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How is the Process of Mathematical Literacy Viewed From the Initial Mathematical Performance?

Gida Kadarisma, Dadang Juandi* & Darhim

Department of Mathematics Education, Universitas Pendidikan Indonesia, Indonesia

*Corresponding email: dadang.juandi@upi.edu

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Abstract: How is the Process of Mathematical Literacy When Viewd From the Initial Mathematical Performance? The role of mathematics functionally in the context of everyday life which refers to the ability of individuals to respond to needs and obstacles in society is known as the conception of mathematical literacy. Mathematical literacy is an important aspect that every individual has to face the 21st century, there are 3 important processes in mathematical literacy, namely formulating, employ and interpreting mathematical results into everyday problems, besides that students' initial mathematical abilities are important and related to mathematical literacy. Therefore the aim of this research is to analyze the process of mathematical literacy in terms of initial mathematical abilities. This research is a qualitative descriptive study with a subject of 3 students consisting of 1 student each with high, medium and low initial math skills in junior high school students in Cimahi. The instruments used in this study were a Mathematical Literacy test instrument consisting of 3 questions, an initial mathematical performancetest and an interview guide. The results of this study indicate that students with low performance cannot carry out the 3 processes of mathematical literacy (Formulation, employ and interpreting), students with moderate abilities can formulate problems in mathematical form and use mathematical concepts for problem solving but are still wrong in doing calculations and unable to interpret the information contained in the table/diagram. Whereas for students with high initial mathematical performance, they can formulate everyday problems in mathematical representations, they can also use concepts, facts and procedures for problem solving but are not yet precise at the stage of interpreting and communicating in writing

Keywords: mathematical literacy, initial mathematical performance.

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INTRODUCTION

Mathematics is a field of science that has a major contribution in all areas of life (Hoffmann & Even, 2023). Therefore, in learning mathematics students are expected to be able to apply the mathematical concepts they learn in solving everyday problems. The role of mathematics functionally in the context of everyday life which refers to the ability of individuals to respond to needs and obstacles in society is known as the conception of mathematical literacy (Jablonka, 2003). One needs to first formulate problems, use mathematical concepts, and interpret mathematics in various contexts. Ability with these three processes is the ability of mathematical literacy. With the mastery of mathematical literacy, each individual will be able to reflect on mathematical logic to play a role in his life, his community, and society. The concept of mathematical literacy is very closely related to the process of mathematization, Lange (2006)

formulates the process of mathematization starting with real problem situations then individuals try to identify relevant mathematical concepts and rearrange the problems into the identified concepts, after that individuals remove/prune things related to the real world then solve mathematical problems and finally solutions mathematics is translated in real-world situations

The term mathematical literacy has been initiated by NCTM before being defined by PISA (Kusumawardani et al., 2018). Namely as one of the visions of mathematics education, namely to become literate in mathematics. Mathematical literacy itself is an individual's capacity to reason mathematically and to formulate, use and interpret to solve problems in a variety of real-world contexts, this includes concepts, procedures, facts and tools to describe, explain and predict phenomena. It helps one to recognize the role that mathematics plays in the world and to make judgments with arguments and decisions necessary to be a constructive, engaged and reflective 21st century citizen. (OECD, 2018).

Apart from being based on the results of international and national studies, several studies state that the mathematical literacy of junior high school students is still low (Fadilah, 2019; Kholifasari et al., 2020; Subaidah et al., 2017). One study stated that students were unable to make mathematical models and design problem-solving strategies The following questions are used by research to measure the mathematical literacy skills of junior high school students (Agustiani et al., 2021).

The following is an example of a mathematical literacy question "Pak Dono raises 14 chickens and cows at his house. If the number of chicken and cow legs that he raises consists of 36 feet. How many chickens and cows does Dono keep?"

question that requires students' ability to use mathematical concepts in solving problems. This question tests three competencies, namely on the number content dimension, on the process dimension. This question requires students to apply concepts, facts, procedures, and reasoning in mathematics in a personal context. The concept needed to solve the problem is to solve the problem with a concept. system of linear equations of two variables. The following are students' answers to the above problems (Agustiani et al., 2021)

The student's answer to this question is many cows = 4, many chickens = 10. Students do not formulate situations systematically. Students also do not describe mathematical situations using symbols and do not find relationships between variables based on the facts in the questions and do not make mathematical models based on the information in the questions, this means that these students have not been able to use good reasoning to use mathematical concepts in solving problems. . Students are not familiar with the problem solving process which includes understanding the problem, planning problem solving, carrying out problem solving and checking the results of problem solving (Wardhani & Rumiati, 2011).

