The Mathematical Literacy Ability of Level 3 Students in Solving PISA-liked Problems at Mathematics-Class Program of MAN 1 Jember

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Abstract
This study aims to describe students' mathematical literacy ability of grade 10 in solving PISA-liked Problems. The students' abilities were seen from 7 mathematical literacy competencies in the solving PISA problems. The research subjects were 3 students of grade 10 of the EKA Mathematic Program, Class A, in MAN 1 Jember at level 3. The method in collecting data was tests, interviews, and documentation. The data analysis used Miles and Huberman data analysis which consists of data collection, data condensation, data display and conclusion. The data is validated using subject triangulation. The results of this study indicated that students at level 3 show good criteria in the communication aspect; mathematization; representation; reasoning and argument; and they were able to choose strategies in solving PISA-liked problems. There are some skills that did not use in solving mathematical literacy, in this case, which is using correct symbols and mathematical tools. Even though level 3 students failed in this skills and failed in use a correct unit, mentally, they success to find the correct solution. Students with mathematical literacy skills at level 3 were categorized as intermediate students who can solve moderate and low level of problems; however, they still had difficulties in solving very high-level problems.

Keywords: mathematical literacy, problem solving, PISA-liked problems

Introduction

Education is one of the main pillars in facing future challenges. The role of education is needed to answer the paradigm in the 21st century, namely students are expected to have the ability to think critically, creatively, analytically, communicatively, able to connect science with the real world, and master technology and information. One of these abilities can be obtained through learning mathematics which nowadays these competencies relate to mathematical literacy. While, mathematical literacy is important for individuals to develop logical thinking and reasoning strategies in their everyday activities.

Mathematics is a scientific discipline that underlies the development of technology in the modern era and can develop students' thinking patterns, namely high-level thinking patterns. Mathematics needs to be associated with life; this makes mathematics is not considered as a subject but more on human activities (Septiadi, 2018). Rizki and Priatna stated that "Mathematical literacy is one of the needed-components to

construct the 21st century skills" (Rizki, LM, and N Priatna, 2019). Based on this opinion, mathematics has an important role in developing 21st century skills, namely developing abilities in terms of mathematical literacy.

Literacy means the ability in terms of writing and reading, namely the ability that is useful in society to achieve one goal, and to develop the knowledge and potential of students (Kirsch, 2001). Further, the term literacy does not only imply about knowledge, but also the ability to apply that knowledge (Thomson et al, 2013). Mathematical literacy is a method used to estimate, describe, and solve problems in everyday life, as well as provide numerical, graphic, and geometric reasons that are compiled by communicating using mathematics (Ojose, 2011). For more, probably we need mathematical literacy to solve problems and make sense of numbers, time, patterns and shapes for activities like cooking, reading receipts, reading instructions and even playing sport. The international surveys that measure the level of mathematical literacy skills in the world are PIRLS, TIMSS, and PISA.

PISA (Program for International Student Assessment) is an official international activity organized by the *Organization for Economic Corporation and Development* (OECD) to see how far the achievement of 15 years-old students in acquiring skills in reading literacy, mathematical literacy, and scientific literacy so that they can contribute in public life (Wilkens, 2011). The survey conducted by PISA is in the form of a survey with questions in the form of traditional multiple-choice items, complex multiple-choice items, closed-constructed response items, short-response items, open-constructed response items (Shiel, 2007). In addition to these questions, mathematicians have also developed PISA model questions that can be used to measure students' mathematical literacy skills. The role of mathematical literacy can help students to understand the usefulness of mathematics in every aspect of life and use it to solve problems in life (Wardono, 2020). We need numeracy to solve problems and make sense of numbers, time, patterns and shapes for activities like cooking, reading receipts, reading instructions and even playing sport. This is the reason that makes mathematical literacy very important for students to have. Therefore, mathematical literacy is important to prepare students to face the challenges of the 21st century.

Mathematical literacy consists of 6 levels, namely level 1 to level 6. The higher the level, the more complex the problems presented (OECD, 2019). In term of the question, level 1 to level 3 is classified as Low Order Thinking (LOT) questions.

