
A CASE STUDY OF STUDENTS' CREATIVITY IN SOLVING MATHEMATICAL PROBLEMS THROUGH PROBLEM BASED LEARNING

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ABSTRACT

Creativity could be interpreted as a person's cognitive abilities in solving problems by bringing up new ideas. The problems of students' math achievement lows are math presented as a finished product, ready to use, abstract and taught mechanistically. This case can be lead to the creativity of the less developed students because students are not given the opportunity to think and use their ideas in solving mathematical problems. Problem Based Learning Model is a learning model that emphasizes the concept and information outlined from the academic discipline. The purpose of this study is to analyzed students' creativity in solving mathematical problems through Problem Based Learning model (PBL) in class VIII-1 MTsN Model Banda Aceh. Data gained based on the students' worksheet in groups. The data acquisition is categorized into 5 levels (highest level 4 and lowest level 0) which is analyzed descriptively. The results are three groups were at level 4 with very creative categories, one group is at level 3 with a creative category and another group is at level 2 with deeply creative enough category. To the conclusion is PBL model could cultivate the students' creativity in solving mathematical problems.

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1. INTRODUCTION

Mathematics is a science that was very closely related to the problems of everyday life. A student In solving a math problem must have a good understanding, skill, and have a variety of strategies that can be used to solve different problems (Grootenboer & Zevenbergen, 2008). Problems that arise in everyday life often require students to think deeper to solve them. This can be done if students are able to understand the basic concepts of the content which is received. One of the most important factors in learning mathematics is the creativity. Creativity is needed to assist students in solving various mathematical problems related to daily life and other science (Brunkalla, 2009).

Creativity can be defined as a person's ability to create a new idea or incorporate an old idea to create something new that can be used in solving the problem. Mathematical creativity is the ability to open avenues of new questions for other mathematicians (Sharma, 2014). Creativity in mathematics is defined as the ability to see and choose solutions in mathematics (Sriraman & Lee, 2011). Creativity is a dynamic process within a person that can produce several strategies to solve problems. Creativity is a very valuable thing that must be owned by students in him, so that in learning mathematics students are expected to grow up their creativity by solving various forms of mathematical problems (Akgul & Kahveci, 2016).

The expected of mathematical learning is the learning that create the students more active and creative in solving the problems were given. Learning like this can involve students directly in solving problems given. But nowadays reality students tend to memorize concepts and definitions which are given without understanding those are (Hendriana, 2012). Low math skills can lead to the appearance of students' disrespect for mathematics. The low math ability of students can be seen from the results of national examinations of mathematics subjects ranging from primary education to secondary education. Based on results the evaluation of The Thrend in International Mathematics and Science Study (TIMSS) and the Program for International Student Assessment (PISA), it is known that Indonesian students have low math skills, where Indonesia is always got lower ranked (Mullis, Martin, Foy, & Arora, 2012). One of the biggest problems causing low mathematics achievement is that mathematics is presented as a ready-made, abstract, and mechanically-taught product (Sembiring, Hadi & Dolk, 2008). This case can be lead to the creativity of the less developed students because students are not given the opportunity to think and use theirs ideas in solving mathematical problems. Good creativity will facilitate students in solving any mathematical problems given, therefore creativity is a very important thing that must be owned by students.

Problem Based Learning (PBL) model is an instructional method that challenge a students to learn. Problem Based Learning Model (PBL) is a student-centered learning model, students learn about subjects in complex, diverse, and realistic contexts. Among the several advantages of PBL models is that PBL will have meaningful learning, in PBL method students integrate knowledge and skills simultaneously and apply them in relevant contexts, and PBL can improve critical and creative thinking skills. This study does not see the work of each student individually but the views are the work of students in groups, the goal is that students can exchange creative ideas that have in solving any given mathematical problems. Based on the forward case, there has been no previous research that discusses about student creativity in solving matematical problems with a groups. So, the formulation of the problem in this research is: "How is the students' creativity in solving mathematical problems through Problem Based Learning (PBL) Model?"

2. METHOD

This research employs a descriptive method to identify students answer of testing the implementation of Problem Based Learning (PBL) learning model to know the level of creativity in solving math problems for 2x40 minutes. The participant of this research is the students of class VIII MTsN Model Banda Aceh. One of the authors as a teacher during the learning process. Learning activities are carried out as follows.

- a. The teacher begins the learning by motivating students about the use fulness of learningto Flat-3D shape. Next, the teacher shows several pictures related to Flat-3D shape such as book shelves, swimming pools, andothers.