Acording to OECD (2017) the low score on PISA is because students are not familiar with the stages of problem solving namely understanding the problem, planning strategies, doing the work, and checking the suitability of answers, but according to Stacey (2011) low mathematical literacy is because students do not use reason in problem solving. This in line with Novita et al (2012) Students usually use formal mathematical knowledge in class so that non-routine problem solving abilities are weak, while Wibowo et al (2018) stated that low mathematical literacy is due to learning only oriented to procedural knowledge and the use of questions routine questions in evaluating student learning outcomes are still very dominant.

Initial ability in mathematics is an important aspect that teachers must pay attention to when teaching. According to Zuyyina et al (2018) the initial ability of students is one that determines

the success of learning mathematics. Each individual has different learning abilities. The initial ability of students is an ability that has previously been owned by students before receiving learning. This also shows the readiness of students to accept new material presented by the teacher. The results of the research by Hevriansyah & Megawanti (2016); Khadijah et al (2018) show that there is a significant influence between early mathematics abilities and student learning outcomes. Therefore students with high mathematical literacy skills can solve mathematical problems related to everyday life. Gais & Afriansyah (2017) state that early math skills are very important for teachers to know before starting learning. Ruseffendi (2006) explains that students relate the new knowledge they acquire to their prior knowledge. In addition Geary&David (2011) in his research stated that the initial ability of mathematics will affect student achievement and student learning success at the next school level. This is in line with research Aragón et al (2019); Nunes et al (2007); Xenidou-Dervou et al. (2018) which found that early mathematical ability will affect later mathematical performance, besides that Castle et al (2008) explains that the initial abilities and cognitive abilities possessed by a person are very influential in learning a new knowledge. Based on this explanation, it is necessary to analyze how the process of mathematical literacy is viewed from the initial mathematical ability.

METHOD

Research Design and Participant

This study aims to analyze the Mathematical Literacy of class IX junior high school students when viewed from the initial mathematical ability which is classified into high, medium, and low. In addition, researchers conducted in-depth exploration of the process of more than one person. so that this research is a type of qualitative research, with a case study design. The subjects of this study were 3 class IX students in SMPN 3 Ngamprah, The selection of these three subjects was based on the consideration of mathematics teachers who could represent each initial mathematical ability group.

Instrument

The test instrument used in this study was a set of mathematical literacy questions on statistical material as many as 3 questions. Interviews were conducted to dig deeper into the process of mathematical literacy carried out by students.

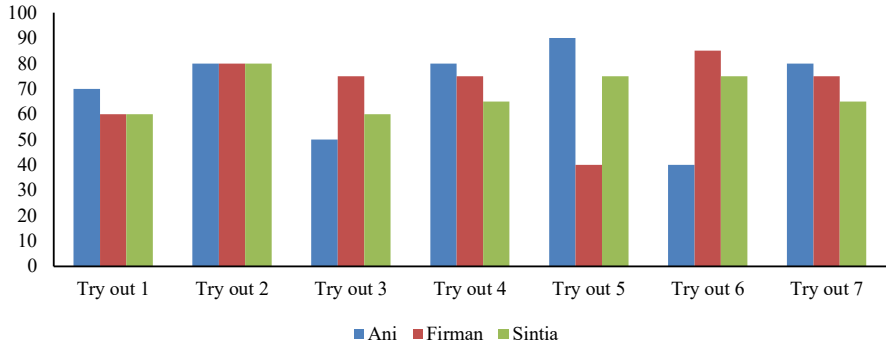
Table 1. Mathematical literacy indicator

