

Analysis of Student Errors in Solving Trigonometry Story Problems¹

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ABSTRACT

Learning and mastering mathematics is important. However, the mastery of mathematics by Indonesian student is still low. According to math teacher grade X in SMAIT Nur Hidayah, trigonometry is the most difficult material for students. The research was conducted to describe the types of student errors in solving trigonometry story problems. The research subjects were 28 students of class X MIPA 4. This research includes qualitative research. Data obtained by test and interview methods. Errors were analyzed according to Newman's Error Analysis (NEA). The results showed that students made five types of errors in solving trigonometric story problems. Students made the most mistakes in process skills errors. While the least error is comprehension errors and encoding errors.

Keywords: analysis of student errors; problem based on story; trigonometric

1. INTRODUCTION

One of the subjects that are required for students to learn from elementary school (SD) to high school (SMA) is Mathematics. This is because mathematics is considered to have a very important role for human survival. Mathematics is also considered a subject that is able to improve students' thinking power and competence, where students can get used to solving various mathematical problems that are considered complicated, which aims so that when students find various problems in their daily environment they can solve these problems and can take action. critical and creative decisions (Savitri & Yuliani, 2020).

Kariadinata (2012) suggests that mathematics is a subject that is believed to increase students' reasoning power. By studying mathematics, students are accustomed to think systematically, structured and have logical arguments in solving a problem. (Yulianti & Sugandi, 2018) added that mathematics is a subject that plays a very important role in the process of developing students' mindsets so that the goal of learning mathematics is that students can use mathematics in solving daily problems can be achieved.

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Various problems of everyday life in mathematics at school are usually manifested through story-shaped questions. (Farida, 2015) states that problems in mathematics are a challenge for students where to answer these challenges requires a procedure and a deep thinking process from what is known. In solving problems in the form of stories, students are required to be able to understand the context of the problems presented, so that they can find methods of solving independently, and can express conclusions from the solutions obtained.

It is important to learn and master mathematics. Fahrurrozi and Hamdi (2017) state that mathematical concepts are almost used in all disciplines in studying the object of study. By studying and mastering mathematics which is a basic science, it will help in learning other sciences.

Mastery of mathematics by students is assessed and measured by certain standards and scales. On an international scale, Indonesian students' mastery of mathematics is relatively low. According to an assessment carried out by the OECD (Organization for Economic Co-operation and Development) through the PISA (the Program for International Student Assessment) program, Indonesia has always been in the top 10 and bottom among other participating countries [2].

One indicator of students not being able to master a material is that students are not able to solve problems related to the material. Based on the results of interviews with SMAIT mathematics teacher Nur Hidayah, trigonometry material is the most difficult material for students in class X to master. The number of students who do not reach the minimum completeness criteria (KKM) in trigonometry material is more than other materials.

Abidin (2012) states that there is a relationship between mathematical material, so it is necessary to master mathematics in a certain order. The results of his research prove this. The reason why many students do not pass the calculus 1 course is the lack of mastery of trigonometry material which is a prerequisite for calculus 1 material.

The same thing can happen to students in mastering trigonometry material. There are certain reasons students are unable to solve trigonometric problems. Based on the description above, the purpose of this study was to analyze the errors made by students in solving trigonometry story problems.

2. METHODS

This research is a descriptive qualitative research with a case study approach. Qualitative research is research that investigates the quality of relationships, activities, situations, or materials and describes them holistically (whole). The case study approach is a microscopic examination (detail) of a person, a group, an institution, a social movement, or a particular event [4].

The research subjects were 28 students of class X MIPA 4 SMAIT Nur Hidayah. Research data collection techniques include documentation of student test results and interviews. The main research instrument is the researcher himself, for the supporting instruments are question sheets and interview guidelines. Data analysis was carried out by means of data reduction, data presentation, and drawing conclusions. Student errors were analyzed based on Newman's error analysis.

3. RESULT AND DISCUSSION

This study uses 3 trigonometric story questions. After being given to students and checked, student errors were analyzed using Newman error analysis. This technique divides student errors into 5 types; reading errors, comprehension errors, transformation errors, process skill errors, and encoding errors [5]. The following is a list of student errors:

Table 1. Student errors based on NEA

	Q1	Q2	Q3
Reading Errors	2	11	0
Comprehension Errors	1	1	5
Transformation Errors	3	5	8
Process Skill Errors	16	6	11
Encoding Errors	3	1	2

3.1 Reading Errors

There are several indicators so that an error is included in a reading error. Indicators of reading errors include; students misread the information in the questions, students do not read the questions well, students do not read or interpret the symbols in the questions correctly, and students do not read or understand certain keywords or terms in the questions [6].

