



The Analysis of Mathematical Literacy Ability in PISA Oriented Questions with Uncertainty and Data Content Based On Gender

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Abstract

The study was carried out in the VIII class of junior school Baitul Aziz of the 2022-2023 school year aimed at analyzing learners' literacy of mathematics skills on the matter of PISA oriented questions with uncertainty and data content. This research implemented a quantitative descriptive method with a cross-sectional research design. The participants of this research was learners of class VIII-1 and VIII-2 as many as 37 learners. The research data included a written test with data analysis by categorizing mathematical literacy abilities into 3 categories, they are low, medium and high. The outcome of the test showed that 1) the mathematical literacy abilities of male learners point to high levels of category at a percentage of 7.14%, a medium figure of 85.71%, and a low category of 7.14%; 2) female learner mathematical literacy abilities indicate at a high category of 17.37%, a medium category of 56.52%, and a low category of 26.09%; 3) it was concluded that the literacy of mathematics of the male learners is equal to the literacy of mathematics of the female learners because the largest percentage of the category falls at medium.

Keywords: Mathematical Literacy, Quantitative Research, Gender

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INTRODUCTION

In the current era, the challenge of the 5.0 industrial revolution encourages everyone to actively and creatively develop their potentials to deal with the increasingly rapid developments of information and technology. The era continues to demand every learner to hone and improve soft skills and hard skills for increasingly tough job competition.

Therefore, to anticipate the matter, the government has aligned the education national curriculum with the requirements of industrial fields in order to shape and improve the human resources which becomes the priority of Indonesia 5.0. So that, in terms of education, it is required to prepare the learners ability that match with the current job requirements.

It is known that one of the learner abilities required in the field of jobs is mathematics. Mathematics in industry plays an important role in the planning and recovery the industrial systems. An important part in administering learners to function effectively in the modern age, having a key role in advancing human thought and various disciplines of science, and the universal science that form the basis of the enhancement of up-to-date technological underpinnings of mathematics (Susanti & Maharani, 2016). In the education field, mathematics is not something strange to be acknowledged because it is one of the important types of knowledge that is required since people's early age (Azizah & Fadlikah, 2023). It is necessary to learn mathematics that relates it to learners' daily life so that the learners are able to deal with problems through the implementation of mathematics in the real life. For this reason, learners must understand and master the mathematical concepts first. The learners' ability to

explain problems that relates to mathematics is mathematical literacy. Therefore, schools are required to increase learners' mathematical literacy skills so that the learners are able to equip themselves to deal with the real job world.

NCTM explained that the objectives of learning mathematics consist of five competencies, namely understanding of the concepts of mathematics, mathematical understanding, mathematical communication, mathematical associations, and mathematical solution finding. The five competencies are contained within one skill, which is the mathematical literacy capability (Ridzkiyah & Effendi, 2021).

The literacy of mathematics ability is the capability of learners to design, employ, and decipher mathematics in different contexts. This includes mathematical understanding and use of concepts of mathematics, procedures, realities and instruments to describe, explain and predict phenomena/events (OECD, 2019). Wibowo (2019) said that with regard to measuring mathematical literacy abilities, the questions used by the teacher in the process of evaluating learner learning outcomes are not in accordance with the indicators at every single level of the literacy of mathematics, because the questions given only tested learners' procedural knowledge in using mathematical formulas and is not able to hone learners' mathematical thinking skills. It indicates that learners are not trained to answer mathematical literacy questions. In the learning process, it can be done by making learners work on mathematical literacy problems to practice the learners' literacy of mathematics abilities.

According to the understanding of mathematical literacy above, there are three indicators that becomes the basis of PISA assessment, namely the ability to design real situations in the mean of mathematics, the use of concepts, reality, procedures and mathematical reasoning, and interpret, implement and evaluate mathematical outcomes (OECD, 2019). Indonesia began to participate in the PISA study from 2000 to 2018 (Kemdikbud, 2019). Indonesia falls below the mathematical literacy capability of learners in accordance with surveys made by the Programme for International Learner Assessment OECD 2018. The 2018 result shows that Indonesia ranks to the lowest level of 79 participating countries (Puslitjak, 2021). One of the possible reasons is because learners are not familiar with PISA questions (Murtiyasa, Rejeki, & Setyaningsih, 2018). This relate with the outcomes of research carried out by Wutsqa (2017) in his study on learners' mathematical literacy skills showing that learners' skills in the literacy of mathematics are still classified as very minimal. According to this finding, the improvement of skills in the literacy of mathematics in Indonesia is necessary to be evaluated (Utami, Sukestiyarno, & Hidayah, 2020).