Meanwhile, questions at level 4 to level 6 are classified as Higher Order Thinking (HOT) questions (Setiawan, 2014). This level also happens for students' mathematical numeracy ability stages which consist of 6 levels. Students in certain level own their ability in solving the literacy problems. To find out students' mathematical literacy level, Ross Turner uses seven competencies which must be owned by students. Those are communication; mathematizing; representation; reasoning and argument; strategic thinking; and use symbols, formal and technical language and operations (Turner, 2010). The level of students' mathematical literacy skills also explain is also explained by MEB (2007, 2010, 2013) at table 1 below:

Table 1. Students' Level of Mathematical Literacy Skills

Level s	Points	Competencies
Level 1	358-419 points	The students at this level can answer questions where all relevant information is present and the questions are clearly defined.
Level 2	420-481 points	The students at this level students are considered to be sufficient in processes that require conclusion from one or more propositions. They can employ basic algorithms and formulate
Level 3	482-543 points	The students at this level can execute clearly described procedures, including those that require sequential decisions.
Level 4	544-605 points	The students at this level can carry out actions by using pre-defined models when there are complex and concrete problem situations that may involve constraints and assumptions.
Level 5	606-667 points	The students at this level can develop and work with models for complex situations. They can identify constraints and specify assumptions regarding the models they develop. They can select, compare, and evaluate different strategies when they face complex problems.
Level 6	668-1000 points	The students at this level can conceptualise, generalise and utilise information based on their investigations and modelling of complex problem situations. They can develop new and different approaches and strategies for the solution of the novel problems.

According to table 1, then it is used to expand students' competencies in solving mathematical literacy problems.

In MAN 1 Jember there is a specific program on studying mathematics that called as the EKA Mathematics-Class Program. This program consists of 12 students who have high score in regular class and high motivation in studying mathematics. The small of classes because of the concern of the school to provide in deep class in math and well-organized class for the learning activities. However, from 12 students, there are 3 students who got level 3 in PISA-liked test simulation which can be said as lower order thinking groups. Therefore, this study will discuss the mathematical literacy skills of student's level 3. It aims to describe the ability of level 3 students in MAN 1 Jember which can be used as evaluation of the program.

Methods

This study uses a qualitative descriptive method, which is to describe level 3 students' mathematical literacy skills in solving PISA-liked problems. Data was collected using test, interview, and documentation. This also part of triangulation to find the validity of the data. The test instrument used in this study was the PISA-liked problems in the theme of Jember local wisdom which had been developed by Septiadi (2019). The developed problems can be said as valid with the validity score of 0.77. Interview instruments were used to see more deeply about the mathematical literacy abilities of students. The subject in this research consist of 3 students come from level 3 in MAN 1 Jember grade 10 EKA Mathematics-Class Program. The data obtained from those 3 students was analyzed based on the competencies used to measure mathematical literacy, namely communication (A1); mathematization(A2); representation(A3); reasoning and argument(A4); choose a strategy to solve the problem(A5); use symbolic, formal, and technical language and operations(A6); and using mathematical tools(A7). These competencies, as can be seen at Table 1, then used to measure students' abilities in solving PISA-liked problem. Researchers analyzed the data using the method proposed by Miles, Huberman, and Saldana (Miles, 2014).

Table 2. Indicators to Measures Students' Ability in Solving PISA-liked Problems

Codes	Competencies	Indicators
A1	Communication	Students can reflect on their actions, formulate, and communicate their actions appropriately and describe in relation to their findings, interpretations, opinions, and conformity to real situations.
A2	Mathematising	Students can conceptualize, generalize, and use information based on analysis and modeling in complex situations and can use above-average knowledge.
A3	Representation	Students can link different sources of information and represent, and translate between them flexibly.
A4	Reasoning and argument	Students at this level have the ability to think and reason to give precise reasons for the results of the solution.
A5	Devising strategies for solving problems	Students can apply knowledge, mastery, and relationships of mathematical symbols and operations, developing new strategies and approaches to deal with new situations.
A6	Using symbolic, formal and technical language and operation	Students can involve the ability to use symbolic language, formal language and technical language.
A7	Using mathematics tools	Students can involve the ability to use mathematical tools, for example taking measurements, operations and so on.

