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ANALYSIS OF STUDENT'S ABILITY TO SOLVE MATHEMATICAL LITERACY PROBLEMS IN JUNIOR HIGH SCHOOLS IN THE CITY AREA

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ABSTRACT

Mathematical literacy problems require counting and solving mathematical problems in daily life. This study aims to analyze the ability of junior high school students to solve mathematical literacy problems. This qualitative research uses a case study approach with the subject of 15 junior high school students in the city area. The instrument in this study is six mathematical literacy questions oriented to PISA test questions and interview guidelines. The data analysis technique in this study is thematic analysis. This study's results show three groups of students' abilities in solving mathematical literacy problems based on their initial abilities: Time Stone, Power Stone, and Mind Stone.

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1. INTRODUCTION

Mathematics is a universal science that benefits all aspects of human existence, forms the basis of contemporary technological advancement, plays a part in many academic fields, and can enhance cognitive abilities (Ashim et al., 2019; Mardhiyana, 2015). Students' ability in mathematics is measured by their ability to count and reason logically and critically when solving problems (Fathani, 2016; Indrawati & Wardono, 2019; Masjaya & Wardono, 2018). "Mathematical literacy," which is characterized as a person's capacity to formulate, utilize, and comprehend mathematics in a variety of life circumstances, is the ability to solve mathematical problems (Anwar, 2018; Fajriyah, 2018; Fathani, 2016; Sari & Wijaya, 2017; Setiawan et al., 2014).

Mathematical literacy is ensuring that all students comprehend mathematics and how to relate it to the actual world to use mathematical information and make intelligent decisions that impact their life, job, and society (Botha & van Putten, 2018; Pillai et al., 2017). Any mathematics literature will make students critical thinkers in understanding concepts and applying them to real-world problems (Abdullah & Richardo, 2017; Anwar, 2018; Fathani, 2016; Permanasari, 2016; Rachmantika & Wardono, 2019; Sukmawati, 2018). Mathematical literacy skills are needed to solve problems mathematically that are closely related to the context of life (Janah et al., 2019; Malasari et al., 2017). The existence of this mathematical literacy ability can help students solve problems because, in using it, they are required to think systematically, conceptually, and causally (Baharuddin et al., 2022; Hwang et al., 2018; Sari et al., 2017; Setiani et al., 2018).

Every student must be able to solve issues in the form of story problems as part of their mathematical literacy (Purnama & Suparman, 2020). Since the student utilizes such skills to solve all his life difficulties involving numerous complicated parts and problems, they are not simply employed to solve mathematical concepts, addressing whether learning only requires cognitive aspects. Thus, it is thought that pupils should be able to grasp this skill.

But in fact, the research results by Sari and Wijaya (2017) show that student literacy levels are still poor and that pupils do not possess the three information literacy skills: identifying the needed information and locating and assessing its quality, and effectively sharing information candidly. According to research results from the 2011 Trends International Mathematics and Science Study (TIMSS), this assertion is accurate (Janah et al., 2019), which showed that the achievement of Indonesian students in mathematics was at the level of 45 out of 50 participants (Noviana & Murtiyasa, 2020).

The Programme for International Student Assessment is used to gauge students' proficiency in mathematics (PISA) (Anggoro et al., 2019; Dores & Setiawan, 2019; Hewi & Shaleh, 2020b; Noviana & Murtiyasa, 2020; Ridzkiyah & Effendi, 2021). Several countries that are a part of the Organization for Economic Cooperation and Development (OECD), headquartered in Paris, France, developed the PISA survey (Hewi & Shaleh, 2020a). Since 2000, Indonesia has taken part in the PISA assessment program. This international initiative, which assesses reading, math, and scientific literacy, is conducted every three years. The involvement of the Indonesian nation in the PISA research is being undertaken to evaluate Indonesian pupils' literacy proficiency, which is far from satisfactory compared to other countries (Mahdiansyah & Rahmawati, 2014). PISA data from 2000 revealed that Indonesian students' proficiency in mathematics was still only moderate, with an average score of 367, placing Indonesia 39th out of 41 participants. Meanwhile, the 2003 PISA results, followed by 40 countries, put Indonesian students in 38th place with an average score of 360. These two outcomes are not significantly different from the PISA outcomes from the ensuing years (2006, 2009, 2012, 2015, 2018), which put Indonesia at the bottom.

PISA creates a variety of questions based on the following four contents: change and relationship, shape and Space, quantity, and uncertainty and data (Dores & Setiawan, 2019). According to PISA, There are six stages of pupils' proficiency in mathematics (Setiawan et al., 2014), as described in Table 1.