The questions of PISA (International Learner Assessment Program) are the assessment at an international level which are composed of procedural mathematical concepts and problems that relates to people's life by connecting each of them. It means that the preparation of PISA questions underlies on mathematical problems. In several studies, experts conducted an analysis of PISA results with the aims of developing or improving the character of education in a country (Safrulloh & Desmayanasari, 2023). The content of the PISA questions consists of 4 sections, namely change and relationship, space and shape, quantity, and uncertainty and data (Gurudiknas, 2020). One of the contents of PISA is uncertainty and data. One of the competences which is measured in the PISA international assessment (programme for international students assessment) is the literacy of mathematics ability.

From the indicators of the literacy of mathematics that must be achieved by each learner, the acquisition of the learner's level of literacy of mathematics ability can also be influenced, one of which is by gender. Firmanti (2017) states that based on the aspect of how to solve problems using logical rules, male learners think more flexibly compared to female learners who are more rigid, limited or always in accordance with what is explained by the teacher. In drawing conclusions, female learners tend to be more careful, thorough in drawing conclusions (Awalyah, Nuraida, & Sunaryo, 2022). Anggoro (2016) it explains that men are stronger in their mathematics than female learners. Having seen from several opinions, it can be concluded

that different genders also differ in their respective abilities and strengths. The difference of gender affects education in the field of mathematics.

The study relating to this research is the research conducted by Karmila (2018) which is about description of the literacy of mathematics capability of learners in the gender. This study discusses the results of learners of male of female and female class X High School at 4th levels of the literacy of mathematics capability where the results of this study indicate that the male matterative literacy ability of men is equivalent to the ability of the literacy of mathematics female learners. Further research conducted by Sutrisno & Adirakasiwi (2019) which is about the analysis of the ability of the literacy of mathematics learners in completing the issue of PISA content of uncertainty and data based of gender, the results of this study is the ability of male the literacy of mathematics male higher than the ability of female's the literacy of mathematics in learners of class XI Junior School, this study shows the results of learner answers on the issue of PISA content Uncertainty and data level 1 to 4. Therefore, researchers conduct analysis of learners of class VIII Junior School related to the ability of literacy of mathematical learners in the matter of oriented Pisa content of uncertainty and data from the gender by using mathematical literacy category. This study aims to analyze the ability of the literacy of mathematics learners in the matter of oriented PISA content of uncertainty and data.

METHOD

This research is a quantitative descriptive study that aims at describing learners' literacy of mathematics skills when dealing with PISA-oriented questions of Content Uncertainty and Data. The research employs a cross-sectional study design that is carried out at one time to find the results and draw conclusions. The population in this study were grade VIII learners of Baitul Aziz Junior High School for the Academic Year of 2022-2023. The samples in this study were 14 learners in class VIII-1 and 23 learners in VIII-2. Data collection was carried out using tests of learners' mathematical literacy abilities in the form of PISA oriented questions of Uncertainty Content and Data. The mathematical literacy capability test of 5 questions about the princess & Zulkardi (2018) in Sutrisno & Adirakasiwi (2019) and Setyaningsih & Munawaroh (2022) with validation results with CVI by Aiken's Value is 0.83 so that instruments are stated by high validity. While the results of the instrument reliability with Cronbach Alpha is an instrument otherwise reliable with a reliability index of 0.98.

