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Analysis of Student Errors in Solving Trigonometry Problems

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Abstract

This study aims to obtain a picture of student errors in working tests on Trigonometry. This research was conducted with a qualitative approach and was descriptive. The subjects studied were Mathematics Education students in the third semester of Class A of the University of Sembilanbelas November Kolaka in the Academic Year 2019/2020. This study uses an instrument in the form of a Final Examination in Trigonometry courses. Based on the research results obtained, an illustration that students' mistakes in working on problems in the Trigonometry course are caused by students not understanding the questions, the lack of accuracy in basic mathematical operations, and mastery of the concepts of trigonometry that students have.

Keywords: analysis of error, math, trigonometry

A. Introduction

The development of modern technology is based on scientific disciplines, including mathematics, which has an essential influence on human thought progress. The human ability to create future technology is based on strong mathematical mastery from an early age (BSNP, 2006). Mathematics is expected to make humans think logically, thoroughly, carefully, critically, creatively, innovatively, imaginatively, and hard-working. Therefore, to master mathematics well, the government establishes mathematics as one of the fields of science studied at every level of education from elementary school to college (Astuti, 2017).

However, mathematics seems to be a proper nightmare for students because mathematics is considered a somewhat complicated subject. Students still encounter difficulties in working on mathematical problems. One material that is considered difficult is Trigonometry. Besides being caused by the many formulas that must be memorized, trigonometry is also a very abstract material, for example, on the topic of the Rule of sines and cosines. As a result, errors will be encountered in the process. Educators certainly have a big responsibility regarding this. One crucial and responsible thing is to identify errors experienced and take precautions that need to

be done. Recognizing the difficulties experienced by students is the initial information that needs to be collected to be correlated with subsequent studies. This can be a significant basis for designing future curricula and shaping teaching methods (Rasmussen, 1998).

From the explanation above, it will be illustrated by the difficulties of students in the process of solving problems related to the Sine and Cosine Rules in the trigonometry course. It was felt necessary that the teacher/lecturer, as an educator, could find out how students' mastery of mathematical concepts and principles to reduce the number of student errors when completing questions about trigonometry.

B. Literature Review

1. Error in Mathematics

The ability of students to receive and understand course material is different. Many factors affect this. Muljono (2007) explain that student learning difficulties can be sourced from their lack of mastery in the material or precondition concepts from material being learned. Sukirman (2012) alsostate that error are deviations from things that are systematic, consistent or incidental in certain areas. Besides that, Mulyono (2009) also revealed that common mistakes made by students in completing assignments in the field of mathematics study are a lack of understanding of symbols, value of place of calculation, use of erroneous processes, writing that cannot be read.

2. Type of Error in Resolving Problem

Error in solving math problems can be used to detect math learning difficulties. Generally, error in solving math problems can be seen from mistakes that are often made. Deviations from the answer include wrong understanding of questions, wrong working on question and wrong understanding of question concepts (Rosyidi, 2015). This is in line with Sartin's research where it was found that student error lie in determining what is known, determining what is asked, making mathematical sentence models, calculation errors, and final answer.Cox in Fadilah (2010) also stated that error made by students were categorized into three types of errors namely systematic errors, random errors, and careless errors. In systematic type errors students usually do not work at all the questions given or students work on problems with procedures that are completely distorted or an error occurs at a certain step. The random error usually causes the error is in the process of thinking that is not known. Furthermore, in careless errors, the form of errors are miscalculation, a sign error and writing errors.

C. Method

1. Research Design

The approaching model used in this study is qualitative and descriptive. Citing the statement of Moleong (2010), qualitative research aims to holistically determine a phenomenon in research subjects by describing narrative contexts, specifically experienced by various scientific methods. In general, exploring the main phenomena in research, research participants, and research locations is the goal of qualitative research (Creswell, 2014).

2. Instruments

The instrument of research used a test instrument that is a question of final testin the form of essay which related to the Sine and Cosine rules in the Trigonometry course. Data was collected based on the results of tests and direct observations conducted by researchers about the phenomena experienced by the target of observation.

