a situation mathematically	Simplify real situations by interpreting the problem according to the correct understanding.
	Represent situations mathematically, using variables and symbols.
	Formulate the stated problem into a mathematical model.
Apply mathematical concepts, facts, procedures, and reasoning.	Designing strategies for solving problems coherently.
	Using mathematical concepts, facts, procedures, and reasoning.
	Finish the problem correctly.
Interpret the settlement results	Interpret the settlement results in a real context.
	Summing up the most appropriate problem-solving results.

Based on this explanation, the mathematical literacy thinking process can be categorized into 3 main processes, namely formulating, implementing, and interpreting. Good mathematical literacy will foster an independent character,

Table 1. Mathematical Literacy Indicators

because students who have good mathematical literacy skills will be accustomed to solving problems independently. Understanding mathematics is very important, especially the ability to activate mathematical literacy in solving problems related to everyday life. Literacy which plays an important role in everyday life is numeracy literacy, where numeracy literacy in Indonesia is still very low so that it is necessary to cultivate it through daily activities. According to Han (2017: 3), numeracy literacy has knowledge and skills including: (a) using numbers and symbols related to mathematics in solving daily problems, (b) examining the information displayed to make decisions. One of the numeracy literacy that can be found in learning mathematics is the fraction count operation material. There are several types of arithmetic operations, namely the count operations addition, subtraction, multiplication, and division. The material of fractions has been applied by students in everyday life, it's just that students do not understand the concept of fractions. It can be seen from the mathematical literacy thinking process, which is the aspect of formulating mathematical situations, students must be able to understand the problem well and write down completely what is known from the problem. Aspects of applying mathematical concepts, facts, procedures, and reasoning, students must be able to explain the procedures used in solving the questions. Aspect interpreting the results of the completion, students must be able to grasp the explanation of the questions and understand the information provided from the question instructions.

Based on interviews with class V teachers at SDN Darungan 01 Lumajang, it was found that students had difficulty solving the addition and subtraction problems of fractions with different denominators and difficulties in simplifying fractions, thus indicating that grade V students had difficulty solving the material of the addition and subtraction arithmetic operations due to lack understanding the concept of fractions.

Research relevant to the following research, Aeni (2020), states that low ability students cannot fulfill the literacy component. Students with moderate ability are able to write down what is known and asked from the questions and are able to formulate problems into a mathematical model. High ability students can fulfill all components of mathematical literacy. Aini (2019), states that students with verbal linguistic intelligence and naturalist intelligence can fulfill the 3 components of literacy thinking but students with mathematical logical intelligence cannot interpret the symbols written in conclusions into real contexts. Kusniati (2018) states that students with the ability to understand aspects are able to solve and understand problems. In terms of reasoning and application aspects, students have not been able to solve problems. In terms of communication aspects, students, if presented with problems of daily life, are able to answer correctly and confidently, then students' mathematical literacy skills from the communication aspect are good enough. Rowanti (2020), states that the component of mathematical literacy is mostly fulfilled, namely the first

component of literacy, namely formulating problems, while the second component of literacy is only a few students who can fulfill it as well as the third component of mathematical literacy, namely interpreting the results of the solution only some students can fulfill. Based on relevant research, it shows that each subject has different abilities. Students can be said to be capable of mathematical literacy characterized by a good analysis process, can provide mathematical explanations and are able to interpret mathematical problems into the real context of the symbols written.

Based on the description of the problem formulations studied in this study, namely: How is the student's mathematical literacy in solving fraction arithmetic operations for class V SDN Darungan 01 Lumajang?

2. METHODOLOGY

This type of research used in this research is descriptive using a qualitative approach. The subjects in this study were students of class V SDN Darungan 01 with a total of 24 students. The instruments used in this study were test instruments and interview guides. Data collection methods used are by using the test and interview methods. Wawancara in this study related to students' mathematical literacy in solving fraction arithmetic operations. Interviews were conducted with 2 students from each category of high, medium, and low cognitive abilities. The test in this study was to provide 4 questions in the mathematical literacy test in solving fraction arithmetic operations.