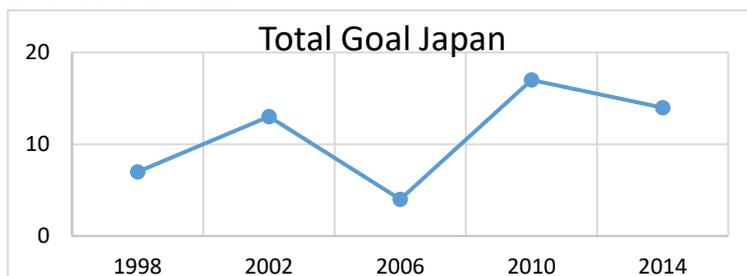
Table 1. Problem test used to test the ability of mathematical literacy students

Test			
1. The following is an estimate of the players who will compete in the 2018 Asian Games along with biodata.			
No	Height	Date of birth	Position
Because Tama	176 cm	January 26, 1997	Goalkeeper
Hansamu Yama	180 cm	January 16, 1995	Beck
Putu Gede	170 cm	January 7, 1995	Beck
Rachmat Irianto	175 cm	3 September 1999	Beck
Nurhidayah Haji Haris	175 cm	5 April 1999	Beck
Evan Dimas	167 cm	March 13, 1995	Midfielder
A Maulana	164 cm	7 July 2000	Midfielder
Andik Vermansyah	162 cm	23 November 1991	Midfielder
Irfan Bachdim	172 cm	August 11, 1998	Midfielder
Rafli Mursalim	176 cm	March 5, 1999	Attacker
Marinus Wancwar	181 cm	February 24, 1997	Attacker

Question : What is the average height of the attacking players?

Putri & Zulkardi (2018) in Sutrisno & Adirakasiwi (2019)

2. The following diagram shows the number of goals scored by Japan at the 1998 Asian Games to the 2014 Asian Games.



Statement : In what year was the biggest decrease in the number of goals for Japan in the Asian Games?

Putri & Zulkardi (2018) in Sutrisno & Adirakasiwi (2019)

3. In a soccer match there are 8 groups consisting of 4 teams per group. In the preliminary round, each team in each group plays against each other. The two teams that will qualify for the next round are determined by the highest number of points in the results of the group matches. Points are earned according to the following rules: win 3 points, draw 1 point and lose 0 points.

Question :

The following are the results of the matches from group A:

Group A		
South Korea	1 - 0	Arab Saudi
South Korea	3 - 0	Malaysia
South Korea	2 - 0	Laos
Arab Saudi	3 - 0	Malaysia
Arab Saudi	3 - 0	Laos
Malaysia	4 - 0	Laos

Which team from Group A will qualify for the next round? Write down how you work.

Putri & Zulkardi (2018) in Sutrisno & Adirakasiwi (2019)

4. Cricket is one of the game sports consisting of two teams with 11 players each. The aim of the game is to score more runs than the opposing team. The table below is the results of cricket matches at the Asian Games

Tim	Lots of Play	Win	Draw	Lost	Run
Malaysia	2	0	0	2	0
Bangladesh	3	2	1	0	75
Japan	1	0	0	1	0
Thailand	3	2	0	1	26
Hong Kong	3	1	0	2	63
Sri Lanka	3	2	0	1	75
Nepal	3	1	0	2	46
China	5	3	0	2	75
Pakistan	3	3	0	0	97
South Korea	2	0	0	2	0

Based on the table above, identify which team won the gold, silver and bronze medals. Write down your reasons

Putri & Zulkardi (2018) in Sutrisno & Adirakasiwi (2019)

5. The Electrix company, and the Tronics company, make video players and audio players. At the end of the production day, the two companies tested their respective video players and audio players. Damaged video players and audio players will be removed and sent for repair. The table below compares the average number of video players and audio players of each type created per day, and the average percentage of faulty video players and audio players per day, for the two companies.

Company	Average Number of Video Players Created Per Day	Average Percentage Broken Per Day
ELECTRIX Company	2000	5%
Tronics Company	7000	4%

Company	Average Number of Audio Players Created Per Day	Average Percentage Broken Per Day
ELECTRIX Company	6000	3%
Tronics Company	1000	2%

Question :

Which of the Electrix companies and Tronics companies has a lower damage rate?
(Setyaningsih & Munawaroh, 2022)

In the literacy of mathematics ability questions, in each question has three indicators of the literacy of mathematics. The indicators of the literacy of mathematics are:

Table 2. Mathematical Literacy Indicators

No	Mathematical Literacy Indicator
1	Formulate a real situation mathematically
2	Using concepts, reality, procedures, and mathematical reasoning
3	Interpret, implement and evaluate mathematical results

(Mutia & Efendi, 2019)

The data analysis technique is to score the learners' mathematics literacy ability that would be analysed to determine the category of the learners' ability levels based on the average value and standard deviations.

