International Conference on Mathematics and Science Education
of Universitas Pendidikan Indonesia
Volume 3, 2018 | P-ISSN 2655-2361, E-ISSN 2655-3252

Problem solving skill of junior high school students on the solid geometry topic

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Abstract. This study aims to investigate problem solving skills of junior high school students in solid geometry (cube, cuboid, prism, and pyramid) topic. A descriptive qualitative research study through individual written test (essay) was conducted to described problem solving skill of junior high school students. A test was given to 32 students of ninth grade in one of junior high school in Bengkulu, Indonesia. The result show that almost all student difficult to: 1) make strategy to solve the problem, 2) use the strategy planned before to solve the problem. This result of the study conclude that junior high school students have a low problem solving skills. The result of this study show us the need for developing an efffective learning which can fasilitate students in improving their problem solving skill.

1. Introduction

Mathematics has a large dimension in many aspects of life. It is not just a collection of formulas and numbers. The mathematical concept itself is useful for the innovations of human life. The National Council of Teachers of Mathematics (NCTM) mentions that one of the five existing mathematical skills is problem solving [1]. Problem solving is the heart of mathematics because fundamentally it consists of problems and solutions, so problem-solving skill becomes the basis of the existence of mathematics [2]. Moreover, students with good problem-solving skill will also have analogic abilities, reasoning skills, critical thinking skills, creativity, and good perception and memory [3]. Therefore, problem solving is the main goal of mathematics [4,5].

Geometry is one of the important materials studied in mathematics because it can relate mathematics to the physical forms of the real world. Geometry is also the only field of mathematics that can enable mathematical ideas to be visualized [6].

The importance of problem-solving skill is not in line with the reality. The results obtained from PISA in 2012 showed that only less than 1 percent of Indonesian students can answer questions in a complex situation, which requires reasoning and the ability to choose, compare, and evaluate appropriate strategies as the solution in solving the given problem [7]. The study on mathematical problem-solving skill of junior high school students showed that 60% of them did not fulfill the minimal score (*KKM*) for mathematical problem-solving test [8]. Furthermore, the results of a research related to the problem-solving skill of junior high school students also indicated that they still had difficulty in solving the problems, such as: (1) failed to use their background knowledge and to define and design a strategy for solving the problems; and (2) performed errors in applying certain mathematical concepts related to the problems. The results showed that they did not understand the concepts well [9,10].

The description of the problem-solving skill above was based on the research that focused on the investigation of problem-solving skill of junior high school students, and was expected to be one of the parameters in creating the learning atmosphere that can improve their problem-solving skill.

2. Experimental Method

This research employed descriptive qualitative method aimed to investigate the students' problem-solving skill. The subjects in this study were 32 ninth-graders at one of junior high schools in Bengkulu. The instrument used was an individual test (essay). This test consisted of four problems that represent every mathematical problem-solving indicator. Within 80 minutes, the students had the opportunity to solve the problems. The results from the students' answer sheets were then analyzed by using descriptive qualitative method.

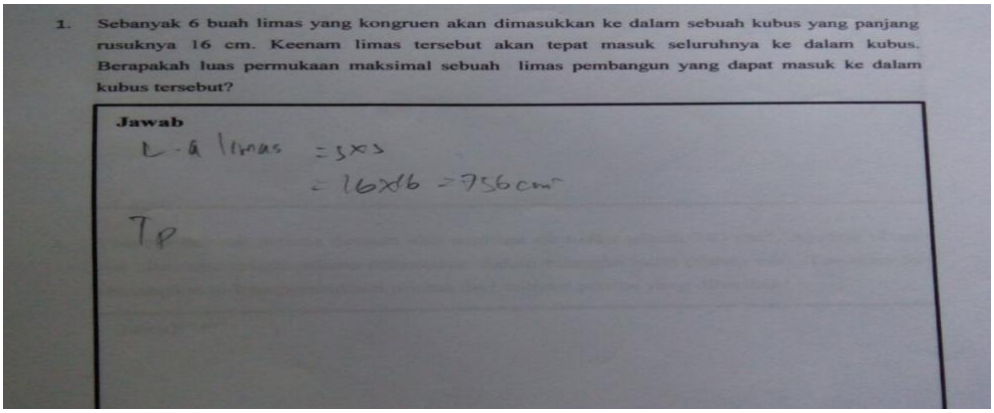
3. Results and Discussion

Table 1 Students' test results

	Correct	Incorrect	No answer	% of the correct answers
1	2	23	7	6,3
2	3	25	4	9,4
3	6	24	2	18,8
4	9	22	1	28,1