- b. Students are requested to ask questions about the surface area and volume of a Flat-3D shape so that students obtain additional information from the material being studied. Next, the students are divided into several small groups consisting of 4-5 people.
- c. The teacher distributes student worksheets for students.
- d. Students solve problems with limited guidance from the teacher.
- e. Each group presents answers alternately in front of the class.
- f. The teacher and students conclude the lesson about building a Flat-3D shape
- g. Students gather their answers, and the teacher ends the learning.

Assessment of student creativity can be seen from several aspects. According to Siswono (2011) aspects that must be considered to assess the creativity of students are:

- a. Fluency is an indicator of creativity in problem solving that refers to the diversity and correctness of answers that have been given by students.
- b. Flexibility is an indicator of creativity in problem solving that refers to the ways used by students in solving problems and correctness in accordance with the problems given.
- c. Originality is an indicator of creativity in solving problems that refers to the answers or ways given are not usually done students at the level of knowledge or it could be with the incorporation of ways done by students to produce a new

Data of students creativity in solving mathematical problems derived from the students worksheet in their groups during lesson. Students' creativity in solving mathematical problems is assessed based on the rubric in Table 1 which is analyzed descriptively. the examples of this research instrument are as follows.

Many things in daily life related to the matter of building a flat side room.

Look at the following picture !!!



In the picture above there are several forms of bookshelves are very beautiful and interesting, as well as some books are arranged on the shelf.

consider the following story!

Mr. Yuda is a very famous interior designer. Mr. Yuda got a job to design a reading room at Mr. Bahrin's house. Mr. Yuda's main job is to make a bookshelves on one side of the room. Bookshelves that must be made have an overall size of 2.2 m x 25 cm x 1.8 m. The tasks you should do are:

- A. Help Mr. Yuda to design a Bookshelves, you may choose one of the shelves of the drawings provided, or you can design your own shelves, so that the book on the shelf looks neat and the shelf design looks interesting! Make a settlement of more than one way!
- B. Determine the maximum number of books that can be loaded on the shelf you've designed! And specify the various sizes of books that you will fill in that shelves !
- C. Do you have to use the volume formula to determine how many books are arranged on the shelf? Why?

Students are said to be creative if they meet the following three aspects of creativity bellows: first is fluency, student can solve the problem given correctly, precisely and clearly. Second is flexibility, student can be provide interpretation and able to complete the calculation of the value of the problems provided in various ways (more than one) completion. The third is Orisinality, student has a different settlement from other groups and can make the image clear, neat and unique (Aizikovitsh-Udi, 2014).

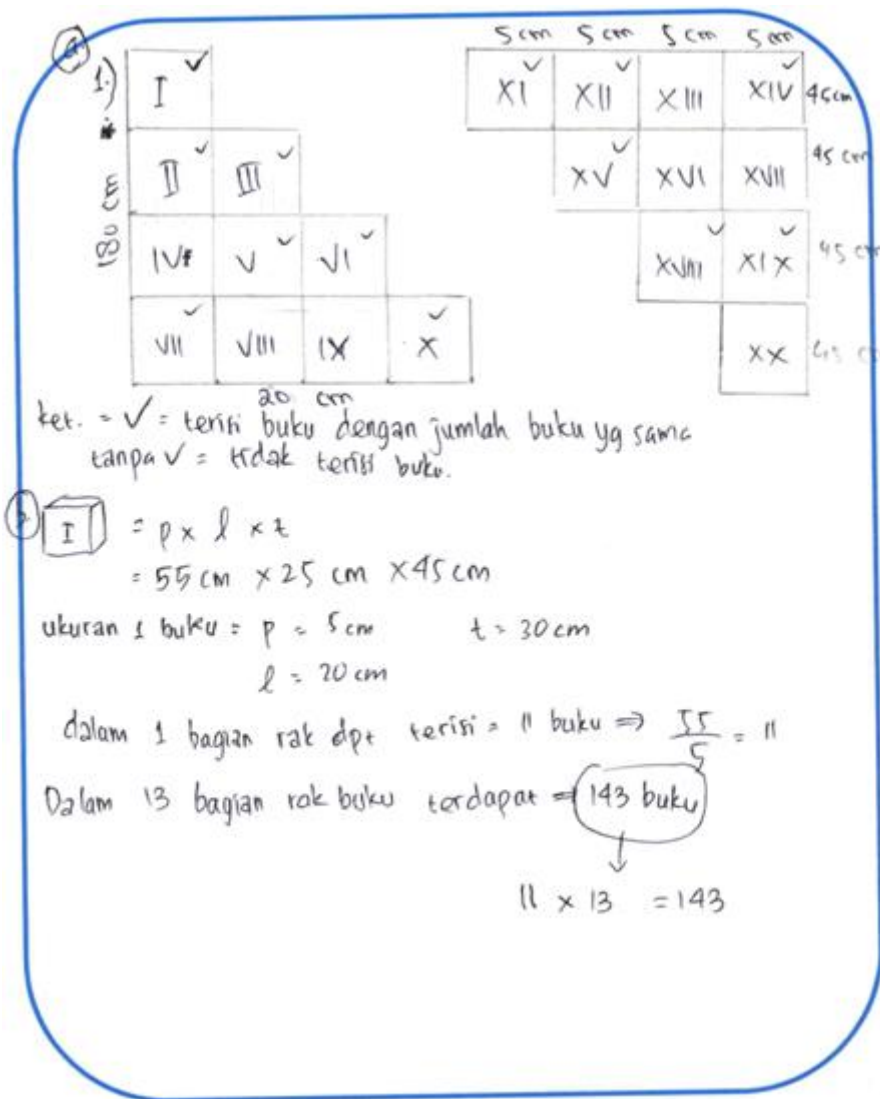
Creativity in solving math problems are divided into 5 levels they are, level 4 (very creative), level 3 (creative), level 2 (creative enough), level 1 (less creative), and level 0 (not creative) (Siswono, 2011). The criteria for determining the level of students creativity as seen at Tabel 1 below.