Table 3. Categorization of Mathematical Literacy Levels

Category	Value Limit
High	$X \geq (\underline{x} + SD)$
Medium	$(\underline{x} - SD) > X < (\underline{x} + SD)$
Low	$X \leq (\underline{x} - SD)$

Arikunto in Ridzkiyah & Effendi (2021)

RESULTS AND DISCUSSION

This study was conducted on grade VIII learners of Baitul Aziz Junior High School Bandar Khalipah Tembung for the Academic Year of 2022-2023 with 2 groups of learners from class VIII-1 and VIII-2. The indicator was to formulate the real situations mathematically,

using concepts, reality, procedures and mathematical reasoning, interpreting, implementing, and considering the results of mathematics. The following table shows the characteristics of grade VIII learners of Baitul Aziz Junior High School:

Table 4. Characteristics of Baitul Aziz Junior High School Learners' Respondents

Characteristics	VIII-1	VIII-2	Total
Gender	Male	Female	
Age Range	13-14 years	13-14 years	
Total learners	14	23	37

The Table 3 shows that the learners in grade VIII of Baitul Aziz Junior High School were in 2 different classes with the different genders, namely class VIII-1 consists of 14 male learners and class VIII-2 consists of 23 female learners. So, the total number of learners in class VIII of Baitul Aziz Middle School is 37 that will be examined for their mathematical literacy skills.

The researcher conducted a test of learners' ability in mathematical literacy of the Eighth-Grade learners of Baitul Aziz Junior High School with the samples as shown in table 3. Mathematical literacy ability tests used the questions oriented to PISA of content uncertainty and data. In this section, the outcomes of the mathematical literacy skills of learners in grade VIII SMP Baitul Aziz as a whole and by gender are presented along with descriptive statistics on the outcomes of the literacy of mathematics ability tests:

Table 5. Descriptive Statistics of Learners' Mathematical Literacy Test Results

	N	Minimum Score	Maximum Score	Average	std. Deviation
Score of Matematical Literacy skill	37	20	83	43,054	15,028

The table 4 shows that the number of respondents was 37 learners with a minimum score of learners' ability on the of literacy mathematics was 20, and a maximum score was 83. From the value of learners' ability on the literacy of mathematics through tests of PISA oriented questions on uncertainty and data content, the average value was 43,054 and the standard deviation (level of data distribution) was 15,028.

Furthermore, the researcher uses the method proposed by Arikunto to determine the category of mathematical literacy ability level, namely research data with an standard deviation and average value as the basis for categorizing. Following are the results of the percentage level of learners' literacy of mathematics ability:

Table 6. The Percentage of Learners' Mathematical Literacy Levels

Category	Value Limit	Students' Number	Presentase
High	$X \geq 59,495$	5	13,5%
Medium	$28,505 > X < 59,495$	25	67,6%
Low	$X \leq 28,505$	7	18,9%
Total		37	100%

Table 5 shows that the capability of the learners' ability on the literacy of mathematics of learners of grade VIII of SMP Baitul Aziz with a high percentage was 13.5% which means that there are 5 learners obtained the score that higher than 59.495. The percentage of medium level category was 67.6% which means that there are 25 learners who gained the score between

28.505 and 59.495. While the percentage of low category was 18.9%, which means that there are 7 learners whose score were lower than 28.505. From the outcomes of Table 5, the category of overall mathematical literacy ability of grade VIII of Baitul Aziz Middle School with the largest percentage is in the medium category.

As for the gender-group separation of 37 learners, there are 14 male learners and 23 female learners. The literacy of mathematics aptitude test of male and female learners points out the difference, following a descriptive statistical test of the learner's mathematical literacy capability in accordance with gender:

Table 7. Descriptive Statistics of Male Learners' Mathematical Literacy Test Results

	N	Minimum Score	Maximum Score	Average
Score of Matemactical Literacy skill	14	21	60	47,79

Based on Table 6, this indicates that the number of male learners studied was 14 learners with the minimum value of learner's mathematical literacy ability of 21 and the maximum value of 60. From the value of the learner's mathematical literacy ability through the standardized Pisa content assessment test and data obtained the average value of the mathematical literacy of the male learner at the VIII-1 Junior High School Baitul Aziz at 47,79.