Table 1 depicts the recapitulation of individual student's test results related to the problem-solving skill. It can be seen from table 1 above that question number four got the highest percentage of correct answers followed by question number three. While, question number one got the lowest percentage of correct answers. In the question number one, only two students could solve the problem correctly, while the rest could not answer it correctly. Even, seven students gave no answer at all. This indicated that the students did not understand at all about the intent of the question number one. They could not read the available data. As a result, they could not fulfill the steps of the problem-solving strategy [11].

In the test number one, most students could not find a way how to place the six pyramids into the cube correctly, which can be done by determining the size of the pyramids themselves first. If they could find a way to place the pyramids into the cube and determe the correct size of the pyramids, they could easily find the surface area of the pyramids. This showed that they did not understand about the concept related to problem 1. Figure 1 below shows the example of the student's answer.


1. Sebanyak 6 buah limas yang kongruen akan dimasukkan ke dalam sebuah kubus yang panjang rusuknya 16 cm. Keenam limas tersebut akan tepat masuk seluruhnya ke dalam kubus. Berapakah luas permukaan maksimal sebuah limas pembangun yang dapat masuk ke dalam kubus tersebut?

Jawab

L. a limas = 5 x 5

= 16 x 16 = 256 cm²

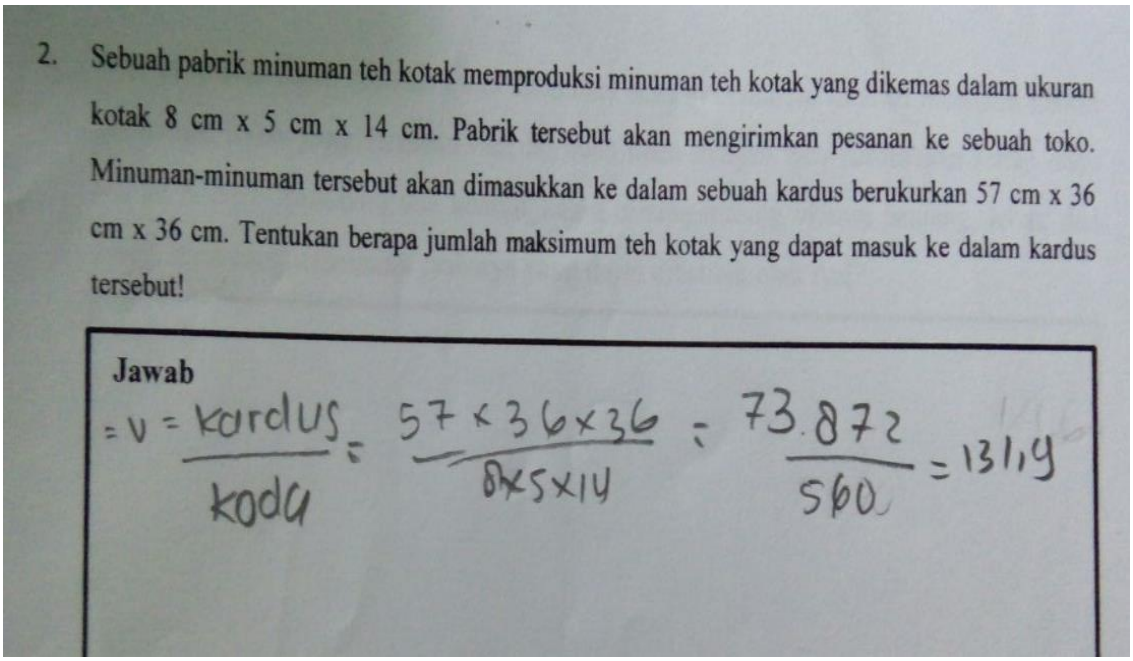
Tp

Figure 1 Example of the students' answers

Volume 3, 2018 | P-ISSN 2655-2361, E-ISSN 2655-3252