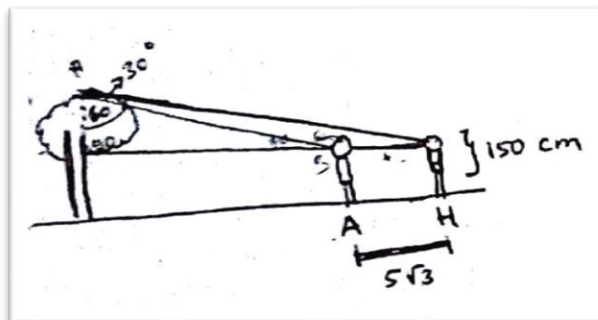


Figure 1. Error reading the question

In the picture above, it doesn't appear that there are any errors, but it is a matter of providing information that there are two people watching the treetops with elevation angles of 60° and 30° . Based on the results of the interview, it is known that students do not understand the meaning of the word 'elevation angle'. Reading errors made by students occur because students do not understand the keywords in the questions.

3.2 Comprehension Errors

Student errors are included in the type of understanding error when students cannot understand the problem well. In summary, students are not able to determine what is asked in the question and cannot determine what is known from the question to answer the question.

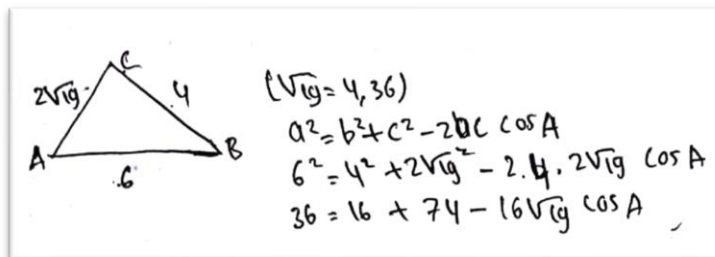


Figure 2. Misunderstanding the question

In the picture above, the problem does not appear, but the question is asking for the largest angle if the lengths of the three sides of the triangle are known. The largest angle is in front of the longest side. Indirectly students have to determine the longest side in order to find the largest angle.

Based on the picture above, the student determines that the longest side of the triangle is 6. Although it can be seen that the student can continue to solve the problem well, the answer that the student gets does not solve the problem in the question. Errors made by students occur because students do not understand what is known from the problem to solve the problem.

3.3 Transformation Errors

This error occurs when students cannot transform what is known into mathematical sentences as the first step to solving problems. Students who are not able to determine or write the right formula to solve the problem are also included in this error.

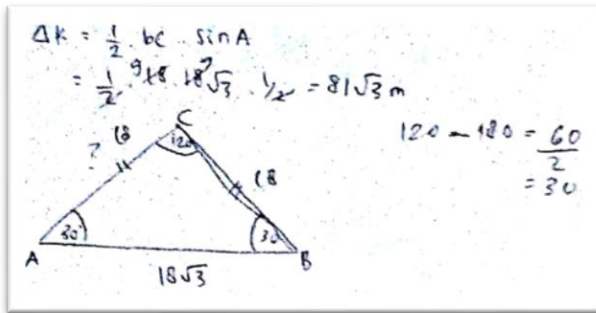


Figure 3. Problem transformation error

In the picture above students can determine the area of the triangle, but the question asks for the length of the fence so that the solution is not quite right. To get the length of the fence, the formula for the perimeter of a triangle is needed rather than the formula for the area of a triangle. The transformation error occurred because students did not choose the right formula.

3.4 Process Skill Errors

This error is related to the students' ability in the basic concepts of mathematics. Errors such as not writing down the completion process, not completing the calculation procedure, or calculating errors are included in the type of process skill error.

$x \cdot \frac{1}{2} \sqrt{3} = 18 \sqrt{3} \cdot \frac{1}{2}$
 $x = 18 \sqrt{3} \cdot \sqrt{3}$
 $x = 18 \cdot 3$
 $x = 54$

Figure 4. Process skill error

In the picture above, students make a basic calculation error. It can be seen that 3 which was originally on the left-hand side of the first line disappears in the next line. It is necessary to determine the value of x . For this reason, the right and left rows must be multiplied by $1/\sqrt{3}$, or in other cases called moving segments. The student made a mistake in moving the segment so that the results obtained were not correct.

Handwritten student work showing a process skill error. The student has written the following equations:

$$\begin{aligned} \text{keliling} &= 18\sqrt{3} + 18 + 18 \\ &= \underline{\underline{54\sqrt{3} \text{ m}}} \end{aligned}$$

Figure 5. Process skill error

The picture above shows students who make mistakes in other process skills. The student is wrong in the concept of adding numbers with roots.

3.5 Encoding Errors

This error is related to the end of solving the problem. This error occurs if the student does not write the final answer according to the question or the student does not conclude the answer.

Handwritten student work showing an encoding error. The student has written the following equations:

$$\begin{aligned} \text{Panjang pagar} &= 18 + 18 + 18\sqrt{3} \\ &= 36 + 18\sqrt{3} \end{aligned}$$

Figure 6. Encoding error

In the picture above, students get the right answer, but do not conclude the answer according to the question. This is because students feel the answer is enough so they stop at that point.

Conclusion

The results showed that students made five types of errors in solving trigonometry story problems. Reading errors, comprehension errors, transformation errors, process skill errors, and encoding errors. The most mistakes was process skill errors. While the least mistakes were comprehension errors and encoding errors.

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