Table 8. Descriptive Statistics of Female Learners' Mathematical Literacy Test Results

	N	Minimum Score	Maximum Score	Average
Score of Matemactical Literacy skill	23	20	83	41,70

Based on Table 7, this indicates that the amount of female learners studied was as many as 23 with the learner's minimum of the ability of mathematical literacy was 20 and the maximum value was 83. From the value of the learner's mathematical literacy ability through the control-oriented test of Pisa content and data, the average value of the literacy of mathematics of female learner at the VIII-2 Junior High School Baitul Aziz at 41,70.

The following bar chart and pie chart present the comparison of the frequency and percentage of learners in each category at the Table 5 based on gender.

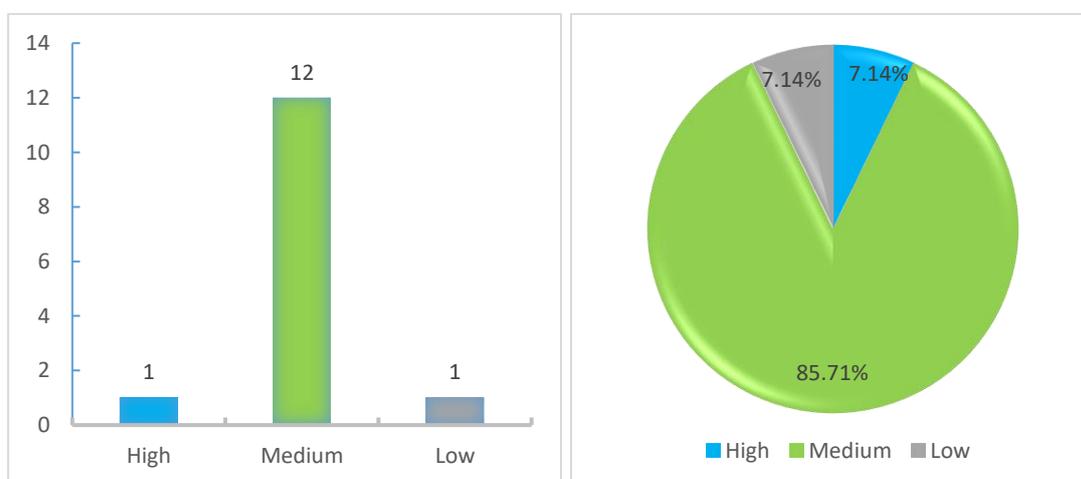


Figure 1. Bar Chart and Pie Chart of Male Learners' Mathematical Literacy Ability Category

Figure 1 shows that the category of the ability of literacy of mathematics of male learners with high category has 1 frequency with a percentage of 7,14%. In the medium category, there are 12 frequencies with a percentage of 85,71%. Meanwhile, the low category has 1 frequency with a percentage of 7,14%. This shows that the category of male learners' literacy of mathematics abilities with the greatest frequency and percentage is learners who are in the medium category.

