

## Analysis of mathematical literacy ability of grade VIII junior high school students in solving PISA questions on proportion material

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### Abstract

This study aims to determine the mathematical literacy ability of seventh-grade junior high school students in solving PISA Level 1 and 2 proportion materials. The research method used is qualitative descriptive. The subjects in this study were seventh-grade students at Islamic Private Junior High School in Cianjur Regency. The research subjects consisted of 20 students. The data obtained were then reduced and analyzed qualitatively by paying attention to the indicators of mathematical literacy ability. Based on the results of the study, students' mathematical literacy ability in the material is mostly at the medium category level, namely in the indicator of using problem-solving strategies.

### Keywords:

Mathematical Literacy;  
PISA;  
Junior high school  
students

## 1. Introduction

Education is important in the establishment of a developed country. The progress of a nation is not only measured by its economic level but also determined by how the development of education for the children of the nation. Progress measured in long-term time units will predict the extent of the nation's quality in the next decades. The result of a planned education is the realization of a society that is highly educated, ethical, and beneficial to its surroundings. The society of an advanced country will give birth to progress in various fields such as development, science, technology, and others (Jumarniati, et al 2021). The term education is a term that cannot be separated from learning.

Learning is a conscious effort of educators to help students learn according to their needs and interests (Arfani, 2016). Mathematics learning is a process designed to create an environmental atmosphere that allows someone to carry out mathematics learning activities, and the process is centered on teaching mathematics by involving active student participation in it (Hamzah, A., & Muhlirarini. 2014). Mathematics learning in schools should ideally be able to equip students with the ability and ability to deal with problems in everyday life (Ramadianti, et al. 2018). Learning in formal schools provides provisions for students in various fields. One of the scientific fields that students will get in formal schools is the scientific field of mathematics.

One of the characteristics of the field of mathematics is that it has abstract objects. Thus, in learning mathematics, it is found that there are students who have difficulty in understanding mathematical concepts. There are many reasons for the importance of students learning mathematics, one of which is as a means of thinking clearly and logically and playing a role in solving problems from the simplest to the most complex (Jumarniati, et al. 2021). Mathematics is a basic science that is taught at every level of education without distinguishing aspects of majors. Mathematics is a tool for developing ways of thinking (Hudojo, 2012).

Students who have been trained to develop their mindset and tend to excel in the scientific field of mathematics, are usually more critical and careful in making decisions when they are faced with a problem. According to Cockroft (in Puspitasari, 2015) mathematics needs to be taught to students because (1) it is always used in all aspects of life, (2) all fields of study require appropriate mathematical ability, (3) it is a strong, concise and concise means of communication, (4) it can be used to present information in various ways, (5) it increases the ability to think logically, accuracy and financial awareness, and (6) it gives satisfaction to the effort of solving challenging problems. From this

explanation, one of the reasons for the need for mathematics to be taught to students is that mathematics is always used in all aspects of life. Mathematics used in aspects of life is called mathematical literacy.

Mathematical literacy helps a person to understand the role and benefits of mathematics in everyday life so that it can be used to make good decisions (Kamaliyah, Z., & Darmawijoyo. (2013). In mathematical literacy, three abilities are emphasized, namely formulate, employ, and interpret. Formulating mathematics includes identifying opportunities to apply and use mathematics in solving specific problems, providing mathematical structures and representations, identifying variables, and simplifying assumptions in solving problems. Using mathematics includes applying mathematical reasoning, concepts, procedures, facts, and tools to obtain mathematical solutions which include calculations, manipulating algebraic forms, mathematical equations, and models, analyzing information from diagrams or graphs, developing mathematical explanations, and using mathematical tools to solve problems. Interpreting mathematics includes reflecting on mathematical solutions and interpreting them according to the context of the problem being solved which includes evaluating mathematical solutions and determining or checking the correctness and reasoning of the results obtained (OECD. 2013).

Mathematical literacy is said to be good if the subject can analyze, reason, and communicate his mathematical knowledge and ability effectively and can solve and interpret the solution mathematically. Mathematical literacy abilities are very important to develop in the world of mathematics education. According to Jamal (2014), students with good mathematical literacy ability must be able to estimate, and interpret existing data, solve problems in everyday life, be able to express reasons that are numerical, graphical, and geometric situations, and communicate using mathematical language (Jamal, F. (2014). One of the programs that assess mathematical literacy ability is the Programme for International Student Assessment (PISA). PISA (the Program for International Student Assessment) is a program to measure achievement for 15-year-old children in the fields of mathematics, science and reading literacy. The assessment conducted by PISA is conducted every 3 (three) years with a focus on the education of a country. The countries participating in the PISA assessment since it was first conducted in 2000 have continued to grow, recorded until 2018 from 41 to 79 countries as participants in the PISA assessment under the Organization for Economic Co-operation and Development (OECD, 2019).