Table 1. Mathematics literacy ability level according to PISA

Level	Student Abilities
1	Students can use their knowledge to address common problems and problems with a broader context.
2	Students can interpret problems and solve them with formulas.

Level	Student Abilities
3	Students are competent at following instructions and selecting problem-solving techniques.
4	Students may choose and incorporate many representations, work well with models, and then relate those representations to the real world.
5	In addition to tackling complex problems, students can work with models for difficult circumstances.
6	Students can utilize their reasoning to generalize, draw conclusions, and discuss the outcomes of their research while still solving mathematical problems.

Due to the PISA results and the low mathematical literacy ability of Indonesian students, researchers did a study to examine the mathematical literacy ability of junior high school students who were PISA-oriented. Some researchers choose the content of numbers because the operation of numbers is an essential aspect of learning mathematics. If the student's ability in the number of materials is low, it will affect the sub-material in other PISA content. This is supported by Noviana and Murtiyasa (2020), which assert that the direct approach to describing and measuring various items in quantity includes evaluating correlations and changes, gathering and analyzing data, and gauging certainty. This allows modeling of the situation to test Space and shape, relationships and change, uncertainty and data (Noviana & Murtiyasa, 2020).

Additionally, compared to other content, the outcomes of mathematical literacy in terms of content amount are still relatively low. The study's findings by Patriana et al. (2021) indicated that all PISA content requires low levels of mathematics proficiency. The same thing was conveyed by Hasnawati (2016), which showed that Space and Shape had the lowest average score for student accomplishment, with an average score of 36.57, and that the most significant domain for student achievement was Change and Relationship, with an average score of 37.75 for each topic. Research Mahdiansyah and Rahmawati (2014) also demonstrates that pupils' achievement in mathematical literacy is still somewhat low, at 24.9, in terms of content amount. Achievement levels were 32.8, 26.8, and 25.7, respectively, in the content areas of uncertainty, data, change and relationship, and Space and shape. In light of this, it can be said that the PISA content quantity is still relatively low. As a result, this study aims to examine junior high school students' aptitude for solving mathematical literacy issues.

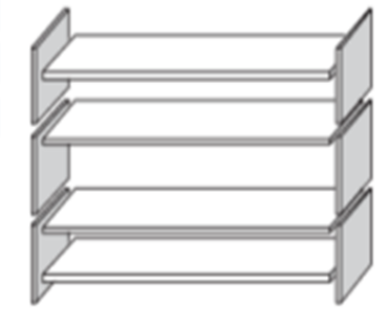
2. METHOD

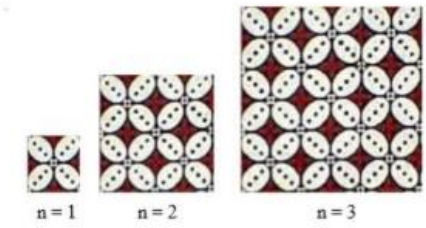
The qualitative research design for this study employed a case study research methodology. Fifteen students from five different Lubuk Sikaping schools participated in this study in West Sumatra and were observed as they attempted to solve mathematical literacy challenges. Purposive sampling, which is the method of choosing samples with specific considerations, is used to choose the subject of the study. Students with various skills are selected (high, medium, and low). The teacher-administered midterm exam reveals the pupils' aptitude. The information employed in this study is quantitative, derived from student math literacy test results, and qualitative, derived from interview responses.

Six literacy test questions based on PISA-oriented math problems on quantity and content serve as the study's research tool. This study's topic of choice is numerical data. Because the operation of numbers is a crucial component of learning mathematics, researchers focus on the substance of numbers. This is supported by research Noviana and

Murtiyasa (2020). It claims if a student's aptitude for the number subject is low, it will impact the sub-material in other PISA subjects. Questions on PISA adapted from previously published research articles, notably Noviana and Murtiyasa's study, cover all levels. The gathered mathematical literacy questions for the amount of content are shown below (Noviana & Murtiyasa, 2020), which can be seen in Table 2.