The example of the student's answer in figure 1 above showed that the problem-solving skill was still low. The students could not determine the right strategy to solve the given problem. There were no cube and pyramid images on the student's answer sheet that can facilitate them in determining the surface area of the pyramid. They have no concept that could be used to solve this problem. This indicated that they could not fulfill the steps of problem-solving strategy, according to Polya, which are planning the strategy and solving the problem based on the previously planned strategies [11].

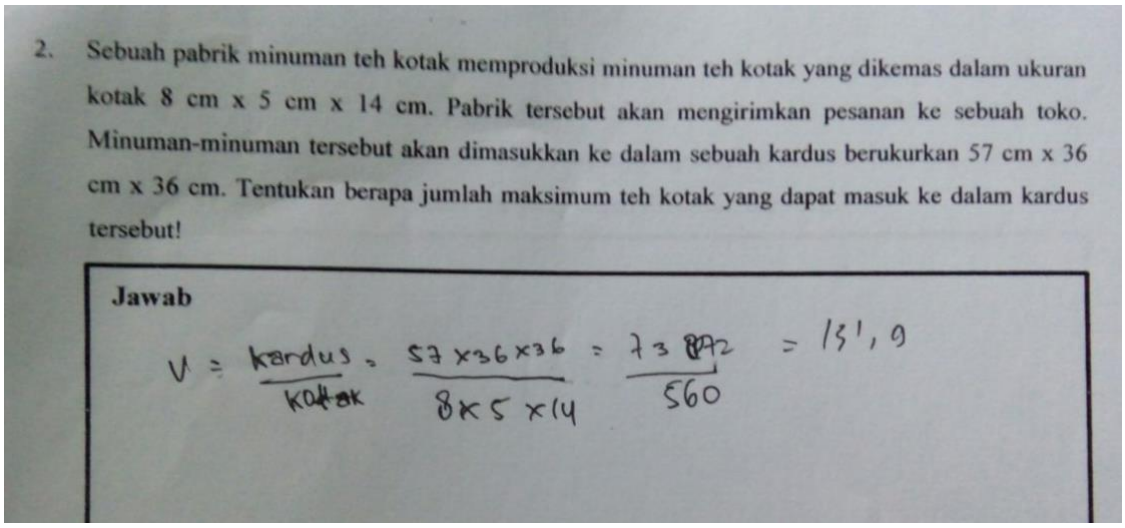
In question number two, only three (3) students could answer the question correctly. While, four (4) students did not give any answer at all, which meant that they could not read the data about the problem. They could not identify which elements of the problem were important to be used in solving the problem. Then, most students gave wrong answers. They gave the same answers as shown in the picture below.


2. Sebuah pabrik minuman teh kotak memproduksi minuman teh kotak yang dikemas dalam ukuran kotak 8 cm x 5 cm x 14 cm. Pabrik tersebut akan mengirimkan pesanan ke sebuah toko. Minuman-minuman tersebut akan dimasukkan ke dalam sebuah kardus berukurkan 57 cm x 36 cm x 36 cm. Tentukan berapa jumlah maksimum teh kotak yang dapat masuk ke dalam kardus tersebut!

Jawab

$= V = \frac{\text{kardus}}{\text{kotak}} = \frac{57 \times 36 \times 36}{8 \times 5 \times 14} = \frac{73.872}{560} = 131,9$

Figure 2 The first student's answer


2. Sebuah pabrik minuman teh kotak memproduksi minuman teh kotak yang dikemas dalam ukuran kotak 8 cm x 5 cm x 14 cm. Pabrik tersebut akan mengirimkan pesanan ke sebuah toko. Minuman-minuman tersebut akan dimasukkan ke dalam sebuah kardus berukurkan 57 cm x 36 cm x 36 cm. Tentukan berapa jumlah maksimum teh kotak yang dapat masuk ke dalam kardus tersebut!

