STUDENTS' REPRESENTATIONS IN SOLVING WORD PROBLEM OF 3-DIMENSIONAL FIGURE BASED ON VISUAL-SPATIAL, LINGUISTIC, AND LOGICAL-MATEMATICAL INTELLIGENCE

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Abstract

Nowadays mathematics' learning is emphasized on learning problem solving. Usually the given problems is word problems. 3-dimensional figure material is often presented in word problems. However, there are still many students who have difficulty in solving word problems in 3-dimensional figure because they have difficulty in representing word problems into mathematical models. One of the factors that influence students' representation is the kind of intelligence they have. Therefore, the aims of this research is to describe students' representation with visual-spatial, linguistic, and logic-mathematic inteliigence in solving word problems on 3-dimensional figure. This research used the qualitative approach. The data for this research is obtained through the students' result of solving word problems on 3-dimensional figure. Representations that use visual-spatial intelligence's student in presenting information from word problems is visual representation. To determine and express outcomes using symbolic repesentation. Student with linguistic intelligence use visual representation to present information from word problems, using symbolic representation to determine outcomes and verbal representations to express the outcomes. Student with logical-mathematical intelligence use visual representation to present information from word problems and use symbolic representation to determine and express the outcomes.

Keywords: representation, 3-dimensional figure, word problem

INTRODUCTION

Nowadays, mathematics learning emphasized on problem solving learning with hope that students not only understand the concept that has been taught but also can apply it to solve problems. As seen in the Curriculum 2013, every basic competency in KI 3 has a partner on the basic competencies in KI 4. The problem used is usually in the form of a word problems. 3-dimensional figure is a mathematical material often presented in word problems. However, there are still many students who have difficulty in solving word problems in 3-dimensional figure because they have difficulty in representing word problems into mathematical models. As seen in Cahyaningrum's research (2015), students' difficulties in word problems with prism and pyramid topics lie is in interpreting words in story problems into mathematical models.

Goldin (2002) defines representation as a configuration (form or arrangement) that can describe something in a way. Villegas, et al (2009) divides the external representation into three types. The three types of representations are visual representation (diagrams, graphs or tables, and images), symbolic representation (equations or mathematical expressions), and verbal representation (written words or texts). The three types of representations have different indicators. In generating an external representation can be influenced by several factors, one of which is the type of intelligence possessed by the individual. Differences in intelligence possessed by each student influences the ability to absorb and the ability to think in learning in school (Baum, et al, 2005). Students with visual-spatial intelligence will tend to use visual representation in solving a problem. Students with linguistic intelligence will tend to use verbal representation in solving a problem. Meanwhile, students with logical-mathematical intelligence will tend to use a symbolic representation in solving a problem.

Based on the above explanation, this research is done to know and describe students' representation in solving the word problems in 3-dimensional figure based on visual-spatial, linguistic, and logical-mathematical intelligene.

METHODOLOGY

This research is a descriptive qualitative research to describe students' representation in solving word problems on 3-dimensional figure. The data in this research were obtained from 9-7 students of SMPN 3 Candi. The subjects of this study were 3 students with criteria:

1. Student with visual-spasial intelligence.
2. Student with linguistic intelligence.

3. Student with logical-mathematical intelligence.

All three subjects have an equivalent level of mathematical ability (the difference in test result is not more than 5 points on a scale of 100).

The test used to determine the subject of this research is a multiple intelligence test and a students' level of mathematics ability test in the form of 5 word problems related 3-dimensional figure.

Test

Data related to the students' representation obtained through the results of the word problem test have done by the subject of this research. The test is in the form of two word problems related to the four sub-chapters of 3-dimensional figure. This test will be given and completed individually by each research subject within 15 minutes for each question.

