Mathematical literacy skills students of the junior high school in term of gender differences

IOP Conf. Series: Journal of Physics: Conf. Series **1315** (2019) 012084 doi:10.1088/1742-6596/1315/1/012084

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M Prabawati, T Herman and Turmudi

Universitas Pendidikan Indonesia, Bandung, Indonesia

E-mail: meganp@student.upi.edu

Abstract. Having good mathematical literacy skills is expected to help students solve problems related to mathematics. The focus of mathematics literacy skills on students is the ability to analyze, justify, and communicate ideas effectively, formulate, solve and interpret mathematical problems in various forms and situations. This study aims to describe students' mathematical literacy skills seen from gender differences. The approach used in this study is a qualitative approach with case studies. The study subjects consisted of two male students and two female students from junior high school students. Data was collected through analysis of student work results and interviews.. Students are asked to convey what they are thinking when solving problems in a given mathematical literacy test. After students finish getting the solution from the problem, the researcher classifies the students' answers and analyzes them. Furthermore, the data obtained are grouped and analyzed according to indicators of mathematical literacy skills. Male students have good results from each indicator in mathematical literacy ability, namely in the first indicator of the sixth indicator, while for female students have good mathematical literacy skills for the first indicator, second indicator, third indicator, fourth indicator and sixth indicator, except for the fifth indicator, female students have sufficient mathematical literacy skills.

1. Introduction

Trends in International Mathematics and Science (TIMMS) and Programs for International Student Students (PISA) are the benchmark for achieving Indonesian students' mathematical abilities. TIMSS 2011 states that the average achievement of Indonesian students is 386, which means it is at a low level [1]. These results indicate that Indonesian students' mathematical abilities are ranked 38 of the 42 participating countries. The results of the 2015 PISA stated that Indonesian students 'mathematical abilities were ranked 69th out of 76 countries with an average score of 386. The 2011 TIMSS and 2015 PISA research showed that Indonesian students' mathematical literacy skills were still very low compared to other developing countries especially in the process mathematical problem solving that requires the ability to examine reasons, communication skills, and interpret problems in various situations. The low level of Indonesian students 'mathematical literacy skills based on reports from TIMSS 2011 and PISA 2015 is an important reason to examine more deeply about Indonesian students' mathematical literacy skills. Reading mathematics is the knowledge to know and apply basic mathematics in our daily lives [2]. The concept of mathematical literacy and connection to the real world is not entirely different but is actually complementary [3]. Mathematical literacy will provide participants with an awareness and understanding of the role played by mathematics in the modern world [4]. The fundamental mathematical abilities that underlie mathematical processes related to

mathematical literacy as the main potential effects of three mathematical processes; formulate, employ and interpret when completing several tasks such as PISA, although in general this capability has not been maximally activated [5]. Mathematical literacy focuses on students' ability to analyze, justify, and communicate ideas effectively, formulate, solve and interpret mathematical problems in various forms and situations [6].

Another reason for the importance of students having mathematical literacy skills is the emergence of PISA (Program for International Student Assessment) questions in the 2014 high school and junior high school mathematics national exam (UN). The emergence of PISA questions at the National Examination aims to map national education, as well as measure student competencies internationally [7]. While on the other hand, this government policy has drawn protests from various circles, especially the UN participants. The reason is that these international standard questions are considered too difficult. In this problem, students are not asked to do procedural calculations, but to analyze a problem. The problems given are in the form of story problems that can be found in everyday life and then mathematically resolved. The characteristics of the PISA question are of course different from the general UN questions that put forward procedural calculations. Therefore, if students have low mathematical literacy, the problem will be considered difficult.