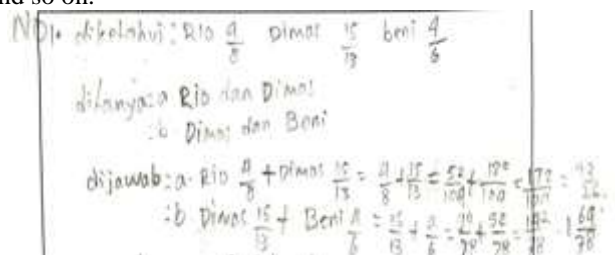
- (1) Rio, Dimas, and Beni must complete a project within a predetermined time. The work will be divided according to their respective abilities. Rio finished $\frac{4}{8}$ part, Dimas finished $\frac{15}{13}$ the part, and Beni finished $\frac{4}{6}$ the part. Determine how many parts the:
 - a) Rio and Dimas
 - b) Dimas and Beni
- (2) Pak Rehan is an employee in a cooperative. Every month he receives a salary of Rp. 640,000.00. Mr. Rehan uses $\frac{6}{16}$ part of wages for household needs, $\frac{4}{14}$ part to pay taxes, $\frac{2}{7}$ part for children's education costs, and the rest is saved. How much of Pak Rehan's money is being saved?
- (3) Pak Heru has an area of $4\frac{6}{10}$ Ha. Then Pak Heru bought another $5\frac{3}{13}$ ha of land next to him. If $6\frac{2}{5}$ ha of land has been used for agriculture and the rest will be used for livestock, how much land is there for livestock?
- (4) Bobi has 1 liter of water which is put into two bottles, namely bottle A and bottle B. Bottle A is filled with water $\frac{4}{8}$ liter and B $\frac{3}{12}$ liter bottle. How much water is left that is not put into the two bottles?

The data analysis method used in this research is the analysis of the validity of the instrument, the results of written tests, and the results of interviews. Analysis of the validity of the instrument before being tested on students

will be tested for its validity by two lecturers of Mathematics Education at the University of Jember. The results that have been given by the validator will be placed in the validation table. After that, a literacy test was carried out and the data on student work results were analyzed according to the indicators of mathematical literacy and grouped based on the cognitive abilities of students in the high, medium, and low categories. Furthermore, the analysis of the results of the interviews was conducted to determine the student's process of working on the questions and to compare the students' work on the answer sheets. After analyzing the data, then presenting the data.

3. RESULTS AND DISCUSSION

Based on the results of the mathematics literacy test of 24 students, there were 4 high category students, 15 medium category students, and 5 low category students. The results showed that there was a tendency that was seen in students of high, medium, and low cognitive abilities in solving math literacy test questions. The results of this analysis contained interview transcripts with codes P01, P02, P03, and so on. The "P" means "interviewer" while "01" means the "1st" question, and so on. Also listed are codes S0301, S0302, and so on, S0601, S0602, and so on, S2001, S2002, and so on. "S03" means the first subject, "S06" means the sixth subject, and "S20" means the twentieth subject. "01" means the student's answer to the first question, and so on.



Known : Rio $\frac{4}{8}$, Dimas $\frac{15}{13}$, Beni $\frac{4}{6}$
 Wanted : a. Rio and Dimas
 b. Dimas and Beni
 Answered: a. Rio + Dimas = $\frac{4}{8} + \frac{15}{13} = \frac{52}{104} + \frac{120}{104} = \frac{172}{104} = \frac{43}{26}$
 b. Dimas + Beni = $\frac{15}{13} + \frac{4}{6} = \frac{30}{26} + \frac{17}{26} = \frac{47}{26}$

Figure 1. Snippets of answers from students with high cognitive abilities

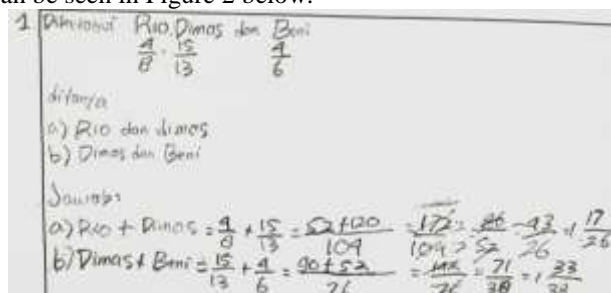
Snippets of interviews of students with high cognitive abilities are as follows.