3. Technique of Data Analysis

The subjects studied were mathematics education students in the third semester of class A after first being given Trigonometry lecture material, especially on the Sine and Cosine Rules material. Samples were taken by purposive sampling technique that is taking research subjects by considering certain conditions. Five students were chosen to be the subject of research, where the

five students were students with unique errors in the trigonometric test questions. The findings of students' answers when working on these problems will be described descriptively

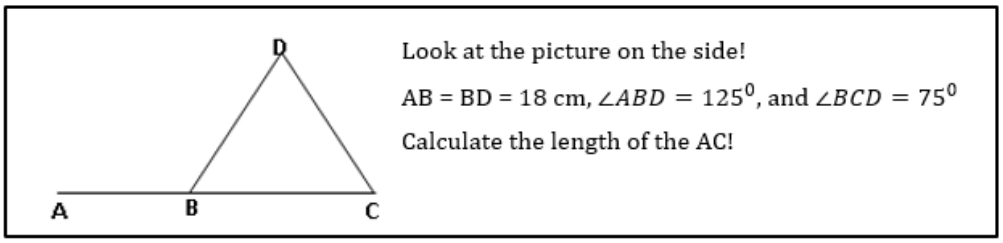
D. Findings and Discussion

1. *Findings*

Presented a description of students' difficulties when working on UAS questions as many as two items given to the Trigonometry course.

Analysis of Student Errors in First Question of Final Test

Problem number 1:



The first student answer:

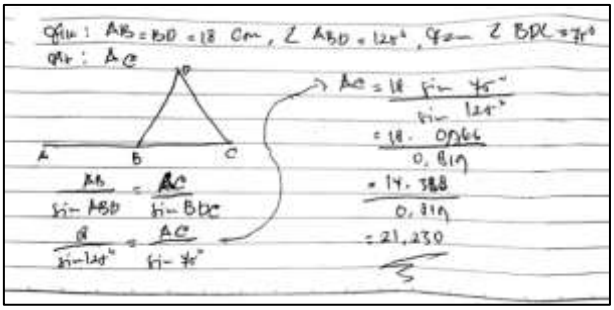


Figure 1 The first student answer

Based on the results of the first student's answers, it appears that students are confused about solving the problem. Students answer carelessly using the sine rule by comparing the sides' length with the angles already available in the problem even though the known sides and angles are not facing each other so that they violate the sinus rules.

The second student answer:

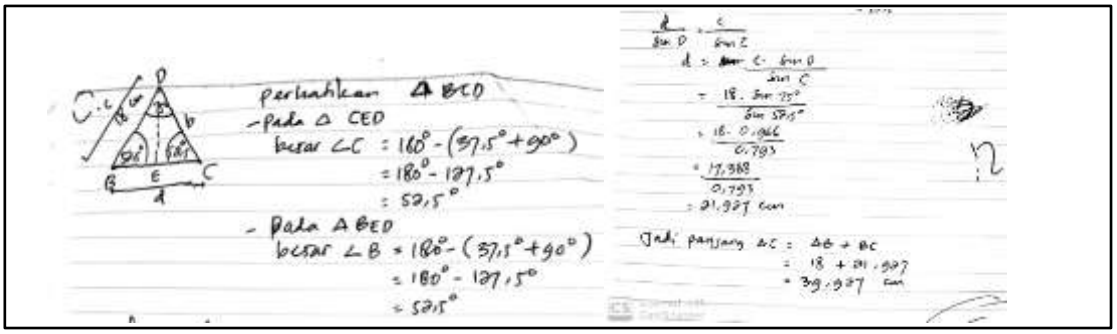


Figure 2 The second student answer

Likewise, from the results of the answers of the second student obtained information that the second student already knew that the sine rule solved this problem. However, the error made was that the second student considered the BDC triangle an isosceles triangle so that the student was wrong in getting the magnitude of B and C angle needed later to find the AC side's length. Even though the problem or picture did not mention and indicated that BD = DC.