To get the subject at level 3, researcher used table 1, as the competencies owned by each levels of mathematical literachy.

Result and Discussion

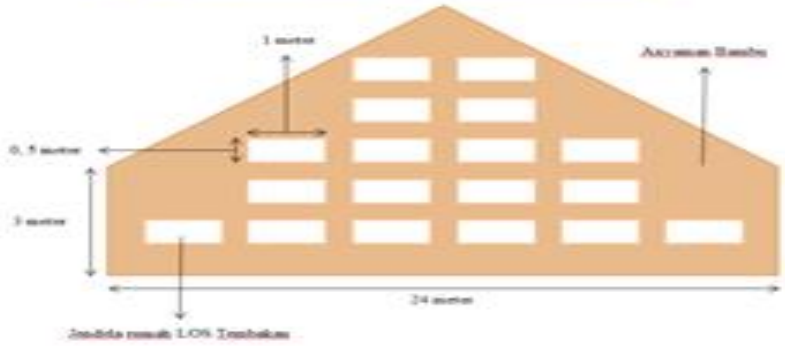
Mathematical literacy is an individual's ability in terms of mathematical reasoning and formulating, using, and interpreting mathematics to solve problems in various real-world contexts. It helps individuals to know the role that mathematics plays in the world and to make the judgments and reasoned decisions required of a constructive, engaged and reflective 21st century citizen (OECD, 2019). This indicates the importance of mathematical literacy in the development of students in facing the challenges of the 21st century. In this study, what is meant by mathematical literacy is the ability of a person/individual to use, formulate, and interpret mathematical concepts in various contexts to solve problems related to procedural problems and real-life problems including the ability to reason mathematically and use concepts, procedures, facts, and mathematical

tools in explaining and predicting an event. At finding the subject, researchers got 3 students placed at level 3, while 9 students has level 4 of mathematical literacy skills. Therefore, those 3 students, namely S1, S2, and S3, was determined as the research subject.

The problem used in this research was in the form of open-ended question in geometry. The question is about local wisdom in Jember, which is tobacco's house, which can be seen at figure 1 below.

Rumah Tembakau

Para petani tembakau biasanya membuat bangunan LOS untuk mengelolah hasil panen daun tembakau dengan ukuran panjang 48 m, lebar 24 m dan tinggi 12 m seperti gambar dibawah.



Gambar a. Rumah tembakau

Keterangan :

: jendela rumas LOS Tembakau
: Anyaman bambu

Bahan yang digunakan terbuat dari bambu yang dianyam. Hitunglah berapa luas anyaman yang dibutuhkan untuk membuat bagian depan bangunan LOS?

Figure 1. PISA-liked Problem at Level 3

The mathematical literacy ability of students is seen from the 7 mathematical competencies determined by the OECD, namely communication; mathematization; representation; reasoning and argument; choose strategies to solve problems; use symbolic, formal, and technical language and operations; and using mathematical tools (OECD, 2014). Based on the data obtained in the study, the following results were obtained:

1. Subject 1 (S1)

The results of the S1 answers on questions at level 3 with the context of the tobacco house question can be seen in Figure 1.