Mathematical literacy is the ability of individuals (individual's capacity) to recognize and understand the role played by mathematics in real life, to be able to provide proper assessment and consideration, to use mathematics that can meet a person's need to be a constructive, caring, and thinking member of society [8]. In this sense, mathematical literacy is used to emphasize mathematical knowledge, which is used in everyday life. Mathematical literacy is not limited to carrying out a number of ways or procedures, and having basic mathematical knowledge [8]. Mathematical literacy also includes mathematical knowledge, methods, and processes, which are used and utilized in various contexts by giving inspiration and opening up insight into thinking. In line with the opinion expressed by Niis [in 8] which states that mathematical literacy includes eight competencies that must be possessed, namely: 1) mathematical reasoning and thinking: Posing questions characteristic of mathematics; knowing the kind of answers that mathematics offers; distinguishing among different kinds of statements; understanding and handling the extent and limits of mathematical concepts 2) mathematical arguments: Knowing what proofs are; knowing how proofs differ from other forms of mathematical reasoning; following and assessing chains of arguments; having a feel for heuristics; creating and expressing mathematical arguments.3) mathematical communication: Expressing oneself in a variety of ways in oral, written, and other visual forms; understanding someone else's work. 4) modeling: Structuring the field to be modeled; translating reality into mathematical structures; interpreting mathematical models in terms of context or reality; working with models; validating models; reflecting, analyzing, and offering critiques of models or solutions; reflecting on the modeling process 5) submission and problem solving: Posing, formulating, defining, and solving problems in a variety of ways 6) representation: Decoding, encoding, translating, distinguishing between, and interpreting different forms of representations of mathematical objects and situations as well as understanding the relationship between different representations 7) symbol: Using symbolic, formal, and technical language and operations. 8) media and technology: Using aids and tools, including technology when appropriate.

In accordance with the PISA objective to assess students 'ability to solve real problems (students' capacity to solve real problems), then the problem in PISA includes mathematical content related to phenomena. In PISA this phenomenon is known as over-arching ideas. Because the math domain is very numerous and varied, it is impossible to identify completely. Therefore PISA only limits the 4 main over-arching ideas, namely change and relationship, space and shape (Space and Shape), quantity (Quantity), and uncertainty and data (Uncertainty and data) [9].

Changes and relationships are events / events in various settings such as the growth of organisms, music, the cycle of the season, patterns of weather, and economic conditions. This category relates to aspects of mathematical content in the curriculum, namely function and algebra. The forms of algebra, equations, inequalities, representations in tables and graphs are central in describing, modeling, and interpreting changes in a phenomenon. Data interpretation is also an essential part of the problem in the Change and relationship category.

Space and Shape, including phenomena related to the visual world that involve patterns, properties of objects, position and orientation, representations of objects, coding of visual information, navigation, and dynamic interactions related to real form. This category exceeds the aspect of geometry content in mathematics in the curriculum.

Quantity is the most challenging and essential mathematical aspect of life. This category relates to the relationship of numbers and number patterns, including the ability to understand size, number patterns, and everything related to numbers in everyday life, such as calculating and measuring certain objects. Included in this quantity content is the ability to reason quantitatively, present something in numbers, understand the steps of mathematics, calculate math outside of the head (mental calculation), and make estimations.

Uncertainty is a phenomenon that lies in the heart of mathematical analysis (at the heart of mathematical analysis) of various situations. Statistical theory and opportunities are used to resolve this phenomenon. Uncertainty categories and data include spot recognition of variations in a process, the meaning of quantification of the variation, knowledge of uncertainty and errors in measurement, and knowledge of opportunities. Data presentation and interpretation are key concepts of this category.

2. Experimental Method

The approach in this study is a qualitative approach to case study. This study involved four students, there were two women and two male junior high school students. The four students were asked to complete a math literacy test. Students are asked to solve problems in mathematical literacy tests. After students get a solution, researchers classify students' answers and conduct analysis. After completing filling out and completing a mathematical literacy test, the four students were interviewed. The material for the test instrument for mathematical literacy ability is SPLDV. There are two main types of instruments that will be used in this study, the main and additional instruments. The main instruments are the researchers themselves who act as planners, data collectors, data analysis, interpreters, and research reporters. The auxiliary instruments used in this study are mathematics literacy tests. Qualitative data analysis is an effort made by working with data, managing data, sorting it into units that can be managed, synthesizing, finding and finding patterns, discovering what is important and what is learned, and deciding what can be told to others, activities in Qualitative data analysis is done interactively and runs continuously until it's finished, so the data is saturated. Activities in data analysis, namely data reduction, data presentation, and verification/conclusion [10, 11]. Indicators of mathematical literacy abilities to review categorization are presented in the Table 1.

