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AN ANALYSIS OF HIGH SCHOOL STUDENTS' ERROR IN SOLVING MATHEMATICS PROBLEMS RELATED TO THREE DIMENSION TOPIC

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Abstract

Solving mathematics problem is a mental activity that someone does by using knowledge, skills, and understanding to get the final result as a response. In solving mathematics problem, many students still make mistakes. An error in solving mathematics problem occurs when students answer the question incorrectly. Newman's Error Analysis is used in this research including reading error, comprehension error, transformation error, process skill error, and encoding error. The causes of students' error from their intellectual ability in understanding the three dimension topic. The research purpose is to describe (1) the location of error made by high school students in solving mathematics problems related to the three dimension topic and (2) the causes of error made by high school students in solving mathematics problems related to the three dimension topic. The researcher used descriptive qualitative research design. The data were collected at SMA Muhammadiyah 1 Taman Sidoarjo. Four subjects of this research were chosen from XII IPS 2. In this research, students are given mathematics problems for knowing the students' error in their problem solving. Mathematics problem related to three dimension is used in this paper based test. The researcher used test and interview to collect the data. Data reduction, data display, and conclusion will be used to analyze the data. The result of the research shows that the students made error in solving mathematics problems related to three dimension topic including reading, comprehension, transformation, process skill, and encoding errors. These errors happened because they do not understand keywords in the problem, do not understand concept of distance in three dimension, do not understand concept of angle in three dimension, do not master prerequisite topic including pythagoras theorem and comparison of areas of triangles, cannot write systematic procedure to solve the problem, and careless in encoding.

Keywords: Reading error, comprehension error, transformation error, process skill error, encoding error.

BACKGROUND

Mathematics is one of the instruments to know the students' understanding of the material that has been taught. According to Effendy (2014), solving a math problem is a thought that someone does by using knowledge, skills, and understanding to get the final result in response. The steps in solving the problem according to Polya (1973) is understanding the problem, devising a plan, carrying out the plan, and looking back. Steps in solving the problem actually help students more thorough in solving math problems. But not everything is applied by students so that students will make some mistakes in solving math problems.

According to Singh (2010) the location of the error is categorized into five categories according to the stages of Newman, namely error readings, misunderstanding, error transformation, process skill mistakes, and coding errors. Meanwhile, according to Abdullah (2015) the location of errors are also categorized into five categories according to the stages of Newman, namely error readings, misunderstandings, error transformation, process skill mistakes, and coding errors. But there are some differences in the meaning of each stage although this difference is actually not very significant.

Error location indicator of this research can be seen in Table 1.

No	Error Location	Indicator
1	Reading	a. Cannot define and explain the words or symbols in the problem. b. Wrong in determining and explaining the words or symbols in the problem.
2	Comprehension	a. Cannot determine what is known.

No	Error Location	Indicator
		b. Wrong in determining what is known. c. Cannot determine what is asked. d. Wrong in determining what is being asked.
3	Transformation	a. Cannot determine the procedure or sequence that will be used to solve the problem. b. Incomplete in determining the procedure or sequence to be used to solve the problem.
4	Process Skill	a. Wrong in making image representation to solve the problem. b. Cannot perform calculations. c. Wrong in doing the calculations. d. Cannot continue calculation.
5	Encoding	a. Write down an inappropriate answer. b. Not writing the final answer.

Table 1. Error Location Indicator

In this research, the factor of cause of error is the factor that comes from within the student concerning the intellectual ability of the students in understanding the material of dimension three refers to Sugiarto's opinion (2017). Factors that cause errors will depend on student work outcomes and interviews.

Error analysis is the investigation and diagnosis of student work. With the student's job diagnosis of student error, the teacher can see the pattern of mistakes made by the students so they can find the possible cause. According Roselizawati (2014), with the error analysis it can be made a diagnosis of student error. This diagnosis is based on the student's work so that a teacher can create an error pattern to determine the cause of the error. Meanwhile, according to Satoto (2012), error analysis can minimize the occurrence of errors again at the next meeting on the same material. If the teacher knows the location and type of student error, then the teacher will improve how to teach it. If the student knows the location and type of error, then the student will also correct the wrong part and not repeat it. The impact of error analysis according to Imswatama (2016) in teaching and learning activities is obtained a detailed description of the weaknesses of students in solving the problem. From student mistakes that have occurred, teachers can use it as a consideration of teaching to improve learning and teaching activities. It is expected that teachers find solutions for student learning outcomes can also increase.

One of the attempts in analyzing student errors in solving three dimensional problems is to use Newman procedures. Zakaria (2010) states that Newman's model of error investigation has been proven to be a reliable model for mathematics teachers. The Newman Error Hierarchial Model is appropriate for use in identifying or analyzing mathematical errors that occur in students.

The aim of this research is to answer the following questions, (1) where is the location of error made by high school students in solving mathematics problems related to the three dimension topic? (2) what are the causes of error made by high school students in solving mathematics problems related to the three dimension topic?

METHOD

This research is a descriptive qualitative research type because this research is a research when there are no manipulated variables and aims to describe the location of errors and causes of errors that occur in students in solving mathematics problems related to the three dimensions. Stages of this research can be seen in Figure 1.

This research was conducted in one of SMA Muhammadiyah 1 Taman on Jl. Ketegan No.35, Sepanjang, Sidoarjo, Jawa Tmur. The study was conducted in the even semester of the academic year 2016-2017. Subjects of this research were students of grade XII IPS 2.