Jawab

$V = \frac{\text{kardus}}{\text{kotak}} = \frac{57 \times 36 \times 36}{8 \times 5 \times 14} = \frac{73\,872}{560} = 131,9$

Figure 3 The second student's answer

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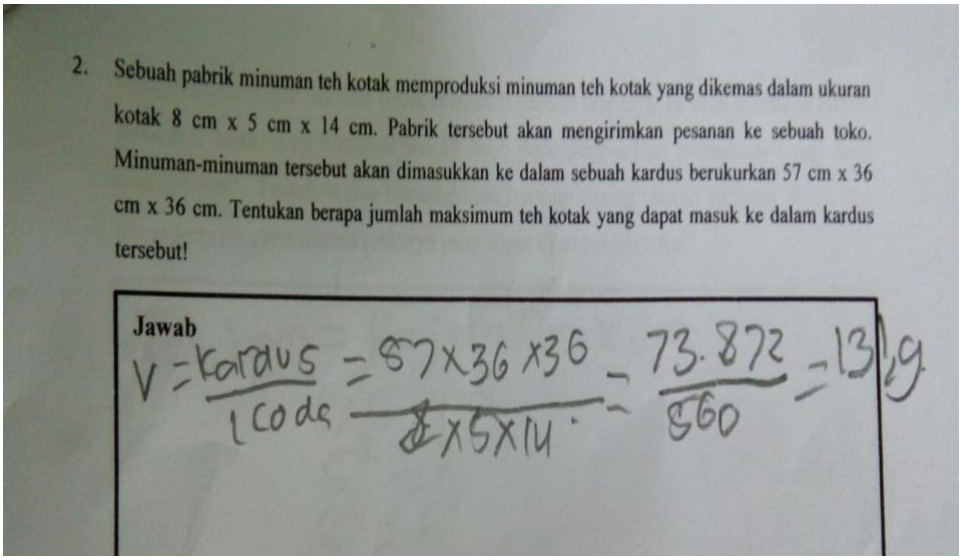

Figure 4 The third student's answer

Figures 2, 3, and 4 showed that the solution given by the students was incorrect, although the answers given by the students have illustrated their understanding on what was asked about related to the problems and what concepts could be used to solve the problem. The majority of their answers indicated that they still did not consider that the number of *Teh Kotak* (the product name) should be an integer, such as: 2, 3 and etc. rather than a decimal number like the answers given by the student. Students could be finished by counting the number of *Teh Kotak* (the product name) that coud be placed in length side, width side, and height side to get the right answer. Then, they could multiply each of the number of *Teh Kotak* in length, width, and height side. This indicated that they still did not fulfill the appropriate steps of problem-solving strategy asserted by Polya, which are finding the right solution strategy and using the previously planned strategy to solve the problem [11].