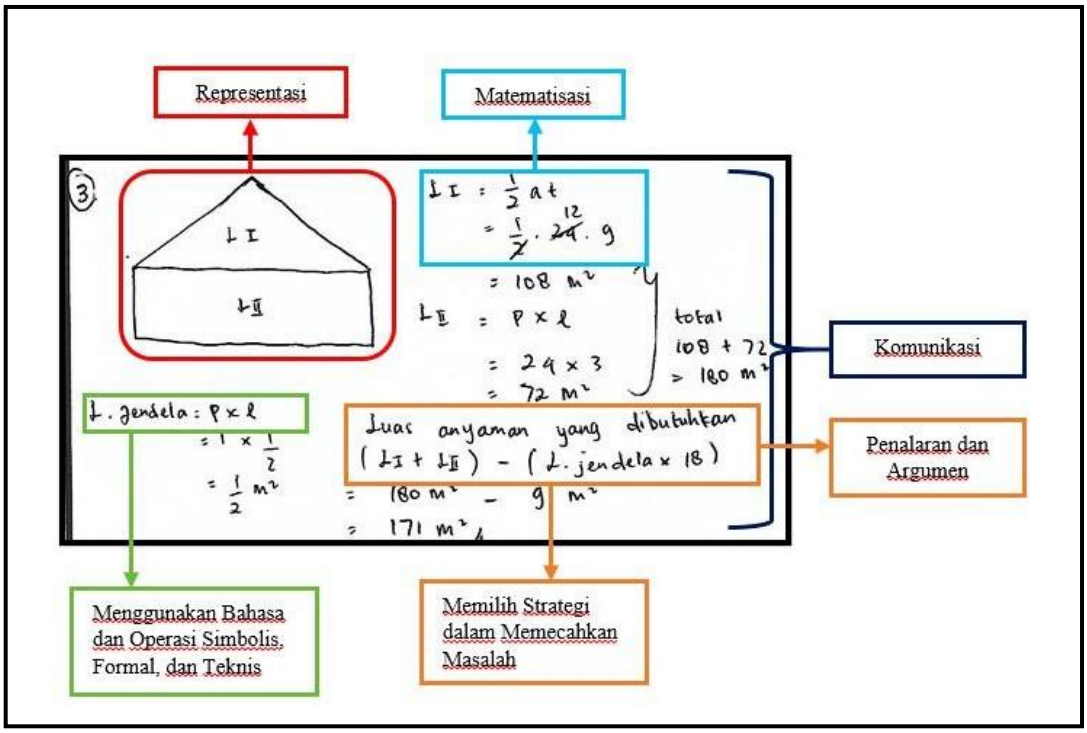


Figure 2. S1' answers

In Figure 2 it can be seen that S1 can work on questions at level 3 correctly and can show the mathematical literacy ability of S1. The mathematical literacy skills possessed by S1 are as follows:

a) Communication

The communication aspect shown by S1 is that S1 can analyze the problems contained in the questions and communicate the processes and results in determining the solution to the problems in the questions. This can be seen in Figure 1.

b) Mathematization

Figure 1 shows that S1 meets mathematical literacy competence in the mathematization aspect. It can be seen that S1 can change the problem in the problem into a mathematical model. Based on the conversation below it can be seen that S1 tried to used his understanding to find the solution.

I1001 : So, what did you do at the first time?

S1001: I tried to illustrate my solution into a picture. I get two pieces of pictures, triangle and quadrilateral.

I1002 : Then, how you find the solution?

S1002: I consider the shape, so I tried to relate it with the area of that shape

From the conversation above it can be seen that he tried to do mathematization, from model of situation to model for solution

c) Representation

Figure 1 shows that S1 changes or represents the problem in the problem using pictures so that it will be easier to understand. This is also emphasized by the transcript that representation did by illustrate into two dimensional figures, triangle and quadrilateral.

d) Reasoning and argument

Aspects of reasoning and arguments shown by S1, namely S1 can show his reasoning in analyzing problems in the problem by dividing the building into 2 parts, namely rectangles and triangles and can provide an explanation in determining the completion steps. This part is also supported by the transcript:

I1007: How come do you realize that it consists of two shapes?

S1007: It was clearly seen, don't you?? The rooftop is triangle while the wall, from the from, looks like a quadrilateral.

I1009: Then, how about the area here?

S1009: I got it by subtracting the total area with the area of every windows.

e) Choose a strategy in solving problems

Figure 1 shows how S1 solves the problem in the problem, namely by dividing the building into 2 parts into rectangles and triangles. This is also strengthened by conversation S1007 and S1009. Those illustrate that he tended to find the solution by subtracting the area.

f) Using symbolic, formal, and technical language and operations

Figure 1 shows that S1 can relate the information in the problem into mathematical rules such as using mathematical symbols.

From the discussion and Figure 2, it can be seen that S1 can show 6 aspects of mathematical literacy skills, namely the communication aspect; mathematization;

representation; reasoning and argument; choose strategies in solving problems; and use symbolic, formal, and technical language and operations. As for the aspect of using mathematical tools, S1 has not shown mathematical literacy skills in that aspect either through tests and interviews that have been conducted.