Table 1. The category of mathematical literacy skills

Category of mathematical literacy skills	indicator
Good	The fluency answer, the right calculation, and the development of the idea/ideas to the maximum.
Enough	The fluency answer, the right calculation, and the development of the idea/ideas is not maximized.
Less	The fluency answer, the calculation is not right, and the development of the idea is not maximized.

3. Result and Discussion

The following are presented the results of research on students' mathematical literacy skill’s in terms of gender differences along with a discussion of findings in this study.

3.1. Problem 1: Tower

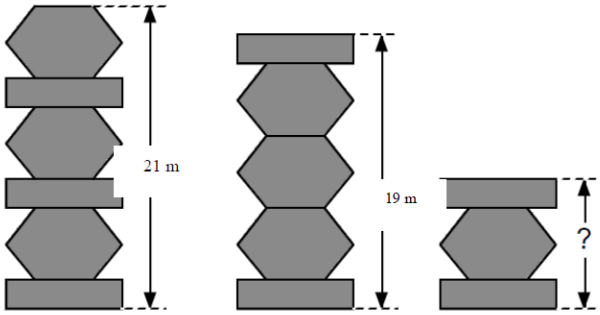

Figure 1. Tower's problem

Figure 1 shows 3 towers that have different heights and are composed of two forms, namely the 6-sided shape and the rectangle. What is the shortest tower height. The above question requires students to be able to reveal the mathematical ideas that exist in the problem, if not students will experience difficulties in solving the problem. After obtaining the mathematical idea, then students are required to connect between one and two towers to find the third tower (Figure 2).

Misalkan:
Tower yang berbentuk persegi panjang = x
Tower yang berbentuk segi-enam = y
Maka:
$3x + 3y = 21$
$2x + 3y = 19$ -
$x = 2$

Sehingga:
$3x + 3y = 21$
$3(2) + 3y = 21$
$6 + 3y = 21$
$3y = 15$
$y = 5$ cm
Maka, Tinggi tower yang terpendek tersebut adalah:
$2x + y = 2\ (2) + 5 = 4 + 5 = 9$ m

Figure 2. One of student solution

3.2. Problem 2: Konser Musik

For rock music concerts, a rectangular field measuring 100 meters long and 50 meters wide is prepared for visitors. Tickets sold out even many fans stood. What is the number of visitors to the concert?

a. 2.000 b. 5.000 c. 20.000 d. 50.000 e. 100.000

To solve this problem students must understand complex situations, starting from the size of the field, then understanding the situation that is because the tickets are sold out so many spectators stand, here students are required to imagine the situation, and the final process is to evaluate possible choices with known facts on the problem. It can be said that this is a matter of level 5 that requires high-level thinking skills.

The initial rarity is to calculate the area of the field, that is, the area of the field is 5000 m^2. After this stage many students are confused to continue the next process. The right step is for students to evaluate possible multiple choices. With an area of 5000 m^2, students must imagine every 1 m^2, how many people might fulfill it, of course must pay attention to that many fans are standing. Following are the evaluations of each multiple choice. For answer A, which is 2000 people is impossible, because there is information that says that the field is full and many fans are standing. This means that if only 2000 people, then each person occupies 2.5 m^2. Of course it doesn't make sense. For answer B, that is 5000 people is also impossible, because 5000 people means that every 1 m2 is occupied by 1 person.