- P02 : So, try to explain again in your own language?
- S0302 : (silence)
- P03 : Try to say what is known from the problem!
- S0303 : Rio finished $\frac{4}{8}$ part, Dimas $\frac{15}{13}$ part, Beni $\frac{4}{6}$

- part.
- P04 : Then what is being asked about?
- S0304 : Rio and Dimas' section
- P05 : Then what is b?
- S0305 : Dimas and Beni's section

Based on the answers and interview results on question number 1, it can be concluded that students with high cognitive abilities fulfill the first component of mathematical literacy, namely formulating situations mathematically, with indicators simplifying real situations by interpreting the problem according to understanding precisely, representing the situation mathematically, using variables and symbols, and formulating the problem given into a mathematical model. Students can also fulfill the second component of mathematical literacy, namely applying mathematical concepts, facts, procedures, and reasoning with indicators of designing coherent problem solving strategies, using mathematical concepts, facts, procedures, and reasoning, and solving problems appropriately. Students can also fulfill the third component of mathematical literacy, namely interpreting the results of completion. The Soal numbers 2, 3, and 4 students do not design a solution strategy but can solve the problems appropriately and can interpret the results of the solution.

Snippets of students with moderate cognitive abilities can be seen in Figure 2 below.



Known : Rio $\frac{4}{8}$, Dimas $\frac{15}{13}$, Beni $\frac{4}{6}$
 Wanted : a. Rio and Dimas
 b. Dimas and Beni
 Answered: a. Rio + Dimas = $\frac{4}{8} + \frac{15}{13} = \frac{52+120}{104} = \frac{172:2}{104:2} = \frac{86}{52} = \frac{43}{26} = 1 \frac{17}{26}$
 b. Dimas + Beni = $\frac{15}{13} + \frac{4}{6} = \frac{90+52}{76} = \frac{142}{76} = \frac{71}{38} = 1 \frac{33}{38}$

Figure 2. Snippets of students' answers with moderate cognitive abilities

The interview snippet of students with moderate cognitive abilities is as follows.

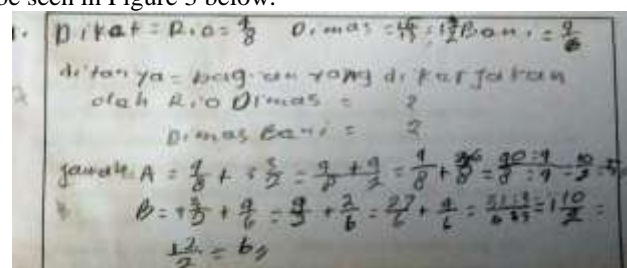
- P01 : Try to read question number 1!
- S0701 : (reading questions)
- P02 : So, try to explain again in your own language?
- S0702 : (silence)
- P03 : Try to say what is known from the problem!

S0703 : Know Rio $\frac{4}{8}$, Dimas $\frac{15}{13}$, Beni $\frac{4}{6}$
 P04 : Then what is being asked about?
 S0704 : a. Rio and Dimas continue
 b. Dimas and Beni

S2003 : Rio $\frac{4}{8}$, Dimas $\frac{15}{13}$, Beni $\frac{4}{6}$
 P04 : Then what is being asked about?
 S2004 : The part done by Rio and Dimas, Dimas and Beni

Based on the answers and interview results on question number 1, it can be concluded that students with cognitive abilities are meeting the first component of mathematical literacy, namely formulating situations mathematically, with indicators simplifying real situations by interpreting the problem according to understanding precisely, representing the situation mathematically, using variables and symbols, and formulating the problem given into a mathematical model. The student in answer (b) cannot solve the problem correctly, but in answer (a) he can solve the problem correctly. After being interviewed, students can design problem solving strategies coherently, use mathematical concepts, facts, procedures, and reasoning, and can solve problems appropriately. Students have not concluded the most appropriate problem solving results. After being interviewed, students can conclude the most appropriate problem-solving results. The Soal numbers 2, 3, and 4 students do not design a solution strategy but can solve the problems appropriately and can interpret the results of the solution.

Snippets of students with low cognitive abilities can be seen in Figure 3 below.