According to OECD (*the Organization for Economic Cooperation and Development*), the mathematical literacy indicators of the PISA model consist of 7 indicators, namely: (1) communication, (2) mathematization, (3) restating, (4) reasoning and reasoning, (5) using problem-solving strategies, (6) using symbols, formal language and techniques, (7) using mathematical tools. The current PISA assessment has been used as a reference reference and evaluation of the quality of education of a country participating in PISA. Indonesia participated in this assessment program PISA as an effort and effort to explore the extent to which educational programs can help children to have mathematics, science, and reading literacy abilities by the standards of the international community, as well as comparing Indonesia's educational programs with countries in the world that participate in the assessment.

In addition to looking at the assessment of students' mathematical literacy ability from PISA, the assessment can be seen based on research conducted by Widiati, W., & Hidayati, N. (2021) obtained, the mathematical literacy ability of class VIII students in one of the junior high schools in Cirebon in solving mathematical literacy ability questions on triangle & quadrilateral material at levels 1, 2 and 3 in the completeness results are classified as lacking and can be seen that the average score of the totality of questions from all students is included in the low criteria. It can also be seen based on research conducted by Asmara & Rochmad (2017) obtained, students with medium and high abilities can only solve problems at level 3 while students with low abilities can only solve problems at level. The same thing was also obtained in research conducted by Fiad et al (2017) that the maximum mathematical literacy ability of students was obtained at level 3. This shows that students' mathematical literacy abilities are still low.

Various studies on efforts to improve mathematical literacy show the importance of mathematical literacy ability for students. However, there are still few studies that analyze student errors in working on Mathematical Literacy problems. The analysis of errors can help teachers identify the extent of student performance in solving problems, determine whether an error is a calculation error or a lack of understanding of a mathematical concept, and error analysis helps teachers prepare appropriate strategies, procedures, and concepts in learning to become a source of information for teachers in

preparing for learning, so knowing errors is important to do so that specific instructions can be applied in learning (Brow & Skow, 2016; Kingsdorf & Krawec, 2014).

In addition, based on the results of observations of researchers at one of the Junior High Schools (SMP) in Cianjur City that I will study, most students working on math problems make calculation errors or there is a lack of understanding of a mathematical concept and are not accustomed to solving problems that are not the same as the procedures learned. If students are given problems with different patterns from the examples taught, then students will find it difficult, especially in solving proportion problems. Thus, researchers are interested in researching Junior High School (SMP) students to know mathematical literacy ability and analyze mathematical literacy ability seen from student errors in working on problems on social arithmetic material.

## 2. Method

The type of research used is descriptive research with a qualitative approach. Descriptive qualitative research is a research method that utilizes qualitative data and is described descriptively. Researchers use qualitative research because it aims to describe the mathematical literacy of VII grade junior high school students on proportion material, as well as the results of interviews as a form of confirmation of student answers. The location chosen in this study was at Isalam Junior High School in Cianjur City. The reason for choosing the school is because it is by the required research objectives, namely grade VII students at the school are studying proportion material, and the number of research subjects is 20 students.

The instruments used in this research are tests and non-tests. The test is in the form of student mathematical literacy questions, while the non-test is an interview. The test used in this research is a written test in the form of a description question. In the description test, students are required to be able to express ideas to solve problems in written form. The consideration of choosing a description test in this study is in line with the purpose of this study, namely to determine students' mathematical literacy in solving proportion problems. The test questions used in this study are questions taken from PISA level 1 and level 2 questions. The type of interview used in this study is a semi-structured interview. The interview guidelines in this study are in the form of questions to find out in depth the mathematical literacy of students and questions can be developed according to the answers of the research subjects.

## 3. Results and Discussion

### 3.1 Results

Based on the results of the analysis that has been carried out by researchers on students' answers in working on mathematical literacy questions, it is obtained that the category of students' mathematical literacy assessment on proportion material is classified in the moderate category presented in Table 1.

Table 1

*Mathematical literacy skill levels*

Interval	Category	Frequency	%
78-100	High	2	10%
37-77	Medium	15	75%
0-36	Low	3	15%
Total number of students		20	100 %

Based on Table 1, the percentage score of the test results of mathematical literacy ability in solving PISA math problems for these students is 15% in the low category, 75% in the medium category, and 10% in the high category. This means that the average test results of mathematical literacy ability in solving PISA math problems in class VII are in the medium category.

To measure mathematical literacy ability in detail, it is necessary to explain based on the indicators. The following Table 2 shows the percentage of students' answers seen from the indicators of students' mathematical literacy ability from each question indicator.