The third student answers:

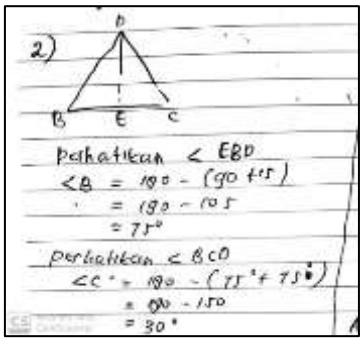


Figure 3 The third student answers

In the answers of the third students, it appears that students are wrong in calculating the angles of B and C in the BDC triangle. Finally, the final results obtained are also wrong.
The fourth student answer:

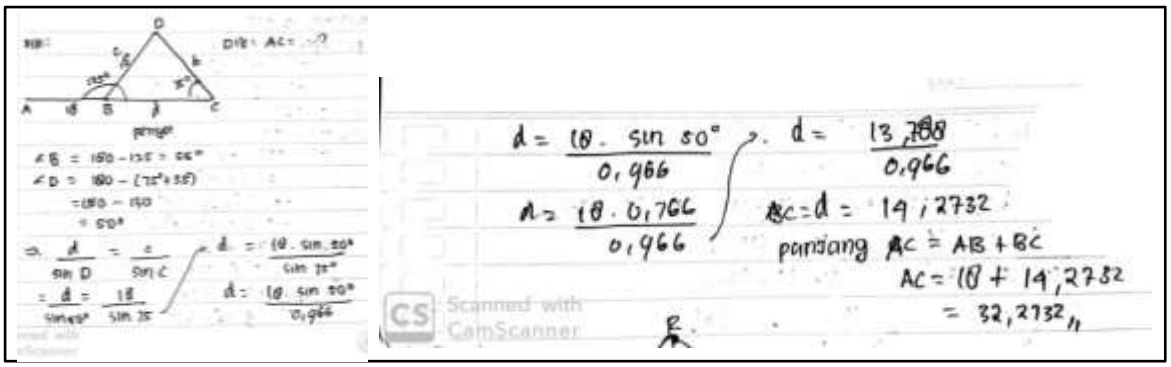


Figure 4 The fourth student answer

The fourth student was able to find out the solution to find the AC length by first finding the unknown angles in any arbitrary BCD triangle so that later it could be used to find the length of the BC side using the sine rule. The fourth student can know that the angles of ABD and CBD are in a straight line. So to find the CBD angle is to subtract 180 o with the ABD angle. However, the fourth student experienced an error when setting the BDC angle at angle C, which should be at angle B. This impacted on the final error obtained even though the steps to solve it using sine rules were appropriate.
The fifth student answer:

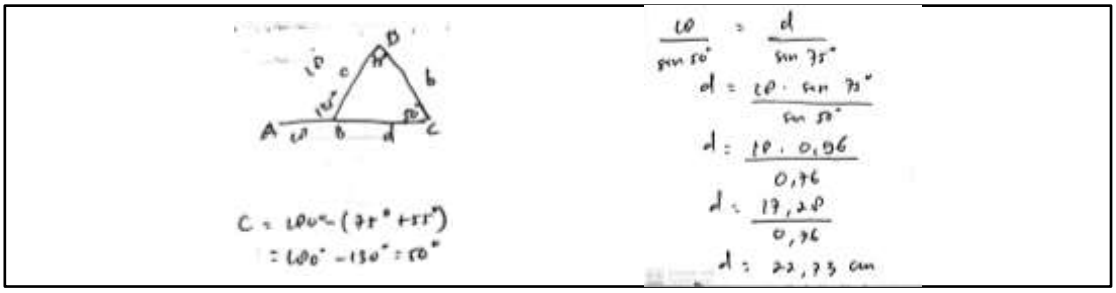
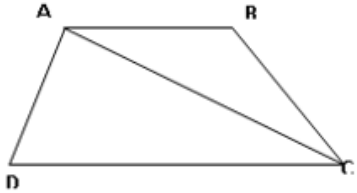


Figure 5 The fifth student answer

The fifth student has been able to get the angles of B and C accordingly. The fifth student has also been able to correctly get the BC side's length by the completion steps using the sine rule. However, the fifth student just stopped there. The fifth student did not add up the length of the BC side he got with the length of the AB side. While the question asked is to find the length of the AC, namely the sum of the AB and BC sides.

