



## Mathematical Literacy Ability of Students for The Content of Space and Shape

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**Abstract.** Mathematical literacy ability is important in life. Someone who has mathematical literacy ability will consider how to apply mathematical knowledge effectively in various contexts. The aim of this study is to find out mathematical literacy ability in space and shape content. The method of study is qualitative descriptive. The subject of study are 32 students of class IX Junior High School with age characteristic (14-15 years old). Data was collected by using test. The study result showed that students' mathematical literacy ability is still problems in the stage of formulating into mathematic model, applying suitable concept and reinterpreting problem solution obtained in context. Based on our study result, to overcome the problem of mathematical literacy ability, students can use realistic mathematic approach which can stimulate students to be active and creative so it can help them to understand the concept.

### 1. Introduction

Mathematical literacy is one ability needed to live the life in financial, social, economic, and culture aspects and modern civilization as well as to be used to make right decisions as citizen [1] [2]. Based on the result of PISA study in 2015, students' mathematical literacy ability is in 61<sup>st</sup> rank from 69 participant countries [3]. It shows that mathematical literacy ability of Indonesian students is still low. It is because lack of students' understanding toward the problems given so it is result in misperception and error to symbolize in defining the intention of that problem [4][5]. Our initial study also found that students' mathematical literacy ability is still obstacles. It is because students are less careful in understanding the problem and using available information from that problem.

Based on that consideration, we conduct the study with aim to find out mathematical literacy ability in space and shape content. Mathematical literacy is individual's capacity to formulate, use and interpret mathematics in various contexts. It comprise mathematical reasoning and the use of



mathematical concept, procedure, fact and tool to describe, explain, and predict phenomena. It demand individual to recognize the role of mathematics in life and to make right judgment and decision making which are needed by constructive and reflective society [6][7]. There are three mathematical processes in literacy, namely: (a) formulate situation, (b) apply mathematical concept, fact, procedure and reasoning, and (c) interpret, apply and evaluate mathematical result [7].

## 2. Method of Study

This study used qualitative descriptive method. This study was conducted in one of Junior High School in Bandung City. This study took place in class IX which involve 32 students with age characteristic is 14-15 years old. The instrument in this study is mathematical literacy ability test which consist of three problems with time duration is 40 minutes. Written test is required to obtain data about students performance in doing mathematical literacy ability test.

## 3. Result and Discussion

In this study, students are asked to solve three mathematical literacy problems which related to space and shape (cube and cuboid). In general, the result of mathematical literacy ability is presented in Table 3.1 as follow.

**Table 3.1.** Description of Mathematical Literacy Ability Data

| Description         | Mathematical Literacy Ability |
|---------------------|-------------------------------|
| Mean                | 2.58                          |
| Deviation           | 1.28                          |
| standard Highest    | 7                             |
| score Lowest        | 3                             |
| score               | 14                            |
| Ideal maximal score |                               |

Based on the data in Table 3.1 descriptively mathematical literacy abilities can be seen from the average score of 2.58 and standard deviation of 1.28. On analysis of test result, it identify the difficulties faced by students in the stage of formulating, applying and interpreting the result into context. The analysis of students answer is presented as follow.

### 3.1. The first problem

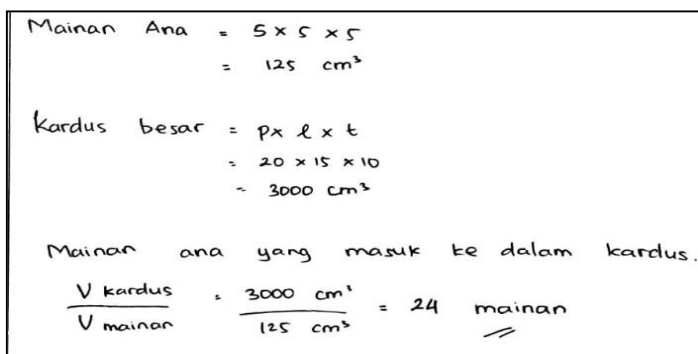
The first problem can be seen in Figure 3.2.