Table 2  
*Percentage of Answers for each Indicator*

Indicators	Question Number 1	Question Number 2	Question Number 3	Question Number 4
Communication	40%	70%	90%	55%
Mathematization	30%	75%	85%	50%
Re-Presenting	10%	60%	80%	45%
Reasoning And Reasoning	5%	50%	90%	45%
Using Problem-Solving Strategies	40%	65%	100%	90%
Using Symbols, Formal Language And Techniques	35%	45%	85%	85%
Average	26,7 %	60,83 %	88,3 %	61,7 %

Based on Table 2 in question 1, the indicator with the highest percentage of achievement is the communication indicator and using problem-solving strategies 40%, while the indicator with the lowest percentage is the indicator of reasoning and giving reasons 5%. In question number 2, the indicator with the highest percentage is the 75% mathematization indicator, while the indicator with the lowest percentage is the indicator using symbols, formal language, and techniques 45%. In question number 3, the indicator with the highest percentage is the indicator of using problem-solving strategies at 100%, while the indicator with the lowest percentage is the indicator of restating at 80%. In question number 4, the indicator with the highest percentage is the indicator of using problem-solving strategies at 90%, while the indicator with the lowest percentage is the indicator of restating and the indicator of reasoning and giving reasons at 45%.

The average percentage of achievement of overall mathematical literacy indicators can be seen in Table 3.

Table 3  
*Average Percentage of Achievement of Mathematical Literacy Indicators*

Indicators	Percentage of Indicator Achievement
Communication	63,75 %
Mathematization	60 %
Re-Presenting	48,75 %
Reasoning And Reasoning	47,5 %
Using Problem-Solving Strategies	73,75%
Using Symbols, Formal Language And Techniques	62,5 %
Average	26,7 %

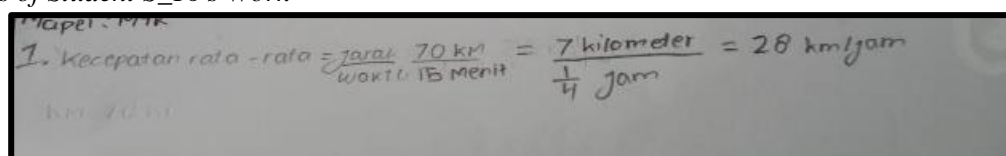
Based on Table 3, it shows that the highest average percentage of achievement of overall mathematical literacy indicators is the indicator of using problem solving strategies of 73.75%. This means that almost all students have been able to re-present well in working on proportion questions on the mathematical literacy test.

Meanwhile, the lowest percentage of overall achievement of mathematical literacy indicators is the indicator of reasoning and giving reasons of 47.5%. This means that almost all students have not been able to reason and reason well in working on proportion questions on the mathematical literacy test. The following will present the results of student work on the question of students' mathematical literacy ability on proportion material based on these mathematical literacy indicators:

One of the answers of student S\_16 on question no. 1 of mathematical literacy in Figure 1.

Figure 1

*Results of Student S\_16's Work*

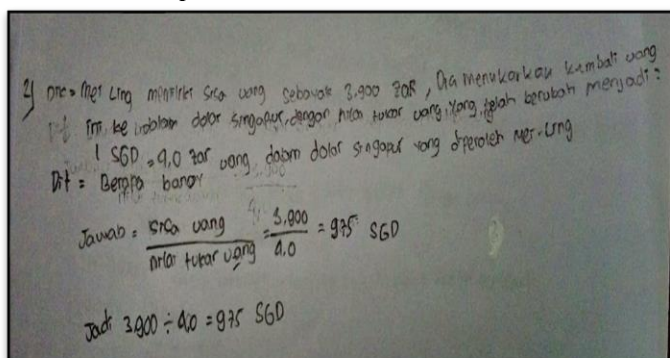


The results of the analysis of student answers per Figure 1, it can be seen that student S\_16 has been able to fulfill the five indicators of mathematical literacy in question no. 1, namely: (1) Communication (students can express mathematical ideas in writing), (2) Representing (students can show reciprocal relationships and use representations according to the situation and purpose), (3) Reasoning and reasoning (students can make mathematical arguments that are logical and can be justified), (4) Using problem-solving strategies (students can make appropriate solution plans) and (5) Using symbols, formal language, and techniques (students can use mathematical symbols by using arithmetic operations), it's just that student S\_16 has not been able to mathematize indicators.

Meanwhile, an example of student S\_6's answer to question no. 2 on mathematical literacy is presented in Figure 2.