For answer C, because there are 20,000 people, every 1 m^2 is occupied by 4 people (obtained from 20,000: 5,000), and this answer makes sense. For answers D and E, students should see that option D

shows that every 1 m^2 is occupied by 10 people, this is obviously impossible, unless the person is piled up, even though the information is not the same and the answer E is more impossible because it means there are 20 people in 1 m^2. So the correct answer is C.

3.3. Problem 3: Toko Sepatu

Mawar has a shoe store. For certain types of shoes, if Mawar sells 2 pairs of shoes more, she gets the same amount of money. The selling price of each pair of shoes is Rp. 20,000.00 cheaper than the normal selling price. If Mawar sells shoes 2 pairs less he also gets the same amount of money. The selling price of each pair of shoes is Rp. 40,000.00 more expensive than the normal selling price.

a. How many pairs of shoes are sold for this type?

b. What is the normal price of a pair of shoes?

To solve this problem students must know the normal price of shoes in the store and the price of other brands of shoes, then compare the prices of one shoe with the other. In this problem the student is required to formulate the situation mathematically with his activities. Identify the mathematical aspects of the problem in the real context situation and identify the important variables. In addition students must understand the structure of mathematics in problems or situations, simplify the situation or problem to make it easily accepted by mathematical analysis, identify the obstacles and assumptions behind the mathematical model and simplify it. Present the situation mathematically by using variables, symbol diagrams and basic models accordingly. in a different way, Understanding and explaining the relationship between language, symbols and context so that it can be presented mathematically, turning the problem into a mathematical language or mathematical model, understanding the aspects of the problem that are related to known problems, mathematical concepts, facts or procedures, Use technology to describe mathematical relationships as part of context problems.

Mathematical Literacy Activity in this problem is Formulating the situation mathematically with its activities identifying the mathematical aspects of the problem in the real context situation and identifying the important variables. Simplify the situation or problem to make it easily accepted by mathematical analysis, represent the situation mathematically by using variables, symbol diagrams and appropriate basic models, representing the problem in different ways, understanding and explaining the relationship between language, symbols and context so that they can be presented mathematics. Understand the aspects of the problem related to known problems, mathematical concepts, facts or procedures.

4. Conclusion

Students' mathematical literacy abilities seen from the gender differences are male students have good mathematical literacy abilities from each indicator, namely the first indicator to the sixth indicator of mathematical literacy. Meanwhile, female students have good mathematical literacy skills in almost every indicator, except for a sufficient fifth indicator.

5. Acknowledgments

The author would like to thank the promoter and co-promoter thesis for his guidance, and the research institute and community service for Siliwangi University.

6. References

[1] Mullis I V S, Martin M O, Foy P and Arora A 2012 *TIMSS 2011 International Result in Mathematics* (TIMSS& PIRLS International Study Center: Chestnut Hill USA) p. 28

[2] Ojose B 2011 *Journal of Mathematics Education* **4** 90.

[3] Ozgen K 2013 *Journal of International Education Research* **9** 307.

[4] Christiansen I M 2006 *Pythagoras* **64** 6.

[5] Dewantara A H, Zulkardi and Darmawijoyo 2015 *Journal Mathematics Education* **6** 48.
[6]. OECD 2009 *Learning Mathematics for Life: A View Perspective from PISA*, (Paris: Organization for Economic Cooperation and Development Publications) p. 12.
[7]Faiza H 2014 Menteri Trial and Error [Online] accessed at kompasiana.com/post/read/651866/1/menteri-trial-and-error.html.
[8] Kusumah Y S 2011 *Literasi Matematis* presented in Seminar Nasional Matematika (Bandar Lampung: Universitas Bandar Lampung).
[9] OECD 2010 *Draft PISA 2012 Assessment Framework* [Online] available online at http://www.oecd.org/dataoecd/61/15/46241909.pdf [6 October 2016].
[10] Creswell J W and Vicki L P C 2007 *Designing and Conducting Mixed Methods Research* (New York: Sage Publication, Inc) p. 112-115.
[11] Maryono 2017 *International Education Studies* **10** 13.