Table 2. The mathematical literacy problem of quantity content

No	Mathematical Literacy Problems
1	You make your salad dressing. This is the recipe for 100 mL of sauce. Salad Oil: 60 ml Vinegar: 30 ml Soy Sauce: 10 ml For a 150 mL batch of sauce, how many milliliters of salad oil are required? (Level PISA: 1, context: personal, process: formulate)
2	Jenn works in a place that rents out video games and DVDs. The annual membership price in this store is 10 zeds. As can be seen in the following table, members pay less to rent DVDs than non-members do: Non-member rental fee for one DVD: 3,20 zeds DVD rental fee for members: 2,50 zeds What is the bare minimum members must rent to make up the cost of their membership dues? Could you show me your work? (Level PISA: 2, context: personal, process: formulate).
3	The carpenter will need the following supplies to complete a set of bookcases: Four long wooden panels, six short wooden panels, twelve little clips, two large clips, and fourteen screws are now in the carpenter's inventory. Additionally, he has 510 screws, 20 large pins, and 200 little clips. How many sets of bookcases can a carpenter construct? (Level PISA: 3, context: educational and occupational) 
4	A simple pizza with cheese and tomato as toppings is available in pizzerias. Additionally, you can customize your pizza by adding other toppings. Bacon, ham, mushrooms, olives, and more topping options are available. Ross wished to have two different topping combinations on his pizza. How many possible combinations does Ross have? (Level PISA: 4, context: educational and occupational)

<table>
<tr><th>No</th><th>Mathematical Literacy Problems</th></tr>
<tr><td>5</td><td>As stated in the table, a milk factory in Bandung can produce milk daily with a fixed pattern within 10 days. Mr Amin is an employee of the dairy factory inspecting table damage.
<table>
<tr><th>Day to</th><th>Number of Productions</th><th>There were lots of table malfunctions.</th></tr>
<tr><td>1</td><td>1500</td><td>30</td></tr>
<tr><td>2</td><td>1400</td><td>28</td></tr>
<tr><td>3</td><td>1550</td><td>31</td></tr>
<tr><td>4</td><td>1500</td><td>30</td></tr>
<tr><td>5</td><td>1600</td><td>32</td></tr>
<tr><td>6</td><td>1600</td><td>32</td></tr>
</table>
How much Mr Amin found production and table damage on the 10th day? (Level PISA: 5, context: occupation)</td></tr>
<tr><td>6</td><td>The following picture is a Javanese batik motif.
 

For fabrics with an area of 6 cm^2, 1 piece of white flower consisting of 4 petals is painted, then for a material of 12 cm^2, 4 parts of a white flower are painted, and so on. Several white flowers = n^2 and area of fabric = 6^n if n is the number of rows of white flowers. If the fabric used is getting more comprehensive with the same white floral motif as the previous pattern, which one increases faster: the number of white flowers or the area of the fabric? Prove and explain your answer! (Level PISA: 6, context: occupation)</td></tr>
</table>

After fifteen students were asked to answer the above six problems, they were interviewed about their answers. The interview strategy is known as the semi-structural strategy. This is based on research from Harisman et al. (2021), this used a technique for conducting interviews known as the semi-structural method. The section rubrics in Table 3 were utilized to evaluate the student's responses (Noviana & Murtiyasa, 2020).

Table 3. Maximum score for each question

Question	Indicators	Maximum Score
1 and 2	Formulating the situation mathematically	10
3 and 4	Reasoning	15
5 and 6	Solving problems	25

The data were evaluated and graded based on the evaluation criteria stated in Table 3 and using mentally accurate replies. The results of the interview analysis were then used to determine the student's conduct from the data.

3. RESULT AND DISCUSSION

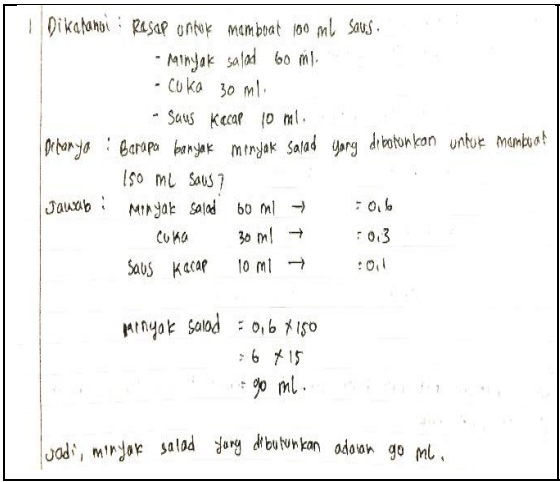
The math literacy skills of the junior high school students at Lubuk Sikaping are described in this section. The labels H for high ability, M for medium class, and L for low ability are given to students. S-1 stands for the first school, S-2 for the second, S-3 for the third, S-4 for the fourth, and S-5 for the fifth. Table 4, which lists the names and abilities of students in each school.