RESEARCH RESULT AND DISCUSSION
Research Result
1. Subject 1 (SKV)

Representation of subject with visual-spasial intelligence in solving word problems on 3-dimensional figure with .
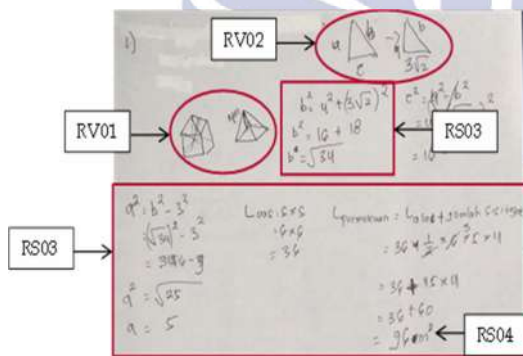
a. In Word Problem Number 1

Figure 1. Subject 1's answer on test Number 1

From the answer sheet above, we can see that SKV presents known information using visual representation (RV01). SKV presents known information by drawing a rectangular pyramid of tent with height $4m$. SKV also develops a resolution strategy using visual representation (RV02), SKV draw some triangles to be searched the length to determine the height of the upright side of the tent. However, when operating the known data, SKV uses a symbolic representation (RS03). SKV operates a mathematical model containing a mathematical equation to determine the length of the triangles side of a rectangular pyramid and to determine the surface area of the tent (rectangular pyramid). In present the outcome, SKV also uses a symbolic representation (RS04).

SKV state the result obtained that the surface area of the tent is $96cm^2$.

Based on the SKV's solution of question Number 1 (Figure 1) above, it can be conclude that to solve the word problem on 3-dimensional figure Numbe 2 SKV uses two types of representation, namely visual and symbolic representations.
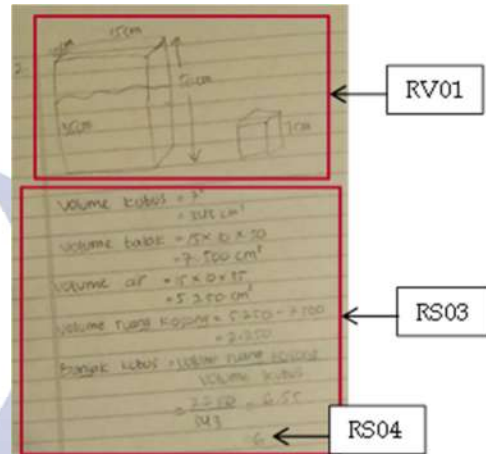
b. In Word Problem Number 2

Figure 2. Subject 1's answer on test Number 2

From the answer sheet above we can see that SKV uses visual representation (RV01) to present the known information in the form of image. The image is a cuboid with the length is $15cm$, the wide is $10cm$, and the height is $50cm$ that contains water as high as $35cm$ and draw a solid cube with length of each side is $7cm$.

After that, SKV uses a symbolic representation (RS03) in operating the known data to solve that word problem. SKV operates known data with mathematical expressions, but does not write mathematical formulas for the operation. SKV also presents the outcome in symbolic representation (RS04). SKV presents the outcome in the form of mathematical expression that the total cube that can contained in the cuboid is 6.

Based on SKV's solution in solving word problem on 3-dimensional figure Number 2 (Figure 2), it can be concluded that SKV uses visual and symbolic representations.

2. Subject 2 (SKL)

Representation of subject with linguistic intelligence in solving word problems on 3-dimensional figure .
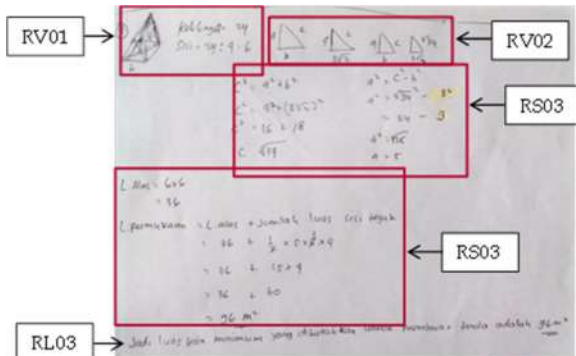
a. In Word Problem Number 1

Figure 3. Subject 2's answer on test Number 1

From the answer sheet above, it can be seen that SKL represents the known information by using visual representation (RV01) by drawing the tent (rectangular pyramid). Furthermore, SKL also uses visual representation (RV02) in develops a resolution strategy for word problem Number 1. It is shown in the draw of some right triangles that will be used to obtained additional information that is the length of upright side of the rectangular pyramid to determine the surface area of the tent. However, when operating the known data to solve that word problem SKL uses symbolic representation (RS03) and in presents the outcome SKL uses verbal representation (RL04).