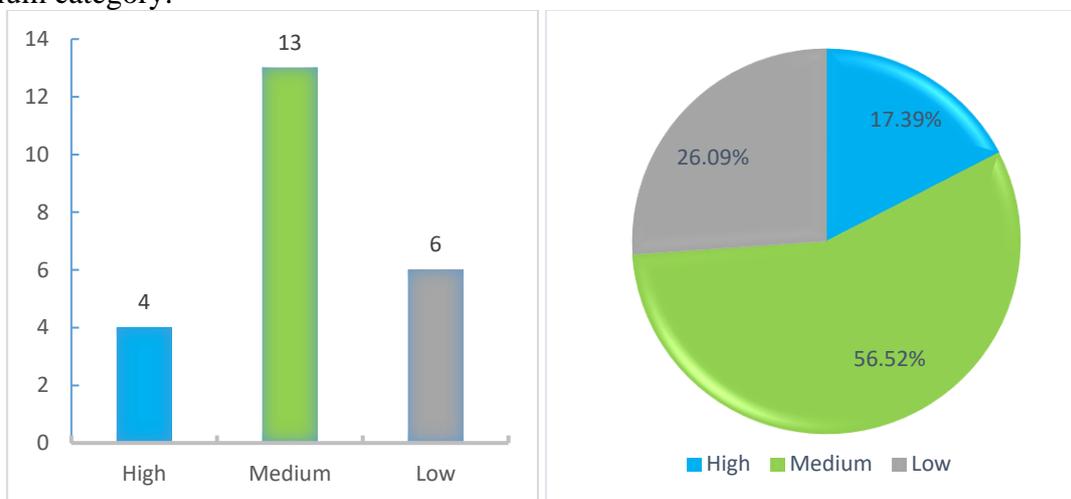


Figure 2. Bar Chart and Pie Chart Female Learners' Mathematical Literacy Category

Figure 2 reveals that the category of female learners' literacy of mathematics abilities in the high category has 4 frequencies with a percentage of 17,39%. In the medium category there are 13 frequencies with a percentage of 56,52%. While in the low category there are 6 frequencies with a percentage of 26,09%. This shows that the category of male learners' mathematical literacy abilities with the greatest frequency and percentage is learners who are in the medium category.

In the category of achievement, the level of literacy of mathematics ability of grade VIII learners of SMP Baitul Aziz has come to the indicators of learners' literacy of mathematics. The following table indicates the percentage of learners' literacy of mathematics indicators by gender:

Table 9. Percentage of Male Learner Mathematical Literacy Indicators

Mathematical Literacy Indicator	Students of Number	Percentage
Formulate a real situation mathematically	14	100%
Use concepts, realities, procedures, and mathematical reasoning	14	100%
Interpret, implement and evaluate mathematical results	8	57,14%

The Table 8 shows that the percentage of indicators of the literacy of mathematics ability of male learners with indicator 1 i.e. formulate a real situation mathematically, there are 14 learners who achieve this indicator with a percentage of 100%. Indicator 2, i.e. using concepts, realities, procedures, and mathematical reasoning, there were 14 learners who achieved this indicator with a percentage of 100%. While indicator 3, namely interpreting, applying and evaluating math results, there were 8 learners who achieved this indicator with a percentage of 57,14%.

Table 10. Percentage of Female Learner Mathematical Literacy Indicators,

Mathematical Literacy Indicator	Students of Number	Percentage
Formulate a real situation mathematically	23	100%
Use concepts, facts, procedures, and mathematical reasoning	23	100%
Interpret, apply and evaluate mathematical results	10	43,48%

The Table 9 reveals the percentage of indicators of literacy of mathematics ability of female learners with indicator 1 namely to formulate a real situation mathematically, there are 23 learners who achieve this indicator with a percentage of 100%. Indicator 2, namely use concepts, facts, procedures, and mathematical reasoning, there were 23 learners who achieved this indicator with a percentage of 100%. While indicator 3, namely interpret, apply and evaluate mathematic results, there were 10 learners who achieved this indicator with a percentage of 43,48%.

Discussion

Baitul Aziz Junior High School is a junior high school that has been established since 2013, which is located on Jalan Pustaka/Muara Kolam Bandar Khalipah Tembung. The researcher indicated that the learners of Baitul Aziz Junior High School have lack of self-awareness towards literacy in accordance with the information from the Math teacher, she said that the learners were not used to answering reasoning questions. This statement is conformable with the research by Azzahroh & Putri (2023) that learners are not used to answering reasoning questions. In this study, which analyzing the literacy of mathematics abilities of Grade VIII learners of Baitul Aziz Junior High School on PISA-oriented questions, Uncertainty content and data based on gender, the researcher categorized the level of mathematical literacy ability into three categories, namely low, medium and high categories. The following are the outcomes of the categories for the level of literacy of mathematics ability of class VIII learners of Baitul Aziz Junior High School:

Male

Low Category

In class VIII-1 in which the learners are male, there are 14 learners in the classroom. There is 1 learner who is in the low category with a score of 21 with a percentage of 7,14%. The learner was in the low category because he answered the questions in a hurry so he did not formulate the information of the questions as known and asked. The learner did not write formulas, concepts and procedures correctly but went straight to the calculations and there were errors in the calculations due to not focusing on answering the questions. This is in line with the findings of Tobondo (2015) which mention that the subject is still wrong to calculate the final result of mathematical literacy. The learner also did not write down the interpretation, application and evaluation of the outcomes of the calculations on the questions and did not completely answer all the questions given, he only answered one third of the questions given.