Table 4. Student labels of student for each school

Student School Origins				
School one (S-1)	**School two (S-2)**	**School three (S-3)**	**School four (S-4)**	**School five (S-5)**
FA (H)	DA (H)	RZ (H)	DA (H)	HB (H)
AI (M)	RO (M)	CT (M)	MK (M)	BY (M)
DT (L)	AN (L)	FZ (L)	AG (L)	RI (L)

Labeling is done to group students more efficiently according to knowing mathematical literacy skills in the final item. Student representatives who have the same response to the first question and the same responses to the other questions are given the data description. The description concludes with a summary of the study's findings for each institution student. Based on the labels already provided above, the mathematical literacy abilities of the students will be described. Here is a summary of the student's mathematical formulations of the situation (Level 1 PISA).

Figure 1 shows the results of student work that the student has a relatively high ability to formulate situations mathematically.



Translation:

Given	Recipe for making 100 ml of sauce -Salad oil 60 ml -Vinegar 30 ml -Soy sauce 10 ml
Question	How much is salad oil needed to make 150 ml of dressing?
Answer	Oil salad 60 ml = 0,6 Vinegar 30 ml = 0,3 Soy sauce 10 ml = 0,1 Oil salad = 0,6 x 150 = 6 x 15 = 90 ml
	So, the salad oil needed is 90 ml

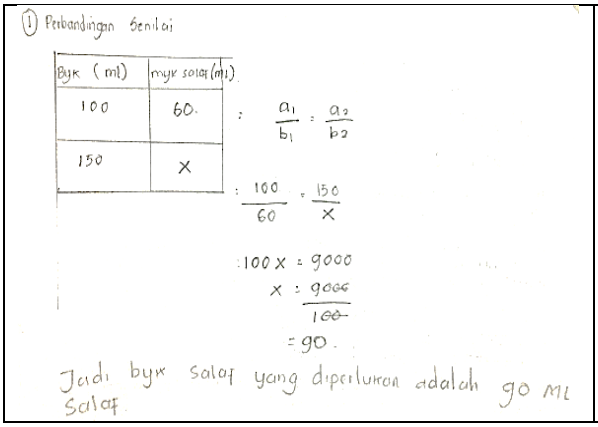
Figure 1. Student answers HS-3

Figure 1 shows that the student has written down the available information on the question in total and can make conclusions about the question. The students' answers are all correct, indicating that they have read the questions thoroughly so that they can answer the questions from the questions. The following are the results of the interview that match the statement above:

P : What information do you get on the question?
HS-3 : Recipe for making 100 ml of sauce
P : What is being asked about it?

HS-3 : The amount of salad oil for 150 mL of sauce
P : How are you going to solve the problem?
HS-3 : Multiplied as usual.

The next step is the analysis of the answers to the first question given by different students from different schools, as shown in Figure 2.



Translation:
Worth Comparison

Many (ml)	Oil salad (ml)
100	60
150	x

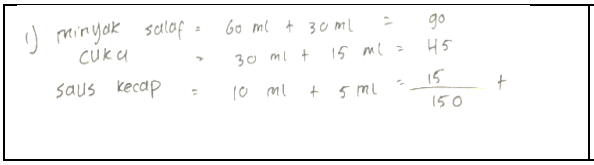
$\frac{a^1}{b^1} = \frac{a^2}{b^2}$
$\frac{100}{60} = \frac{150}{x}$
$100\,x = 9000$
$x = \frac{9000}{100}$
$x = 90$
So, the salad oil needed is 90 ml

Figure 2. Student answers HS-1

Figure 2 demonstrates that the student has noted the information about the question and can draw conclusions about it. This is evident from the answer sheet; students can deduce the data from the tables and respond to questions using a grade comparison. The pupils' answers are accurate, showing that they have carefully read, comprehended, and been able to respond to the question. The outcomes of the HS-1 interview process are listed below.

P : What information do you get on the question?
HS-1 : Recipe, mam
P : What is being asked about it?
HS-1 : Plenty of salad oil to make 150 mL of salad sauce.
P : How do you solve the problem?
HS-1 : By using a comparison method, mam

The interview results and the student's responses indicate that HS-1 pupils have reasonably excellent mathematical literacy skills, demonstrating that they comprehend problems and have effective problem-solving techniques. Additionally, Figure 3 shows the responses from HS-4 students for other diverse solutions.