Ana has toys in the form of cube with the length of its edge is 5 cm. Ana put her toys into cuboid cardboard box sized 20cm in length, 15cm in width, and 10cm in height. How many Ana's toys that can be put into that cardboard box?

**Figure 3.2.** The first problem

The first question of the indicator is the case which relates to cube and cuboid with certain size is known. Students are asked to determine the amount of toys put in cardboard box. In this first problem, the process of mathematical literacy studied is employing mathematical concept, fact, procedure and reasoning.

Students' answers will be analyzed to determine students' difficulties in mathematical literacy. Total of 24 students answer correctly. However, in giving solution to the problem, they do not give sketch in advance. It indicates that the ability in mathematical model is still constrained. It shows that students are still find difficulty in translating word problem sentence into mathematical symbol [8]. One of student's answer is presented in Figure 3.3.



Mainan Ana =  $5 \times 5 \times 5$   
=  $125 \text{ cm}^3$

Kardus besar =  $p \times l \times t$   
=  $20 \times 15 \times 10$   
=  $3000 \text{ cm}^3$

Mainan ana yang masuk ke dalam kardus.

$$\frac{V \text{ kardus}}{V \text{ mainan}} = \frac{3000 \text{ cm}^3}{125 \text{ cm}^3} = 24 \text{ mainan}$$

Figure 3.3. RR's answer to first problem

Furthermore, 7 students use the formula of cube volume and area of cuboid surface or vice versa, using the formula of cuboid surface area and cube volume without understanding the meaning of that problem. As a result, the given answer has not suited with its problem. Students are not able to relate the information which had been given to that problem. It shows that student are still find difficulty in making meaning the problem. The error in determining the rule which is suited with problem in part is influenced by students performance level. The low performance level had experienced difficulty in initial stage of mathematical process such as in modeling into mathematics so it influences the using of suitable rule in giving solution to that problem [8][9].

The inability of students to apply the applicable rules, indicates the ability of the horizontal mathematical process of problematic students. Horizontal mathematical processes include the ability of students to change the problems given to mathematical models [10]. One of student's answer is presented in Figure 3.4 then one student do not answer the problem.


$$\begin{aligned}
 V &= p \times l \times t \\
 &= 20 \times 15 \times 10 \quad \rightarrow \text{balok} \\
 &= 300 \times 10 \\
 &= 3000 \text{ cm}^3 \\
 \\ 
 k &= 6 \times 5 \times 5 \\
 &= 6 \times 5 \times 5 \\
 &= 150 \text{ cm} \\
 \\ 
 &= \text{Mainan yg dapat masuk adalah} \\
 &= \frac{3000}{150} = 20 \text{ mainan}
 \end{aligned}$$

Figure 3.4. HN's answer to first problem

### 3.2. The second problem

The second problem can be seen from Figure 3.5.

Below is the drawing of two dices. Dice is a cube with special number in each its sides with the rule as follow: the number of dots in two opposite sides always 7.



You can make that dice by cutting, folding and attaching it with card. It can be done by many ways. In the figure below, you can see four pieces which can be used to make dice with dots in each sides. Which pieces which if it is folded can met the rule that the numbers of dot in its opposite sides is 7? For each pieces, mark “yes” or “no” in the table below accompanied with its reason.

Figure 3.5. The second problem [11]

The second question of the indicator is the case which relates to cube nets. Students can interpret it in accord with the given case. In this second problem, the process of mathematical literacy expected is interpreting.