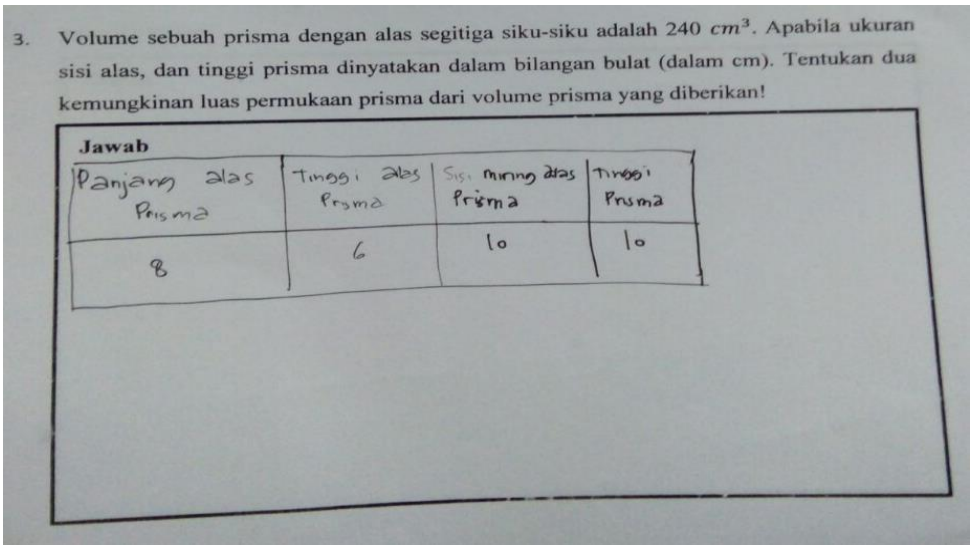

Figure 5 Example of the student's answer for question number three

Figure 5 depicts one of the student's answer on question number three. It represents that the students knew what they needed to do to obtain the size of a prism, but only gave one size type of the prism, whereas the question asked them to provide two possible answers. Furthermore, they did not give an answer about how much surface area of the size of the prism was. This showed that they could

Volume 3, 2018 | P-ISSN 2655-2361, E-ISSN 2655-3252

not fulfill the Polya's steps of problem-solving strategy, which are finding the problem-solving strategy and using it to solve the given problem [11].

Question number four represents the results that the majority of the students gave correct answers; one of which is shown at Figure 6 below. However, there was one step that they forgot; that was finding the length of the cube rib. They directly calculated the length, width, and height of the formed block.

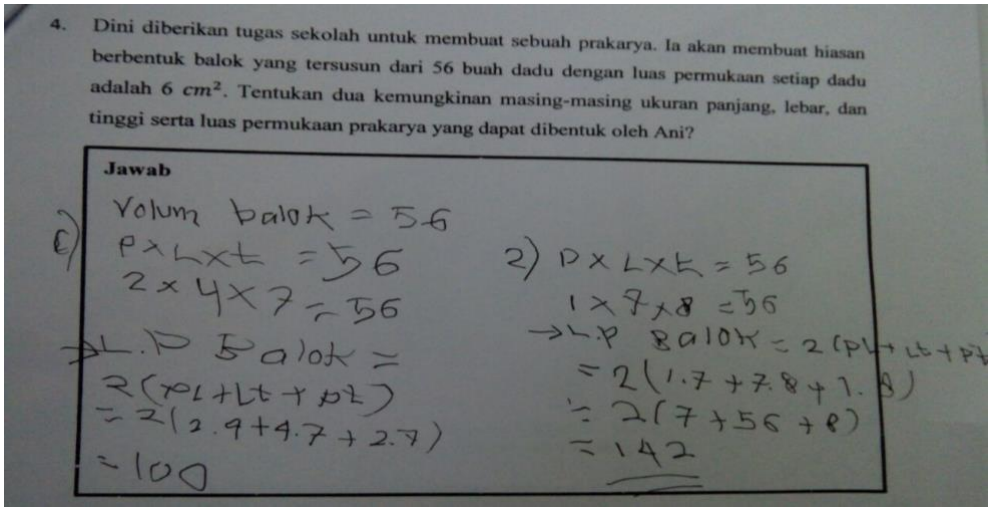

Figure 6 One of the students' answers for question number four

This showed that the students could not write down the complete steps to get the block's surface area. They did not fulfill Polya's problem-solving strategy, which is finding the right strategy to solve the problem.

4. Conclusion

Based on the results of the students' answers that have been described before, it appears that their problem-solving skill was still low. There were some students who did not understand what was being asked about the given problem. Some students could not determine what concept was used to solve the problem. As a result, they had difficulty in planning and using appropriate strategies to solve all problems. This might be caused by the learning charcteristic that only emphasized on assigning questions, but not included the problem-solving category.

5. Acknowledgments

We thank the students and the teacher who have participated in this research.

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