Figure 2

*Result of Student S\_6's Workmanship*

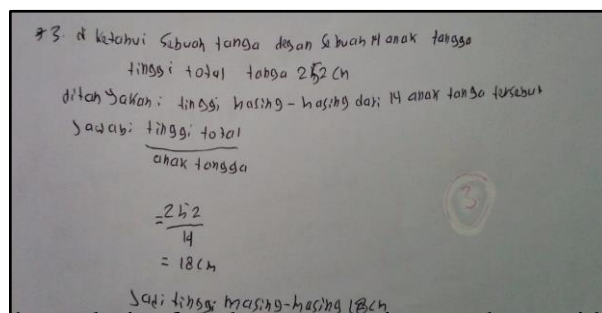


The results of the analysis of student answers in accordance with Figure 2, it can be seen that student S\_6 has been able to fulfill the indicators of mathematical literacy in question no. 2, namely: (1) Communication (students are able to express mathematical ideas in writing), (2) Mathematization (students are able to present mathematical phenomena in the form of mathematical models), (3) Representing (students can show reciprocal relationships and use representations according to the situation and purpose), (4) Reasoning and reasoning (students can show the conclusion of a statement and explain logically) (5) Using problem solving strategies (students can solve problems and conclude them) and (6) Using symbols, formal language, and techniques (students are able to use mathematical symbols by using arithmetic operations).

One of the results of student S\_7's answer to question no. 3 on mathematical literacy is presented in Figure 3.

Figure 3

*Student S\_7's Work Result*

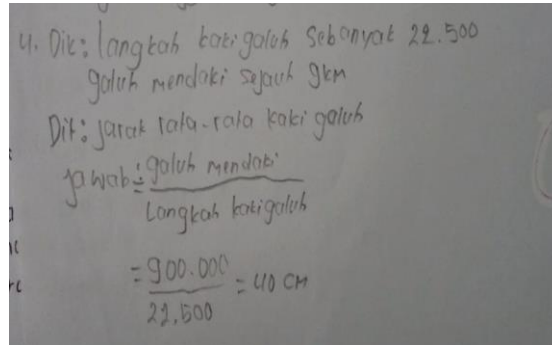


The results of the analysis of student answers in accordance with Figure 3, it can be seen that student S\_7 has been able to fulfill the indicators of mathematical literacy in question no. 2, namely: (1) Communication (students are able to express mathematical ideas in writing), (2) Mathematization (students are able to present mathematical phenomena in the form of mathematical models), (3) Representing (students can show reciprocal relationships and use representations according to the situation and purpose), (4) Reasoning and reasoning (students can show the conclusion of a statement and explain logically) (5) Using problem solving strategies (students can solve problems and conclude them) and (6) Using symbols, formal language, and techniques (students are able to use mathematical symbols by using arithmetic operations).

One of the answers of student S\_9 on question no 4 of mathematical literacy is presented in Figure 4.

Figure 4

Results of Student S\_9's Work



The results of the analysis of student answers per Figure 4, it can be seen that student S\_9 has been able to fulfill the indicators of mathematical literacy in question no. 2, namely: (1) Communication (students can express mathematical ideas in writing), (2) Mathematization (students can present mathematical phenomena in the form of mathematical models), (3) Representing (students can show reciprocal relationships and use representations according to the situation and purpose), (4) Reasoning and reasoning (students can show the conclusion of a statement and explain logically) (5) Using problem-solving strategies (students can solve problems and conclude them) and (6) Using symbols, formal language, and techniques (students can use mathematical symbols by using arithmetic operations).

### 3.2 Discussion

Based on the results of the percentage of students correct answers that have been described, each indicator is then averaged to get a percentage of 75%, which means that according to the mathematical literacy category, it is included in the moderate category. Some indicators of mathematical literacy have been considered capable of being fulfilled by students, including the indicator of using problem-solving strategies of 73.75%. The percentage is included in the high category according to the categorization of students' mathematical literacy because students have been able to be able to re-present well in working on proportion problems on the mathematical literacy test.

Students have been able to meet the 63.75% communication indicator, using symbols, formal language and techniques 62.5%, mathematizing 60%, restating 48.75% and the lowest percentage of the overall achievement of mathematical literacy indicators is the indicator of reasoning and reasoning 47.5%, meaning that almost all students have not been able to reason and reason well in working on proportion questions on the mathematical literacy test. This is in line with research by Kholifasari, R., et al. (2020) that mathematical literacy ability is still low in the indicators of *reasoning* and *argument*

### 4. Conclusion

Based on the results of research and discussion about the mathematical literacy of junior high school students on proportion materials in solving mathematical literacy test questions taken from PISA, it is found that most students' mathematical literacy abilities are in the moderate category. Based on students' ability, students' mathematical literacy indicators are in the indicator of using problem-solving *strategies* (*Devising strategies for solving problems*).

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