Mathematical Literacy Process	Indicator	Question Number
Formulate	formulating situations in mathematical forms or models using appropriate representations	1
Employ	using mathematical concepts, facts, and procedures to solve everyday problems	2
Interprete	interpreting and communicating results or math problem solutions	3

(OECD, 2018)

Mathematical literacy questions in numbers 1 and 2 were developed by researchers and meet the criteria for validity and reliability. For question number 3, the researchers adapted the PISA question (OECD, 2018) .The following are the mathematical literacy tes instruments provided:

1. Mr. Munir will determine who must take part in the remedial of the 10 students who are taking the math test. Students whose grades are below the class average are required to attend remedial. The scores of each student are as follows: 60, 75, 65.80, 75.65, 50, 80,75,80. By making a frequency table, determine how many students should take remedial!
2. Mr. Rudi will choose 1 best student to be a representative in the National Science Competition, therefore Mr. Rudi gives tryouts for the 3 best students 7 times. The following are the results of the tryout obtained



Who should Pak Rudi choose to represent the school? How do you think Pa Rudi made his choice?
3. The following is country data with smartphone users in Asia:

Country	Populations (in million)	Number of Smartphone users (in million)	Proportion of Smartphone users (%)
Banglades	166.735	8.921	
Indonesia	266.357	6.757	
Japan	125.738	65.282	
Malaysia	31.571	20.98	
Pakistan	200.663	23.228	
Pilipina	105.341	28.627	
Thailand	68.416	30.486	
Turki	81.086	44,771	
Vietnam	96.357	29.043	

From these data, which country is the mode of "number of smartphone users"? In addition, determine the mode of "proportion of smartphone users". Give reasons whether the "number of smartphone users" mode is the same as the "proportion of smartphone users" mode?

Figure 1. Mathematic literacy task

Data Analysis

Data analysis in qualitative research takes place in collection and after completion the data is collected. Along with collection data, analysis (interpretation) is carried out with the aim of sharpening the focus observations and deepen issues relevant to the subject the problems studied. The data analysis steps used are based on Miles & Michael (1992) 1) Data Collection, Data and information obtained from informants by means of interviews, observation or documentation put together in a research note which contains two aspects, namely descriptive notes and reflection notes 2) Data Reduction, namely the process of selecting and focusing attention to steps of simplification, abstraction and transformation of coarse data emerging from written records in the field. 3) Data Presentation, this is intended to make things easier for researchers in viewing research results. 4)

Drawing conclusion, namely efforts to looking for or understanding the meaning of regularity of patterns, clarity, flow and effect or proposition.

■ RESULT AND DISCUSSION

This mathematical literacy process will be reviewed based on the initial mathematical performance aspect in which student grouping based on initial mathematical performanceis done by giving previous initial mathematical performance questions to 105 students from 3 junior high schools in Cimahi. Based on the grouping results, the researcher took 3 students with high, medium and low initial mathematical performance. To analyze the students' mathematical literacy process, 3 students were given 3 mathematical literacy test questions which had previously been validated by experts and met valid and reliable criteria and had good index of difficulty and discrimination. Each student is given a code as follows:

Students with High initial mathematical performance: H, Students with Moderate initial mathematical performance: M, Students with Low initial mathematical performance: L, Teachers : P

Formulating situations in mathematical forms or models using appropriate representations

The Formulate Process indicator in this study is formulating a situation in a form or a mathematical model using an appropriate representation to solve contextual problems. The items used met the criteria for use. Students with low initial mathematical abilities were seen not doing calculations on their answer sheets, Subject R only stated that there were 4 students who took remedial with minimum completeness criteria is 75. Subject L could not make a mathematical model/representation of the problem given as shown in Figure 4.

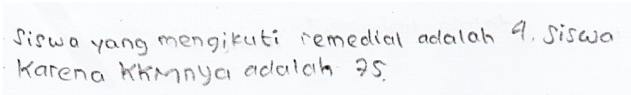


Figure 2. L's answer for the formulate process

Based on the results of interviews the Students with low initial mathematics abilities (L) said that there were 4 students who were remedial because the four students got scores below the minimum standard (KKM) of 75. Students involved KKM scores even though they had nothing to do with the questions. it can be analyzed that L cannot formulate the situation in a mathematical form or model using the appropriate representation. This is in line with research Haeruman et al (2017) which found that students with low mathematical abilities were unable to answer questions using their thinking abilities.. Furthermore, for M, namely students with early mathematical abilities are calculating the average by adding up the scores and dividing by the amount of data, M is right in determining the average and determining the number of students who must take remedial as shown in Figure 5.