Table 1. Characteristics of Student Creativity

Level	Characteristics
Level 4 (very creative)	Students are able to demonstrate fluency, flexibility, and Orisinality or Orisinality and flexibility in solving math problems
Level 3 (creative)	Students are able to show fluency and Orisinality or fluency and flexibility in solving problems
Level 2 (Creative enough)	Students are able to show orisinality or flexibility in solving problems
Level 1 (Less creative)	Students are able to show fluency in solving problems
Level 0 (not creative).	Students are unable to show the three aspects of the indicators in solving the problem

3. RESULTS AND DISCUSSION

Problem Based Learning (PBL) model requires the students to solve problems by using their own ideas, this requires students to explore the information and think how to solve problems given so that creative ideas that they have can be used. The idea used by students for problem solving were different from group to others, so the results are vary. This can be seen in the picture below.



Translation:

Note :
 \checkmark : filled books with the same number of books

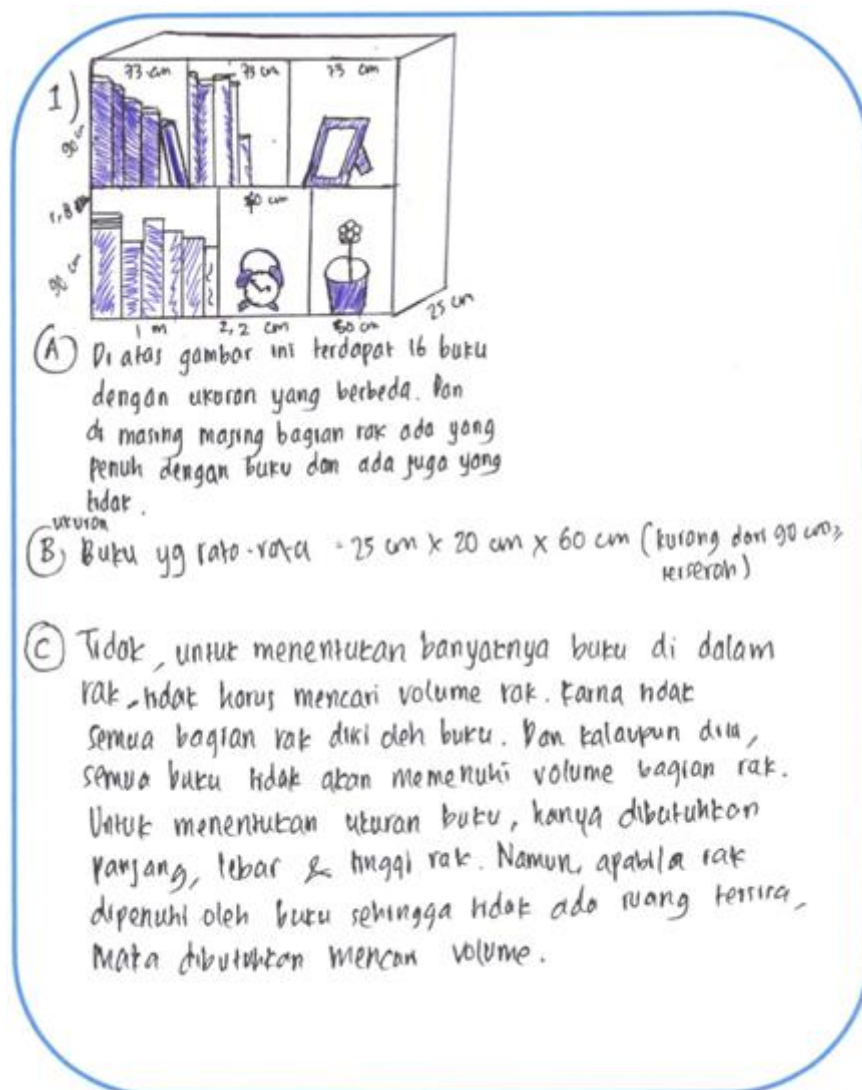
Without \checkmark = unfilled books

In one part of the shelf can be filled 11 books

In 13 sections of bookshelves there are 143 books

Figure 1. Student's answer

Figure 1 shows that students illustrated the picture of the bookcase along with the contents of the shelf, the students also gave an explanation of the illustration of the image in accordance with the material of the flat side room that has been learned. In the picture above students explained about the number of books that can be placed on the shelves that have been designed with several different book sizes. Based on the illustrations of drawings and book sizes that have been established then the bookshelf can be filled with 143 books, with some shelves not filled with books. The picture above shows that students have a good creativity in answering a given problem.

Translation:

- A. In the picture above there are 16 books of different sizes. Every shelf is loaded with books and there is also an unfilled shelf full of books
- B. The average size of each book is 25 cm x 20 cm x 60 cm (less than 90 cm)
- C. No, to find the number of books placed on bookshelves do not have to look for rack volume because not all shelf parts are filled with books. if the shelf is full of books also do not meet the rack volume. To specify the size of a book only takes the length, width and height of the shelf.

Figure 2. Student's answer