2. Subject 2 (S2)

The results of the S2 answers on level 3 questions with the context of the tobacco house question can be seen in Figure 3 below.

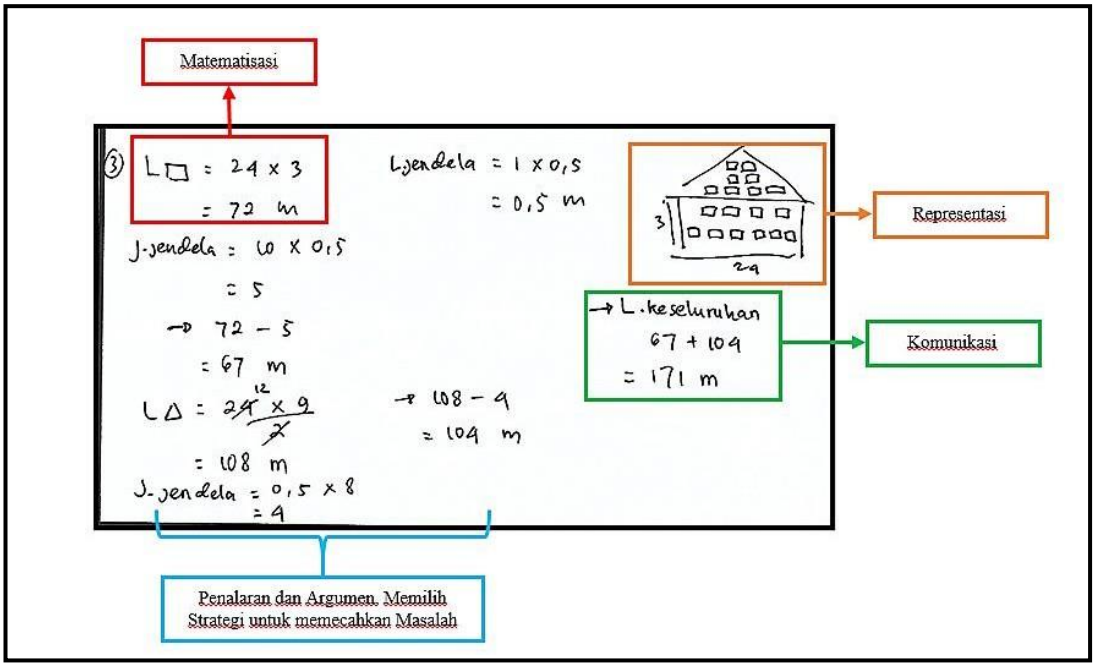


Figure 3. S2s' Answer

In Figure 3 it can be seen that S2 can do the questions at level 3 correctly and can show the mathematical literacy ability of S2. The mathematical literacy skills of S2 are as follows:

a) Communication

Figure 2 shows that S2 can communicate the process in problem solving and write down the results of the solution clearly.

b) Mathematization

The mathematization aspect shown by S2 can be seen from Figure 2 that S2 is able to change the information in the problem into a mathematical model and can analyze the problem in the problem. As in RME, the model of situation and model for solution also appeared in this section, such as:

I2001 : What did you do at the first thing?

S2001 : I represented it into my own figure, as can be seen here (*by pointing the Figure*).This really helps me. Then I realize and try to find it by using the area of triangle and quadrilateral.

I2003 : So, do you know the area formula of quadrilateral and triangle?

S2003 : Area of quadrilateral should be $l \times w$, while triangle $\frac{1}{2} \times b \times a$

c) Representation

The representation that emerges from the subject of S2 is that S2 can analyze the problem in the problem and represent it in the form of an image as shown in Figure 2. Moreover, transcript S2001 has clearly stated that S2 can illustrate it into his figure. And the figure is different to S1.

d) Reasoning and Argument

Figure 2 shows that the S2 can use its reasoning well. This can be seen with the S2 dividing the building into two parts making it easier to work with. Then each section is subtracted by the area of the window on the building.