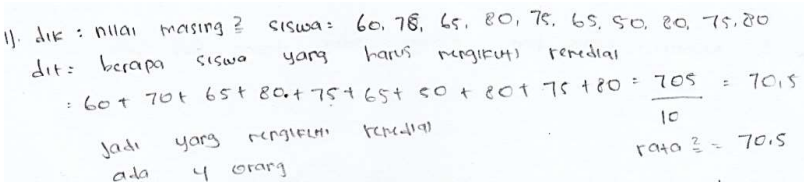


Figure 3. M's answer for the formulate process

Subject M has correctly determined the answer but subject M did not make a frequency distribution table as a strategy for problem solving (see Figure 5). The researcher explored student answers by interviewing student M by asking how to determine that there were 4 people who needed to be remedied, Student M answered by determining the average and calculating the number of students who were below the average, apart from that, based on the results of the interview, student M could determine the average accurately. Student M did not make a frequency distribution table because he admitted that he had forgotten how to make it, but even without using a table, this problem could be solved well. This is in line with research Dewi & Machromah (2022) which states that students with moderate mathematical abilities can solve problems correctly but only in one way.

Subjects with high initial mathematical ability (H) can formulate situations in mathematical forms or models using appropriate representations and also perform simple calculations

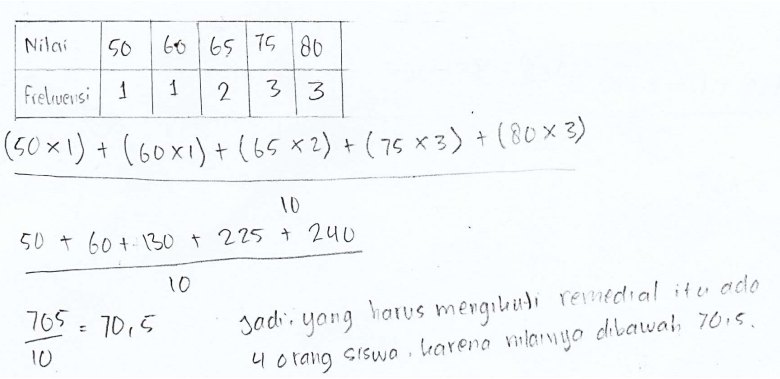


Figure 4. H's answer for the formulate process

According figure 6, Subject H can make a mathematical representation by making a table and then determining the correct average. Subject H can also perform simple calculations with precision. This is in line with research Dewi & Machromah (2022) which found that students with high mathematical abilities can answer questions fluently.

Employ Process : using mathematical concepts, facts, and procedures to solve everyday problems

The Employ process in this study with indicators of designing and implementing strategies to find solutions and using mathematical concepts, facts and procedures to solve everyday problems is measured using description questions that have been validated by experts and are suitable for use.

The questions in the Employ process require students to be able to read a bar chart by looking at the unit value on a vertical line, besides that students are asked to use the concept of concentration measurement to determine who is entitled to be chosen by Mr. Rudi to represent the school. Subject L misread the graph so that the results obtained are not correct, besides that L cannot use the average concept to solve the problem

As consequently L cannot determine the mean of a set of data. In presenting a problem situation, students need to construct a model of the main components of the problem. To present the problem accurately, students must understand