Based on the Figure 2 also shows that the students make illustrations of the problems provided and provide an explanation of the illustrations he did. At point A students explain the rack design illustrated, point B students determine the size of the book that can be arranged in the shelf, the size of the book specified adjusted to the size of the shelf given to LKPD. Point C is the conclusion given to the problem being worked on. Based on the work of the students together with each group then the conclusion obtained is to determine the number of books that can be arranged on a rack with a certain size does not have to use the formula of built up volume, in this case is to build a cube or block, but all it takes is the size of the book Which corresponds to the size of each rack level in the design. From the students' worksheet in Figures 1 and 2, there are three indicators of creativity are fulfilled is fluency, flexibility and novelty, so that based on the criteria in the assessment rubric, the two groups of students are at level 4 with very creative category.

Students' work in Figures 1 and 2 shows that students taught by implementing Problem Based Learning (PBL) model will have a good creativity in solving various problems given. the results obtained according to the theory forward by (Padmavathy & Mareesh, 2013) which states that one of the characteristics of learning with PBL model is

to produce a new works that will be exhibited, this requires students to use creativity in solving problems given

Not all students have the ability and good creativity in solving a problem, there are any students who do not understand the material taught and have difficulty in doing the task given. Some things that make the students difficult in doing tasks are because students are less accustomed in solving non routine problems, so that students experience some obstacles when doing the task. This is in line with the research conducted by Yuliani, Noer, & Rosidin (2018) which is the less developed mathematical creativity in solving mathematical problems caused by the learning that has been going on in the classroom, The students are given definitions and examples of routine questions without being linked first with the problems in daily life.

Leikin (2013) suggest that students' creativity will develop when students can use a different thinking in solving a given problem. but the results obtained from this study, there are still some students who were not able to use a different thinking in solving the problems given. this can be seen based on the following picture.