Translation:
Oil salad = 60 ml + 30 ml = 90
Vinegar = 30 ml + 15ml = 45
Soy sauce sauce = 10 ml + 5 ml = 15 +
150

Figure 3. Student answer HS-4

Figure 3 demonstrates how poorly the pupils comprehend the issue. This is evident from the answer sheet: students cannot discern questions from the questions and do not record general information, so the children do not comprehend the problem. The interview's findings that support the previous assertion are as follows.

P : What information do you get on the question?
HS-4 : How to Prepare Sauce Powder
P : What is being asked about it?
HS-4 : The amount is mam
P : How do you solve the problem?
HS-4 : Summing them up, mam

HS-4 learner answers, HS-4 does not understand the problem, so it cannot answer the question correctly. The next question is done with the same treatment as the first question. Low-skilled students tend not to write down in detail what is asked and the strategies used in solving the problem. Moderately capable students tend to identify issues well, but some students cannot answer correctly and make many miscalculations. Students with high mathematics skills tend to do better because they can accurately calculate and identify problems.

Based on the above description, it is known that students with low, medium and high abilities have different levels of ability. Although it does not meet all indicators of mathematical literacy, students can already understand and solve the problem's meaning. This aligns with research conducted by Kafifah et al. (2018), which states that some students can interpret and solve problems and even communicate the correct answers. This is in line with how the Draft Assessment Analytical Framework defines mathematical literacy, which is the capacity for people to formulate, use, and comprehend mathematics in various circumstances. This shows that acquiring knowledge, articulating, solving, and understanding issues based on logic using existing concepts and facts and following suitable methods are all aspects of mathematical literacy.

The study's findings aim to identify the skills held by fifteen junior high school pupils. After reviewing the assignments and creating interview transcripts for each student, in this paper, the students' mathematical literacy skills are collected into three groups, namely: the Time Stone, the Power Stone, and the Mind Stone. Time Stone is a term for students who have low initial ability but have moderate literacy skills; Power Stone is a term for students who have the medium early ability but have high literacy skills; and finally, Mind Stone is a designation for students who have increased initial capabilities but have moderate literacy skills. The results of the above analysis showed 15 students from 5 different schools with different initial abilities also entered the category, including 3 students who had low initial knowledge and low mathematical literacy ability as well, 2 students in the Time Stone category, 4 students with the medium ability and moderate mathematical literacy ability, 1 student in the Power Stone category, 1 student with high initial knowledge and high literacy ability, and 3 students in the Mind Stone category. From the analysis results, it can be concluded that students with high initial abilities do not necessarily have high literacy skills. This follows the results of Kafifah et al. (2018) that the mathematical literacy ability of students with high, medium, and low initial abilities is still below average, so it can be suggested to increase literacy questions regarding mathematical literacy skills in students.

Researchers in the future will be able to assess students' mathematical literacy skills using the findings of this analysis, and teachers will be able to enhance teaching strategies in the classroom using the results as a guide. The teachers should be aware of students' learning preferences and modify their teaching techniques (Noviana & Murtiyasa, 2020; Putra et al., 2016; Syawahid & Putrawangsa, 2017). Mathematical literacy skills must also be developed during learning (Afriyanti et al., 2018; Madyaratria et al., 2019; Mardiana, 2018). The one of the essential life skills is mathematics literacy. It is a fundamental ability that is equally important to have as reading. As a result, mathematics instruction in schools

must focus on fostering mathematical literacy and improving each student's capacity to use and apply mathematics to real-world issues or circumstances (Dahm & De Angelis, 2018; North, 2017; Sumirattana et al., 2017; Tokada et al., 2017). According to Wati et al. (2019), if students possess mathematical literacy abilities, they will be able to recognize mathematical elements in the context of real-world problems and recognize known variables, math models, and problem-solving techniques, as well as design and put into practice solutions-seeking strategies and determine facts, procedures, algorithms, and mathematical models (Kariman et al., 2019). Math results back into real-life contexts and assessing mathematical solutions in real-life contexts (Khanifah et al., 2019; Mutia & Effendi, 2020; Zahroh et al., 2020). Students' literations ability depend on teachers' and student background (Harisman et al., 2020).

4. CONCLUSION

Following work review and the creation of recordings of each student's interview outcomes, this paper grouped students' mathematical literacy abilities into three groups: the Time Stone, Power Stone, and Mind Stone. Students with low initial abilities but moderate literacy skills are referred to as Time Stones; students with medium initial abilities but high literacy skills are referred to as Power Stones; and students with high initial abilities but moderate literacy skills are referred to as Mind Stones. The Power Stone is the initial ability of medium students but has high literacy skills. The last one, the Mind Stone, is for students with high initial abilities but moderate literacy abilities.

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