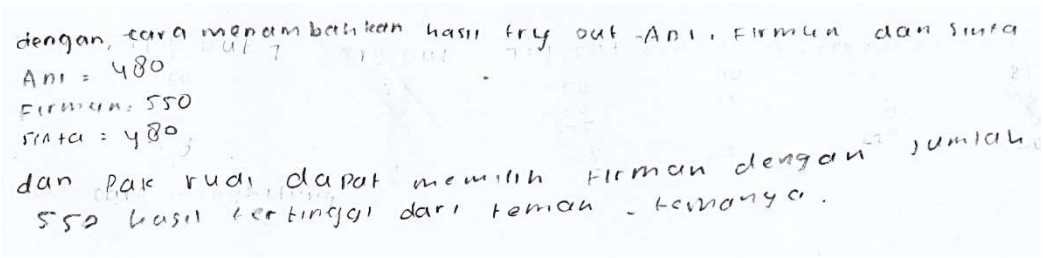


Figure 5. L's answer for the employ process

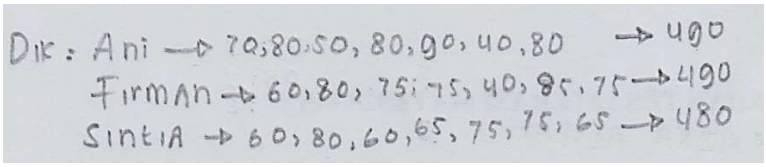


Figure 6. M's answer for the employ process

the situation and key issues to determine the elements of mathematics and ignore elements that are not relevant. This step can be facilitated by making pictures/diagrams, writing equations, or making other appropriate forms of representation (Herman, 2007)

Based on picture 6, student M only added up the scores of each student without providing a conclusion about who should be chosen to take part in the competition. The researcher asked M why he did not continue to find another measure of centrality. M answered that Ani and Firman would get the same average score so M was confused about choosing Ani or Firman. Based on the results of the interviews, it can be concluded that M is able to use the average for this problem, but cannot use another central tendency for problem solving. Students are not yet familiar with mathematical literacy questions. This can be solved by giving various assignments from teachers. This is in line with research Hwang & Ham (2021). This research shows that students can improve their mathematical literacy by being involved in various types of tasks ranging from procedural tasks, story problems, to pure and applied mathematical reasoning

For the employing process, base on figure 9 Subject H can design strategies to find mathematical solutions. Subject H uses the concept of average and other statistical measures.

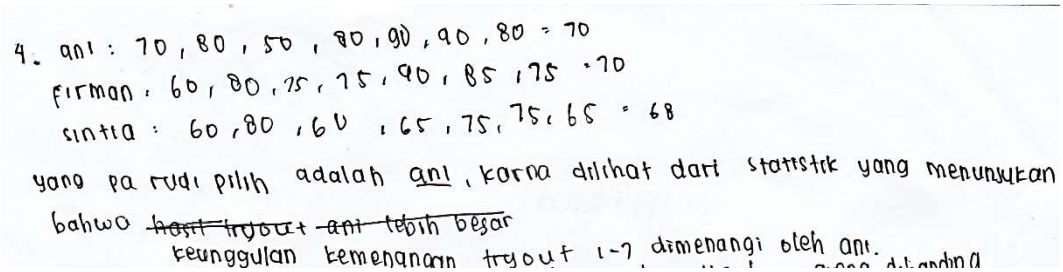


Figure 7. H's answer for the employ process

Researchers conducted interviews with subject H to examine H's answers to questions to measure the employability process. The researcher asked how H carried out strategies for problem solving. Based on H's answer, he calculated the average for each student then he

found that Ani and Firman got the same average, namely 70, therefore H used another measure of concentration, namely mode, so he chose Ani to take part in the competition.

Interpreting and communicating results or math problem solutions

The indicators for the Interprete process are interpreting the information presented in the form of graphs/diagrams and communicating the results or solutions to mathematical problems. The questions used use questions from PISA 2018 which have been modified and have been assessed by experts so that they meet the criteria for use. This question requires students to interpret the smartphone user table and relate it to the mode concept. Students are also asked to communicate the results of problem solving. Subject L answered that the mode of the number of smartphone users is Japan and the mode of the proportion of smartphone users is Indonesia. Subject L does not correctly interpret the proportion of smartphone users even though the column must be filled in first by calculating the proportion (see figure 8).