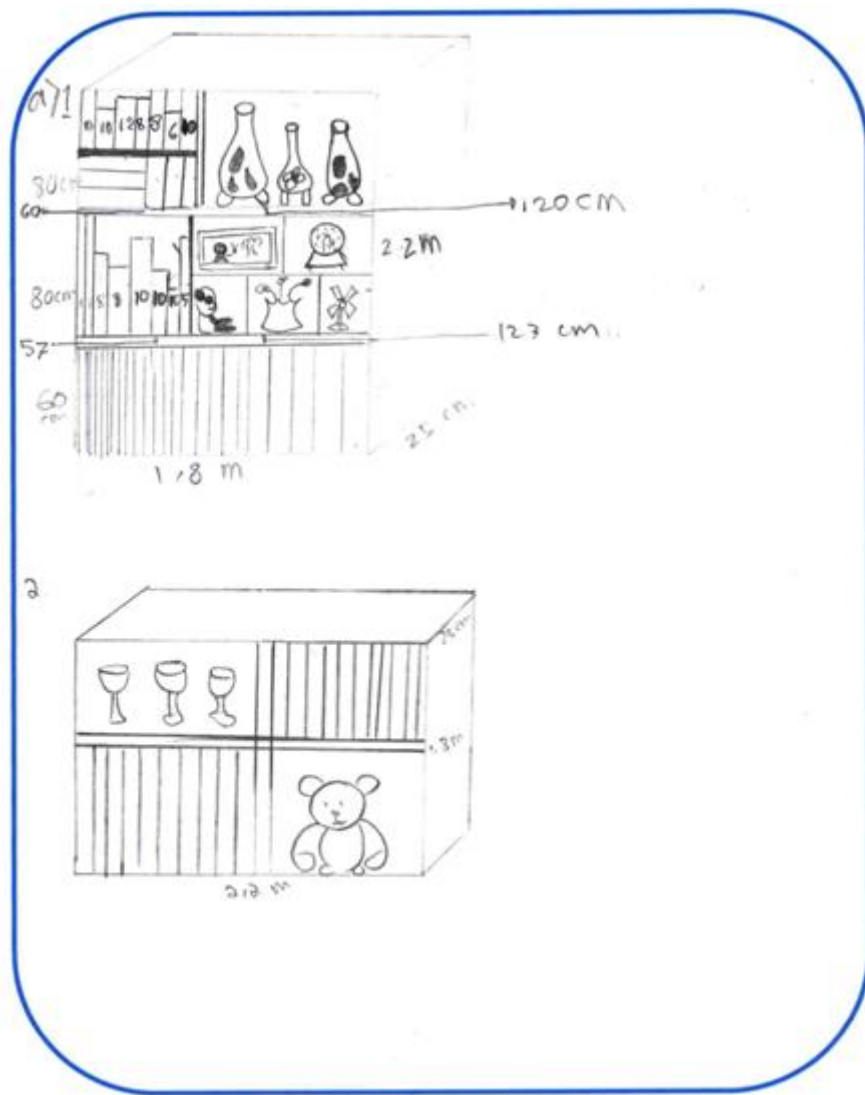


Figure 3. Student's answer

Figure 3 shows that some students are only able to illustrate the problem, but are unable to give a proper explanation of the problem, so that the indicator of creativity that is

fulfilled is only flexibility and novelty, then the students in this group are on level 2 with enough creative category. This is due to the fact that students in this group spend more time tidying up and perfecting the picture resulting the neatest and most beautiful picture in the class. Consequently, their mathematical explanation of the answer is incomplete. However, the teacher has reminded students as shown in the following passage.

T: where is the answer?

S: In a moment miss, the picture has not finished yet, after this we will make the answer

T: Two people should draw, two people should continue to answer, otherwise you will not be able to finish as the time goes on.

S: well miss, a little more for the picture.

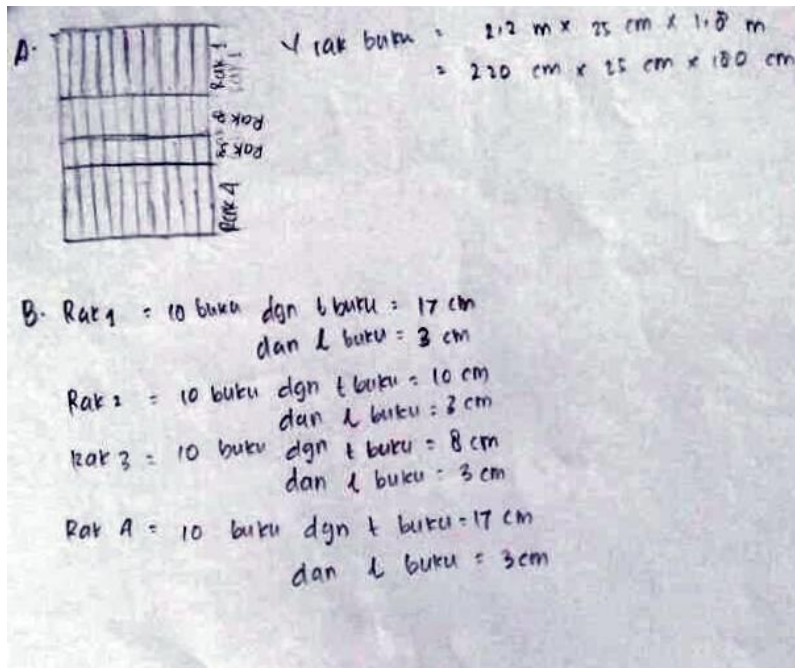
The group's mathematical answers were also not written on the answer sheets that were collected in stead they wrote numerical answers on the other sheets, and their solutions were not complete as shown in Figure 4.