Based on the SKL's solution (Figure 3), it can be concluded that SKL uses all three type of representation in solving word problem on 3-dimensional figure Number 1.
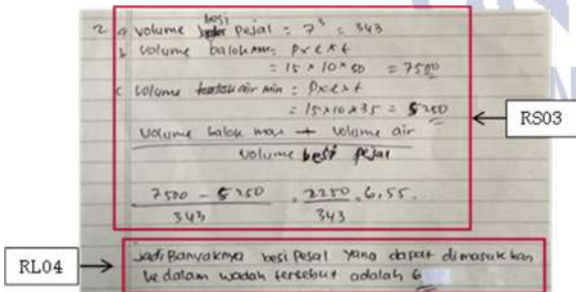
b. In Word Problem Number 2

Figure 4. Subject 2's answer on test Number 2

From the answer sheet above, it can be seen that SKL uses symbolic epesentation (RS03) for determine the solution of word problem Number 2. It is shown by the mathematical equation containing symbols of mathematical expression that operated in accordance with its rules by SKL to determine the outcome of that word problem. However, in expressing the outcome SKL uses verbal representation (RV04).

Based on SKL's solution in solving word problem on 3-dimensional figure Number 2 (Figure 4), it can be concluded that SKL uses symbolic and verbal representations.

3. Subjek 3 (SKM)

Representation of subject with logical-mathematical intelligence in solving word problems on 3-dimensional figure.
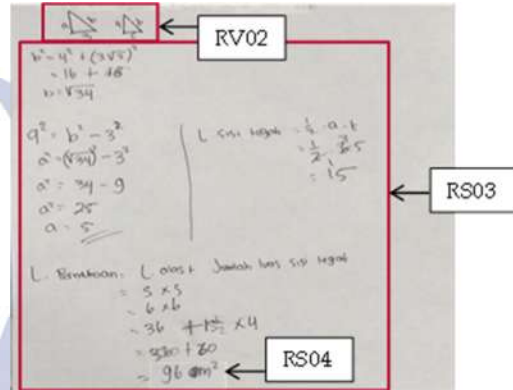
a. In Word Problem Number 1

Figure 5. Subject 3's answer on test Number 1

From the answer sheet above, it can be seen that SKM uses visual representation (RV02) when making a strategy to solve that word problem. In making strategy to solve that word problem, SKM draw some triangles. The figure of two triangles that are used as as aids to determine the additional information that needed to determine the length of the upright side and surface of of rectangular pyramid. Furthermore, SKM uses symbolic representation (RS03) in calculation to determine the outcome of the solution of that word problem. It is shown by SKM operating symbols and mathematical equations to determine the surface are of rectangular pyramid. SKM also express the outcome in the form of mathematical expressions. In other word, SKM uses symbolic representation (RS04) to express the outcome.

Based on SKM's answer in solving word problem on 3-dimensional figure. Number 1 (Figure 5), it can be concluded that SKM uses symbolic and verbal representations in solving word problem on 3-dimensional figure Number 1.

b. In Word Problem Number 2

Figure 6. Subject 3's answer on test Number 2

From the answer sheet above, it can be seen that SKM directly operate the equation that contains symbol or mathematical expression to determine the outcome of the solution of that word problem, without presents the known information first. This indicates that SKM uses symbolic representation (RS03) to determine the outcome of that word problem Number 2. SKM also express that outcome in symbolic representation (RS04).

Based on SKM's answer in solving word problem on 3-dimensional figure Number 2 (Figure 6), it can be concluded that SKM uses symbolic representation in solving word problem on 3-dimensional figure Number 2.

Discussion

According to existing theories, students with visual-spatial intelligence will potentially use visual representation of images in solving word problems on the 3-dimensional figure. Students with linguistic intelligence will potentially use verbal representation in solving word problems on the 3-dimensional figure. Students with logical-mathematical intelligence will potentially use symbolic representations in solving word problems on the 3-dimensional figure. That's because of students' representation is influenced by their intelligence. But in practice the results obtained differ with the theory.