Medium category

For male learners, there are 12 learners who were into the medium category with a score of 37-57 with a percentage of 85,71%. These learners are in the medium category because they are able to formulate information on the questions given and are also able to use concepts, realities, procedures, and mathematical reasoning well. But there are some learners who have not been able to interpret, apply, and evaluate the questions given. Aligned with Utami Research Results, Sucestiyarno, & Hidayah (2020) who argue that most students can meet the first mathematical literacy indicator of formulating real problems in understanding the problem.

High Category

For male learner, there is 1 learner who is in the high category with a score of 60 with a percentage of 7,14%. In formulating the information contained in the problem, it would appear that all male learners are capable. He is also able to use concepts, realities, procedures, and reasoning very well and is also quite good at interpreting, applying and evaluating the questions given. In line with the results of the research Setiawan (2019), the ability of male mathematical literacy is seen to determine the settlements of the completion and draw conclusions appropriately.

Female

Low Category

In class VIII-2 in which all the learners are female, there are 23 learners in the classroom. There are 6 learners who fall into the low category with a score of 20-22 with a percentage 26,09%. The learners were in the low category because they answered the questions in a hurry so they did not formulate the information about the questions before. Some of them did not write formulas, concepts and procedures correctly but went straight to the calculations and there were errors in the calculations due to not focusing on answering the questions. This is in line with the Simalango dkk (2018) research can be categorized into the difficulty of change, namely the difficulty in using the mathematical procedures relevant to the matter.

Medium category

For female learners, there are 13 learners who fall into the medium category with a score of 33-55 with a percentage 56,52%. These learners are in the medium category because they are able to formulate information on the questions given and are also able to use concepts, realities, procedures, and mathematical reasoning well. This is in line with Mutia & Effendi (2019) learners already able to use activity to replace various kinds of situation in the process of finding solutions by looking at the results. They also did not write down the interpretation, application, and evaluation of the calculation outcomes on the tests and did not completely answer all the questions given, they only answered one third of the questions given. But there are some learners who have not been able to interpret, apply, and evaluate the questions given.

High Category

For female learners, there were 4 learners who were in the high category with a score of 66-83 with a percentage 17,39%. The learners are in the high category because they are able to formulate the information contained in the problem. They are also able to use concepts, realities, procedures, and reasoning very well and are also good at interpreting, implementing and evaluating the questions given. This is in line with Azzuhroh & Princess's research (2023) that high-level female's learners are easy to meet the three mathematical literacy indicators.

The conclusion of the discussion is that the ability to have the literacy of mathematics achievement of grade VIII of learners of SMP Baitul Aziz is classified as medium. The mathematical literacy ability of the male learner and the mathematical literacy skill of the female learner are equivalent. This is in line with the opinion of Martinah (2019) that the literacy of mathematics ability between male and female learners is no difference. But this is not in line with Lastuti's opinion (2018) that male learners are higher than female learners at their level of mathematical literacy ability and the opinion of Azzahroh & Putri (2023) that female learners are superior to men of the same mathematical ability.

CONCLUSION

Male learners show a medium level of literacy of mathematics. The male learners answered the test lists in the way of answering essay questions system but with short answers and most of them did not include mathematical formulas but went straight to the calculations so they answered the questions incorrectly. Female learners also show medium level of mathematical literacy. They answered questions in the same way as male learners, except those who were more detailed on how to answer questions.

RECOMMENDATION

Based on the results of the study, the advice of researchers was submitted to the teacher to adjust the evaluation with the level of mathematical literacy and more attention to the learners in the setting of the consolidated completion when giving a mathematical literacy test. Since learners in this study tend to write things on the answer sheet when the process of interpreting, concludes and applying mathematical results. The completion of the injury in odor is beginning from the process of formulating a real mathematical situation, using concepts, facts, procedure and mathematical reasoning, and interpret, conclude, and apply mathematical results.

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