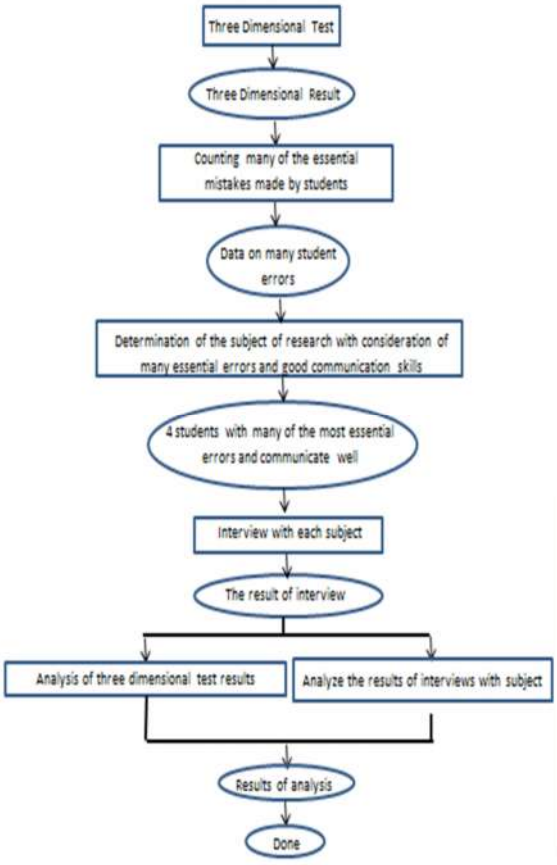

Figure 1. Stages of research

RESULT AND DISCUSSION

The following is the details of where the subject error was found in the research

1. Reading error
   The subject has difficulty in understanding the word "midpoint of pyramid height" on problem number 1. Based on the location of the error indicator that has been made it can be said that the subject can not determine the words or symbols that exist in the matter. So it can be said that the location of the subject error is the error reading.
2. Comprehension error
   a. The subject should write down all the information known in question 2 on the answer sheet completely. But the subject does not write down what is known from the problem. The subject goes directly to the procedure that the subject is correct. Based on the error location indicator that has been made it can be said that the subject does not write down what is known. So it can be said that the location of the subject error that is understanding error.
   b. The subject should write down what is asked in question number 3 on each answer sheet. But the subject wrote incomplete, so researchers wonder when correcting. Based on the error location indicator that has been made it can be said that the subject does not write what is asked incomplete. So it can be said that the location of the subject error that is understanding error.
3. Transformation error
   The subject does not use the operation and the proper way of solving the problem. Based on the error location indicator that has been made it can be said that the subject is not able to determine the procedure or sequence of steps that will be used to solve the problem. So it can be said that the location of the subject error is a transformation error.
4. Process skill error
   a. The subject of writing half of the side diagonal for the number 1 is 6 √ 2 which should be 3 √ 2 because the length of the pyramid base rib is 6 cm. Based on the error location indicator that has been made it can be said that the subject is wrong in performing calculations to solve the problem. So it can be said that the location of the subject error is a process skill mistake.
   b. Subject counting using the calculator tool when at number 2 must calculate (√ 3 + 1) / 2 because the subject is not able to calculate numbers that contain the root form. Based on the error location indicator that has been made it can be said that the subject is unable to continue the calculation to solve the problem. So it can be said that the location of the subject error is a process skill mistake.
   c. The subject stops the calculation process when on question 2 the subject finishes using the trigonometric comparison procedure. When sin x = 1/2 appears, the subject is unable to determine how large the angle is so that the calculation process stops only there. Based on the error location indicator that has been made then it can be said that the subject did not continue the calculation to solve the problem. So it can be said that the location of the subject error is a process skill mistake.
5. Encoding error
   The subject can not write the correct final answer correctly.

CONCLUSION

Based on the data of analysis, it can be concluded that:

1. Location of student error in solving math problems related to material dimension three, that is as follows.
   a. Reading rror

Cannot determine and explain the words or symbols that exist in the matter of understanding the meaning of the midpoint of pyramid height and rectangular pyramid square ribs.

b. Comprehension error
Cannot determine what is known correctly, cannot determine what is asked correctly, cannot determine the distance requested by the problem, and cannot determine the angle requested by the problem.

c. Transformation error
The students' error is not being able to determine an appropriate problem-solving procedure such as the wrong student using Pythagorean theorem whereas it should use a triangle area comparison to solve the three dimensional problem.

d. Process Skill error
The error students make is unable to continue the calculation due to certain constraints. One example of student work is sin x = 1/2 then must determine how big the angle is. The student cannot continue so the work stops.

e. Encoding error
Writing inferences that are inconsistent with the matter, not writing conclusions, and incomplete in writing conclusions (only angles without any description of which angle the writing is written).

2. The cause of the mistakes made by students in solving mathematical problems related to three dimensional topics can be summarized as follows.
   a. Causes of reading error
   The subject has difficulty in understanding the word that exists in the phrase "midpoint of pyramid height". That means the subject cannot understand the term in three dimensions.
   b. Causes of comprehension error
   The subject does not understand the concept of point-to-point distance, point-to-line spacing in three dimensions, concept of the angle between the two fields in the three dimensions, and the subject forgets in writing down what is known and what is questioned.
   c. Causes of transformation error
   Subject does not master the prerequisite material that is Pythagoras theorem the ratio of triangle area, trigonometry, and the number of angles in the triangle.
   d. Causes of process skill error
   The subject does not control the calculations that contain the root form in it, unable to write down the steps systematically to solve the problem and cannot make image representation.
   e. Causes of encoding error
   The subject cannot determine the final step to solve the problem.

SUGGESTION

Some suggestions that can be given by researchers related to the results of this study are described as follows.

1. For further research should be made more detailed interview guidelines to find information causes students to make mistakes.
2. For further research should be investigated about the causes of errors committed by students not only those derived from teaching materials but also the causes that come from teaching in the classroom.

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