I2008: How come there is decimal out of there?

S2008: Because I realised it's the same, among ½ and 0.5. So, because it's just 0.5, then it's still easy for me to calculate

I2010: How about this division, why did you don't use decimals? (in area triangle)

S2010: Because it's easier to calculate it by using fraction/division, there is multiplication of 2, so there is a relation among division of 2 and multiplication of 2.

e) Choose a strategy in solving problems

Figure 3 shows the S2 process in solving the problems in the problem. S2 can choose the right strategy in finding the solution. The strategy is to divide it into two, namely a square and a triangle and find the area of the two shapes.

From the discussion and Figure 2, it can be seen that S2 can show 5 aspects of mathematical literacy skills, namely the communication aspect; mathematization; representation; reasoning and argument; and choose strategies in solving problems. As for the aspects of using language and symbolic, formal, and technical operations

and using mathematical tools, S2 has not shown mathematical literacy skills in these aspects either through tests and interviews that have been conducted.

3. Subject 3 (S3)

The results of S3 answers in the context of the tobacco house question can be seen in Figure 4 below.

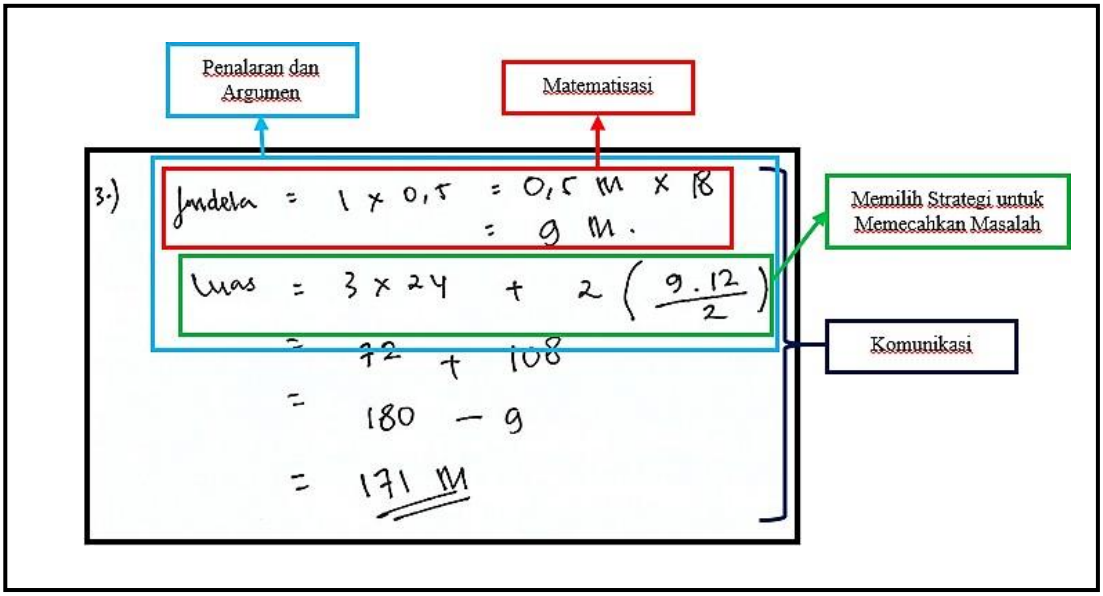


Figure 4. S3s' Answer

In Figure 4 it can be seen that S3 can work correctly and can show the mathematical literacy ability of S3. The mathematical literacy skills possessed by S3 are as follows.

a) Communication

Figure 4 shows that S3 is able to answer questions correctly and can communicate the process and results in detail and precisely.

I3003 : What do you mean by Jendela = 1 x 0.5 = 0.5 x 18 = 9 m?

S3003 : That's the area of the window, so I wrote it as Jendela = 1 x 0.5 = 0.5 x 18 = 9 m

I3005 : Then how about Luas = ..., what kind of area do you mean?

S3005 : That's the total area of the front shape.