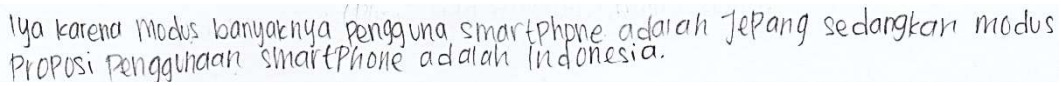

Iya karena modus banyaknya pengguna smartphone adalah Jepang sedangkan modus proposi penggunaan smartphone adalah Indonesia.

Figure 8. L's answer for the interprete process

Based on the interview results, Subject L interpreted the table incorrectly and could not perform calculations to find proportions because he did not understand the concept of comparison. If students' initial mathematical performance is low, they tend not to master the prerequisites even though when the teacher conveys knowledge and relates it to students' initial abilities, students will learn to build meaning so that the teacher can help students to connect new information with students' prior knowledge by designing learning that can facilitate it (Nasution et al., 2017). Good teaching materials, of course, must facilitate students' initial mathematical performance to increase (Kadarisma et al., 2019, 2020) one of which is with the apperception displayed at the beginning of the teaching material

Subject M tries to do a calculation to fill in the percentage proportion of smartphone users by dividing the number of users by the population of each country, M is correct in determining the percentage proportion of smartphone users, but subject M is wrong in calculating the percentage and M has not yet communicated the results of the solution base on figure 9.

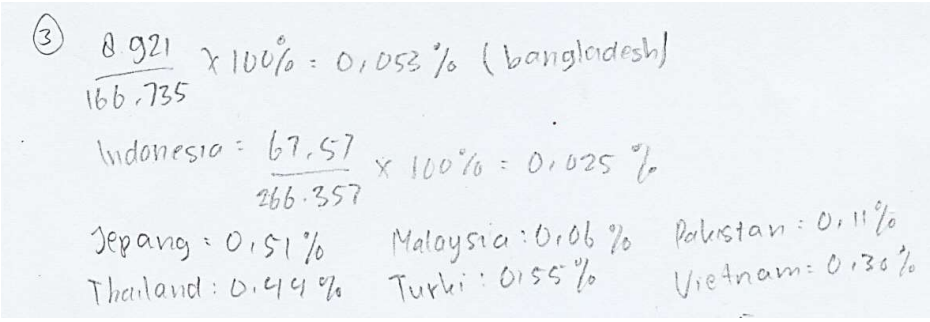


Figure 9. M's answer for the interprete process

Based on the results of the interview, student M understands what mode is so that he can determine Japan as the mode of smartphone users, but student M is wrong in determining the mode of proportion for smartphone users because he does not understand the concept of proportion, so he gets the wrong answer, namely Turkey, because he is wrong in carrying out the multiplication operation. This is in line with Agoestanto et al (2019) research which states the cause of the error is students' lack of understanding related to the objectives of the problem, deficiencies understanding related to mathematical modeling, lack of student understanding accuracy, student inaccuracy in using knowledge to change an equation balanced equations, students' inability to calculate the solution to an equation, students deviate from the formula they used previously and student errors lack of understanding related to units of measurement in mathematics.

In the interprete process, subject H can interpret the information presented in the table,based on Figure 10, subject H performs the procedure to calculate each proportion percentage by dividing the number of smartphone users by the population in a country. Subject H can also communicate in writing the reasons for his answers. However, Subject H was wrong in calculating division and multiplication with percentages and was wrong in placing the percent symbol.