Based on the results of the analysis related to the students' representation in solving the word problem on the 3-dimensional figure Number 1 and 2, it can be seen that students with visual-spatial intelligence use visual representation in form figure when presenting known information. Students with visual-spatial intelligence use a symbolic representation to determine the outcome of the solution and express the outcome also by using symbolic representations. Although using more than one type of representation, students with visual-spatial intelligence

dominant use symbolic representation to solving word problems on the 3-dimensional figure. This is contrary to the theory that students with visual-spatial intelligence will tend to use visual representation to solving word problems on the 3-dimensional figure.

Based on the results of the analysis related to the students' representation in solving the word problem on the 3-dimensional figure Number 1 and 2, it can be seen that students with linguistic intelligence using visual representation, verbal, and symbolic. However, dominant use symbolic representation. Visual representation is only used to represent the known information in word problems. Verbal representation is only used to express the outcome of the solution. Meanwhile, to determine the outcome of the solution of the word problem by using symbolic representation. It is also different from the theory that students with linguistic intelligence will tend to use verbal representation in solving word problems on the 3-dimensional figure.

Students with logical-mathematical intelligence also use more than one type of representation in solving word problems on the 3-dimensional figure. The representation used is visual representation and symbolic representation. However, student with logical-mathematical intelligence is more dominant using symbolic representation in solving word problems on the 3-dimensional figure. Visual representation is used by the students with logical-mathematical intelligence only to making strategy to solving word problems on the 3-dimensional figure. To determine the outcome of the solution, students with logical-mathematical intelligence using symbolic representation. In express the outcome students with logical-mathematical intelligence also using symbolic representation. This is in line with the theory that students with logical-mathematical intelligence will tend to use a symbolic representation in solving word problems on the 3-dimensional figure.

CONCLUSION AND SUGGESTION
Conclusion

Based on the data of the research and discussion that has been described by the researcher, it can be concluded that the students' representation in solving the word problems on the 3-dimensional figure based on the visual-spatial, linguistic, and logical-mathematical intelligence as follows.

1. Representation used by students with visual-spatial intelligence in solving the word problems on the 3-dimensional figure are visual representation and symbolic representation. Visual representation is used to represent the known information from the word problems and making a solving strategy. The use of symbolic representation is indicated by the

mathematical equations or symbols used by the students and operated according to the mathematical rules to determine the outcome of solution and express the outcome in solving the word problems on the 3-dimensional figure.

2. Representation used by students with linguistic intelligence in solving the word problems on the 3-dimensional figure are visual representation, verbal representation and symbolic representation. The use of visual representation to present the known information contained in the problem. The use of symbolic representation is indicated by the mathematical equations or symbols used by the students and operated according to mathematical rules to determine the outcome in solving the word problems on the 3-dimensional figure with . Verbal representation is used to express the outcome of the solution.

3. Representation used by students with logical-mathematical intelligence in solving the word problems on the 3-dimensional figure are visual representation and symbolic representation. Visual representation is used to present the known information that contained in the word problem. Meanwhile, the use of symbolic representation is indicated by the mathematical equations or symbols used by the students and operated according to mathematical rules to determine the outcome in solving the word problems on the 3-dimensional figure.

Suggestion

Based on research data, analysis, and drawing conclusions that have been done by researchers, there are several suggestions that can be mentioned by researchers as follows.

1. The word problem used in this research gives the result that the students' representation in solving the word problems on the 3-dimensional figure is symbolic representation. Thus, it can be seen that not all word problems can gives the result in a diversity of representations in the solution. Therefore, the selection of word problems is important for the further research to make the students' representations appear more diverse.

2. The result of this research is shown that students withs visual-spasial, linguistic, and logical-mathematical intelligence used symbolic representation in solving the word problems on the 3-dimensional figure. That is indicate that students' intelligence is not always be the factor of the diversity of students' representation. Therefoe, there are should be another research that examines more about the factors that cause the diversity of students' representation.

3. In this research, it is not known yet the cause of students with visual-spatial, linguistic, and logical-mathematical intelligence using symbolic representation in solving the word problems on the 3-dimensional figure. That's because researchers did not conduct interviews test to obtain in-depth information. Therefore, for a similar study it is desirable to have an interview test in order to obtain in-depth information on the representation used by the student and the cause of the student using that representation.

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