Known : Rio = $\frac{4}{8}$, Dimas = $\frac{15}{13} = 3\frac{3}{13}$, Beni = $\frac{4}{6}$
 Wanted: the part done by
 Rio and Dimas =?
 Dimas and Beni =?
 Answer: A = $\frac{4}{8} + 3\frac{3}{13} = \frac{4}{8} + \frac{9}{2} = \frac{4}{8} + \frac{36}{8} = \frac{40:4}{8:4} = \frac{10}{2} = 5$
 B = $3\frac{3}{13} + \frac{4}{6} = \frac{9}{2} + \frac{2}{3} = \frac{27}{6} + \frac{4}{6} = \frac{31:3}{6:3} = 1\frac{10}{2} = \frac{12}{2} = 6$

Figure 3. Snippets of students' answers with low cognitive abilities

The interview snippet of low cognitive ability students is as follows.

P01 : Try to read question number 1!
 S2001 : (reading questions)
 P02 : So, try to explain again in your own language?
 S2002 : (silence)
 P03 : Try to say what is known from the problem!

Based on the answers and interview results on question number 1, it can be concluded that students with low cognitive abilities fulfill the first component of mathematical literacy, namely formulating situations mathematically, with indicators simplifying real situations by interpreting the problem according to understanding precisely, representing the situation mathematically, using variables and symbols, and formulating the problem given into a mathematical model. In questions 2, 3, and 4 students have not completed the questions given.

Based on the results of the analysis of tests and interviews, students with high mathematical literacy abilities are able to fulfill 2 components of mathematical literacy, namely formulating mathematical situations, interpreting the results of completion, but students are able to solve problems correctly. Students with moderate mathematical abilities are able to fulfill 1 component of mathematical literacy, namely to formulate mathematical situations while solving problems there are some who cannot solve and interpret the results of students with moderate mathematical literacy abilities who have not been able to fulfill them. Students with low mathematical literacy abilities are able to meet 1 indicator, namely formulating situations mathematically, but students also cannot solve problems appropriately and interpret the results of the solutions.

The component of mathematical literacy which is fulfilled by many students is the first component, namely formulating mathematical situations. In the second component, namely applying the concept, some students cannot design completion strategies. Students are not able to provide an example to the questions so that what is written is too long. In the third component, namely interpreting the results of the solution, only students with high mathematical abilities arrive at the process of interpreting and concluding the most appropriate problem solving results.

The results of the students' mathematical literacy tests that have been analyzed are compared with the results of the literacy tests on PISA which are in accordance with relevant research, the results are not much different. Research conducted by Aini (2019) obtained the results of research, namely students with verbal linguistic intelligence and naturalist intelligence could fulfill the 3 components of literacy thinking but students with mathematical logical intelligence could not interpret into the real context of the symbols written in the conclusion. In this study, when compared with indicators of literacy thinking, students with high cognitive abilities meet 2 indicators of literacy thinking, students with moderate math abilities are able to meet 1 literacy indicator, but there are some who can solve the problem correctly, Students with low mathematical literacy abilities are able to fulfill 1 indicator of literacy thinking, but

students also cannot solve the problems correctly. These results indicate that the mathematics literacy of students in Indonesia is still low.

4. CONCLUSION

Based on the results of data analysis and discussion of the fifth grade students of SDN Darungan 01 Lumajang in solving fraction arithmetic operations, it can be concluded that of the 24 students who took the math literacy test there were 4 students who could fulfill 2 components of mathematical literacy. These students have a fairly high ability, namely being able to write down exactly what is known and asked from the questions, and formulate problems into a mathematical model. There are several questions that are able to design a solution strategy and can solve problems appropriately. Students are also able to interpret the most appropriate solutions. Meanwhile, 15 students can fulfill 1 component of mathematical literacy. Students tend to only be able to formulate situations mathematically, by writing down things that are known and asked from the questions, but does not formulate the given problem into a mathematical model. Students are not able to design a solution strategy, but there are some questions that cannot solve the problems correctly. While the other 5 students can fulfill 1 component of mathematical literacy. Overall students were only able to fulfill the first component of mathematical literacy for problem number 1, namely formulating mathematical situations, while for questions number 2,3 and 4 there were 3 students who could not formulate mathematical situations.

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