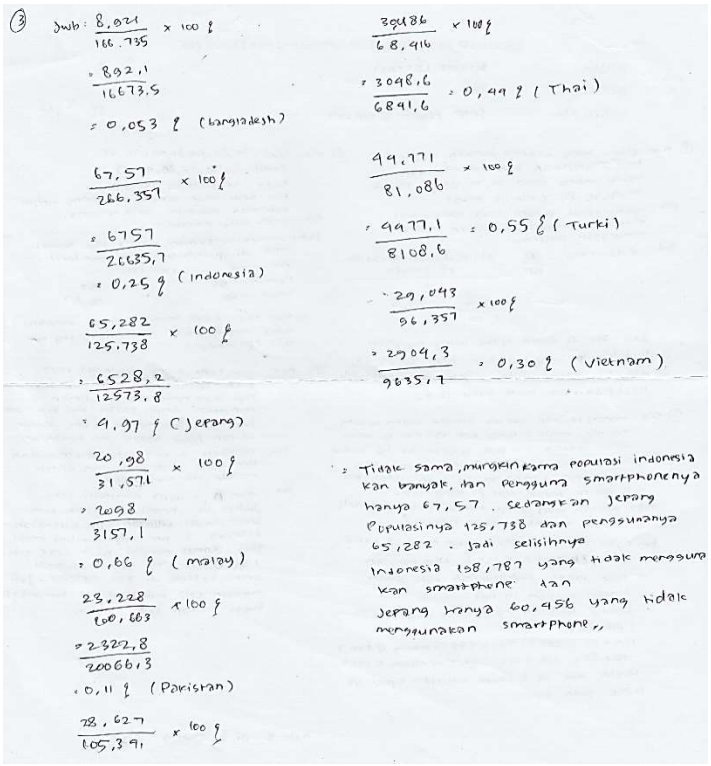


Figure 10. H's answer for the interprete process

Based on Figure 10. Subject H was not correct in stating his reasons and was wrong in making calculations, Subject H gave reasons by analogy with the examples of cases in Indonesia and Japan. He argues that to calculate the proportion must be compared with the total population of the country. Researchers indicate that H is able to determine which country has the

highest proportion of smartphone users but it is difficult to communicate precisely. Following are the results of interviews with students H

Based on the results of the interview, Subject H had difficulty communicating ideas in writing, but after digging deeper Subject H was able to communicate answers orally. In addition, Subject H made a mistake in calculating the division because time was limited and there were no calculators during the test. Errors in calculating are errors that are often found (Cho & Nagle, 2017; Huu Tong & Phu Loc, 2017; Riastuti et al., 2017) this can automatically affect the final results of student tests, to minimize this, students must Re-check the results of the answers.

Mathematical literacy is an important aspect for students to have considering their role in solving students' daily problems (Bansilal et al., 2012; Lange, 2003; Ojose, 2011; Rathburn, 2015; Sandström et al., 2013). Based on the results of the study, in fact, both students with high, medium, and low initial mathematical abilities experience problems when solving problems that require the use of mathematical literacy abilities. Not all mathematical literacy processes can be carried out precisely even by students with high abilities when carrying out the interprete process. In the formulating process, the tendency for students to have difficulty formulating problems into mathematical models, this is in line wit h(Edo et al., 2013) which states that students experience difficulties in the process of formulating problems in everyday life into mathematical models found in subject L.

Initial mathematical ability is closely related to problem solving abilities, critical thinking and mathematical communication skills (Haeruman et al., 2017; Lieung, 2019; Minarni et al., 2020; Nugraha et al., 2020; Prasasti et al., 2019; Tanjung et al., 2020; Yuliani, 2022). In addition, early mathematical abilities will also affect mathematical literacy abilities(Jufri, 2015; Nurdianti et al., 2022; Rohana et al., 2021; Trihatun, 2016) therefore it is important as educators to identify initial mathematical performance as one of the characteristics of students in developing teaching materials.

CONCLUSION

Based on the results of the research, the conclusions in this study were that low ability students could not carry out the 3 processes of mathematical literacy (Formulation, employ, interpreting), subject L could not formulate problems in mathematical models, besides that subject L could not use the concept of measuring data concentration for troubleshooting. Students with moderate abilities can formulate problems in mathematical form and use the concept of measuring data concentration for problem solving but are still wrong in doing calculations and cannot interpret the information contained in tables/ diagrams. Whereas for students with high initial mathematical abilities, they can formulate everyday problems in mathematical representations, they can also use concepts, facts and data centering measurement procedures for problem solving but are not yet precise at the stage of interpreting and communicating in writing.

Suggestions from this study should be that in teaching in the classroom the teacher facilitates students more so that literacy skills can develop by using mathematical problems related to students' daily lives. In addition, early mathematical ability is an important factor that can influence learning success, teachers should conduct an analysis of student characteristics before designing teaching materials so that learning can benefit students with high, medium and low initial math abilities.

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