According to the transcript and the document, S3 failed to communicate his answer in the form of written. He tended to write it as long as he understood the meaning of his calculation.

b) Mathematization

The mathematical aspect shown by S3 can be seen in Figure 4, namely S3 can show that S3 can change the problem in the problem into a mathematical model. It can be seen that all the information on the problem can be converted into a mathematical model.

I3006 : I see, so what will you find actually?

S3006 : I tried to find the total area, then I got that number 171 m

I3007 : are you sure that's the area?

S3007 : Yes, of course, I've already check it so many times

I3008 : How did you check it?

S3008 : I re-calculated it based on the formula of area

From those transcript, actually even though he failed in writting the correct statement, however he could understand that it was the correct solution.

c) Representation

From figure 4 above, there is No. model of situation and model for solution of the problem. It can be seen clearly that S3 did not make any illustration for the real-life problem. He tended to calculate it directly. Even though there was no evidence (in the document) of representation, researcher can see that he can represented it mentally. However, he still failed to realize that what he was searching for solution is area, meanwhile his unit in the solution still in the form of length (by meter).

d) Reasoning and argument

Based on the conversation from S3003 until S3008, it can be seen that he gave correct explanation for his answer. Even though there is some errors in his asnwer (about the representation), it did not disturb his skill in finding the solution.

e) Choose a strategy in solving problems

From figure 4, it cannot be seen that S3 can solve the problem correct. There were some eroors overthere, for example in the line of Luas = ... Suddently in the line 3 after that statement appears subtraction by 9. Then it doesn't

clear where it came from. However, after the interview, researcher got that that number came from the area of rectangle.

From the discussion above and Figure 3, it can be seen that S3 can show 5 aspects of mathematical literacy skills, namely the communication aspect; mathematization; representation; reasoning and argument; and choose strategies in solving problems. As for the aspects of using language and symbolic, formal, and technical operations and using mathematical tools, S3 has not shown mathematical literacy skills in these aspects either through tests or interviews that have been conducted.

Based on the results of data analysis from this study, the following data were obtained:

Table 2. Mathematical Literacy Ability Among Subject

Subject	**Ability**						
	A1	A2	A3	A4	A5	A6	A7
S1	√	√	√	√	√	√	-
S2	√	√	√	√	√	-	-
S3	-	√	-	√	√	-	-

From Table 2 above, it can be seen that the mathematical literacy skills of students at level 3 meet the indicators in the communication aspect; mathematization; representation; reasoning and argument; and choose strategies in solving problems. Meanwhile, aspects of using language and symbolic, formal and technical operations only appear on the subject of S1. So, it has not been able to prove that the subject at level 3 fulfills these aspects.

The results of research on students who are at level 3 are in line with previous research which showed the results of the literacy abilities of middle group students based on the opinion of Thomson, Hilman, and Bortoli who explained that items or questions with a relatively moderate level of difficulty were at level 3 and level 4 (Thomson, 2013). The results of the comparison of research conducted with previous research conducted by Rini, both concluded that students' mathematical literacy skills at level 3 or students with intermediate literacy skills had not shown mathematical

literacy skills in the aspect of using mathematical tools. The results of the research at level 3 are in line with research conducted by Rini in 2016 which stated that the subjects in the middle group showed deficiencies in 2 aspects of literacy, namely reasoning and argument, and using formal symbolic language and operations, and technical aspects, as well as on aspects of literacy. using mathematical tools is not owned by the middle group subject.

Based on this analysis, in this study it was found that the mathematical literacy skills that have been achieved by level 3 students are aspects of communication, mathematization, representation, reasoning and argumentation, and choosing strategies in solving problems. Students with intermediate skills can solve problems on questions with moderate and low levels of difficulty, as well as difficulty solving very high level questions.

Conclusion and Suggestion

In this study what is meant by mathematical literacy ability is the ability of a person/individual to use, formulate, and interpret mathematical concepts in various contexts to solve problems related to procedural problems and real-life problems including the ability to reason mathematically and use concepts, procedures, facts, and mathematical tools in explaining and predicting an event.

There are some skills that did not use in solving mathematical literacy, in this case, which is A6 and A7 which related to using correct symbols and mathematical tools. Even though they failed in this skills and failed in use a correct unit, mentally, they success to find the correct solution.

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