From the second problem, total of 12 students are able to interpret from the problem given accompanied by clear and correct reason. Total of 20 students are able to determine the criteria in

cuboid nets presented with accompanying reason. However, the reason given has not completed. One of student's answer is presented in Figure 3.6 as follow.

| Bentuk | Memenuhi kriteria | Alasan  |
|--------|-------------------|---|
| (i)    | Ya/Tidak          | karena sisinya yg beraturan Tidak Berjumlah 7 |
| (ii)   | Ya/Tidak          | karena sisinya yg beraturan Berjumlah 7       |
| (iii)  | Ya/Tidak          | karena sisinya yg beraturan Berjumlah 7       |
| (iv)   | Ya/Tidak          | karena sisinya yg beraturan bidou Berjumlah 7 |

Figure 3.6. MP's answer to second problem

Based on Figure 3.6, it can be obtained that in nets I and IV, students choose “no” because it is not suited with the rule asked in problem. Then in nets II and III, students choose “yes” because it is suited with the rule in problem. Subsequently, they give reason to each criteria chosen. However, students are not able to write completely the example of dice dot which is suited and not suited in nets I, II, III and IV. It shows that students are still lack in deciphering, interpreting and checking two way relation between model and reality [12].

### 3.3. The Third problem

The third problem can be seen in Figure 3.7.

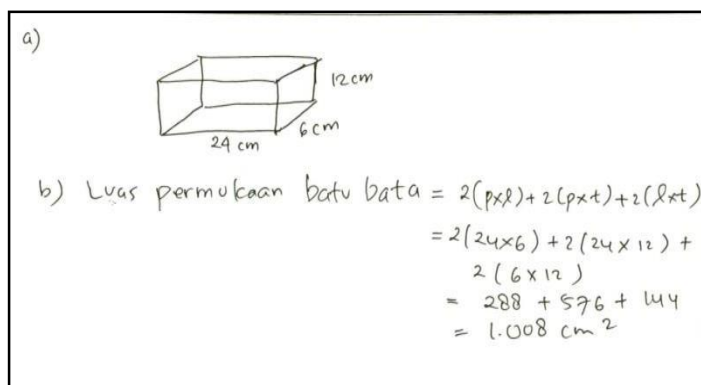
A brick with 24 cm in length, 12 cm in width, and 6 cm in thick.  
 a) make sketch of that brick and put its size;  
 b) count the area of that brick surface.

Figure 3.7. The third problem (Malasari, 2017 [13]).

The indicator of third problem is the case which relates to cuboid with certain size is known. Students are asked to make sketch of brick and count the area of brick surface. In this third problem, the process of mathematical literacy studied by formulating the situation mathematically and by employing mathematical concept, fact, procedure and reasoning

Total of 10 students sketch the brick correctly and put its size and count the area of that brick surface. Then, total of 15 students sketch the brick correctly along with its size but they are wrong in counting the area of brick surface. Total of 7 students sketch the brick but they are wrong in putting its size on sketch and as a result, they are wrong in counting the area of brick surface. It shows that

the ability in reasoning and problem solving which is basic ability of mathematical literacy is still constrained [14]. One of student's answer is presented in Figure 3.8 as follow.



a)

b) Luas permukaan batu bata =  $2(pl) + 2(pt) + 2(lt)$   
 $= 2(24 \times 6) + 2(24 \times 12) +$   
 $2(6 \times 12)$   
 $= 288 + 576 + 144$   
 $= 1.008 \text{ cm}^2$

Figure 3.8. KG's answer to third problem

#### 4. Conclusion

Based on analysis of student's answer, it obtains that mathematical literacy ability viewed from mathematical literacy process needs to be enhanced. It can be seen from the aspects of formulating problem, applying suitable concept, and reinterpreting answer into context which are constrained. Based on this, we suggest to use learning with realistic mathematic approach to help student in understanding concept. Mathematics is considered as human activity [15]. Mathematics is acquired because of experience and not because it is told, so mathematics which is acquired will be more meaningful for student. In realistic mathematic approach, students are first trained to model the given problem into mathematics. Modeling made by student pass through informal, semi formal, and formal stages. Then it is continued toward concept, principle, rule used in solving those problems so formal mathematical solution is obtained. Learning that make students are skillful to find the model from informal, semi informal until formal will give effect to student ability particularly to mathematical literacyability.

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