<p>Dik : Panjang rak = 2,2 m = 220 cm Lebar rak = 25 cm tinggi rak = 1,8 m = 180 cm</p> <p>Dit : Jumlah buku maksimal yang dapat diletakkan pada rak ?</p> <p>Volume rak = $P \times L \times t$ $= 220 \times 25 \times 180$ $= 990.000$</p> <p>Rak I : Panjang buku = 15 15 cm lebar buku = 1,5 cm tinggi buku = 23 cm</p> <p>Banyak buku yang dapat diletakkan dalam rak I adalah 15000 990</p>	<p><u>Translation:</u></p> <p>Known: Shelf length: 2,2 m = 220 cm Shelf width : 25 cm Shelf height : 1,8 m = 180 cm</p> <p>Asked: The maximum number of books that can be filled on the bookshelf ?</p> <p>Shelf volume : $l \times w \times h$</p> <p>Shelf I : Book length : 15 cm Book width : 1,5 cm Book height : 20 cm Book that can be filled on bookshelf I are:</p>
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Figure 4. Student's answer

Based on Figure 3 and 4, it can be seen that the students' answers are not detailed and profound so that these students do not meet the criteria of fluency in their creativity as students in this group prefer to complete the picture entirely and neatly resulting in insufficient time to provide answer. This is in line with the research conducted by Surya (2010) which states that visual type students prefer to solve a problem by using an image if the problem given is a new problem for them or the problem given is a matter of the story.

In addition, other groups try to provide explanations and illustrations of the problem. however, the explanation given is not appropriate to answer the problems that exist in student worksheet, this is shown in Figure 5, so it only meets the indicators of fluency and originality. Based on criteria in the rubric of creativity assessment then this group is at level 3 with creative category.



Translation:

Volume Bookshelf

$$= 2,2 \text{ m} \times 25 \text{ cm} \times 1,8 \text{ m}$$

$$= 220 \text{ cm} \times 25 \text{ cm} \times 180 \text{ cm}$$

- **Shelf 1 = 10 book,**
with $h = 17 \text{ cm}$
And $l = 3 \text{ cm}$
- **Shelf 2 = 10 book,**
with $h = 10 \text{ cm}$
And $l = 3 \text{ cm}$
- **Shelf 3 = 10 book,**
with $h = 8 \text{ cm}$
And $l = 3 \text{ cm}$
- **Shelf 4 = 10 book,**
with $h = 17 \text{ cm}$
And $l = 3 \text{ cm}$

Figure 5. Student's answer

Based on the results above, it can be generally be argued that there is 1 group achieved level 2, 3 groups achieved level 3, 3 groups achieved level 4, and no group in level 1 or 0. Mathematics learning with Problem Based Learning model (PBL) gives a positive impact in fostering student creativity. This is in line with finding by Gunantara, Suarjana & Riastini (2014) state that the Problem Based Learning (PBL) model can improve students' ability in solving mathematical problems.

Students who have good skills in solving mathematical problems will also have good creativity in solving various problems given, this is in line with the theory put forward by Savery (2015) stating that the PBL model can increase students' ability in solving math problems. Research conducted by Pelczer & Rodriguez (2011) also states that students' creativity will develop if students are given an open problem so that students can use their mind, imagination and instinct to solve the given problem.

4. CONCLUSION

Based on the results of trials that have been done in MTsN 1 Banda Aceh with the subject of research is class VIII-1 by applying the model of Problem Based Learning (PBL) learning to cultivate students' mathematical creativity, then obtained the result that were three groups are in very creative category, one group was in creative categories and one group was in the creative enough category. These results reveal that PBL learning model can foster students' creativity in solving math problems.

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