Analysis of Student Errors in Second Question of Final Test



The picture to the side is a trapezoid ABCD, with AD = 5 cm, CD = 21 cm and AB = 10 cm. $\angle ADC = 60^0$, and $\angle BAC = 13^0$

Calculate the length of the BC!

The first student did not know how to answer it. Students are not able to write anything on the answer sheet.

The second student answer:

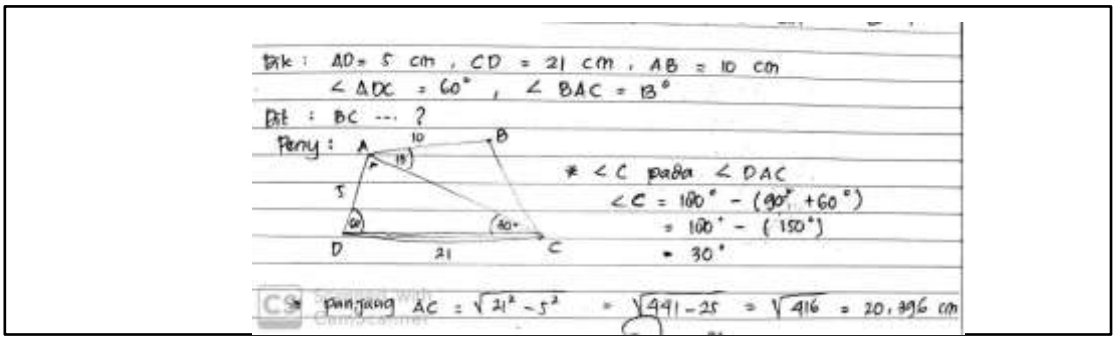


Figure 6 The second student answer

The second student also has no idea to solve this problem. This student thinks that the ACD triangle is right-angled in A. Even though there is no information in the problem that shows that the CAD angle is right-angled. The only information available is that$\angle BAC = 13^0$

The third student answers:

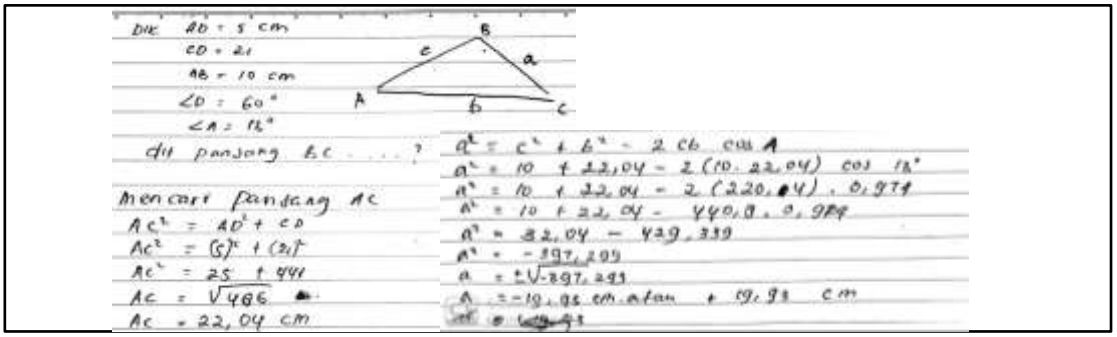


Figure 7 The third student answers

The third student was mistaken for searching AC length using the Pythagorean formula. This student then uses the wrong AC length value into the cosine rule formula to find BC's length.

The fourth student answer:

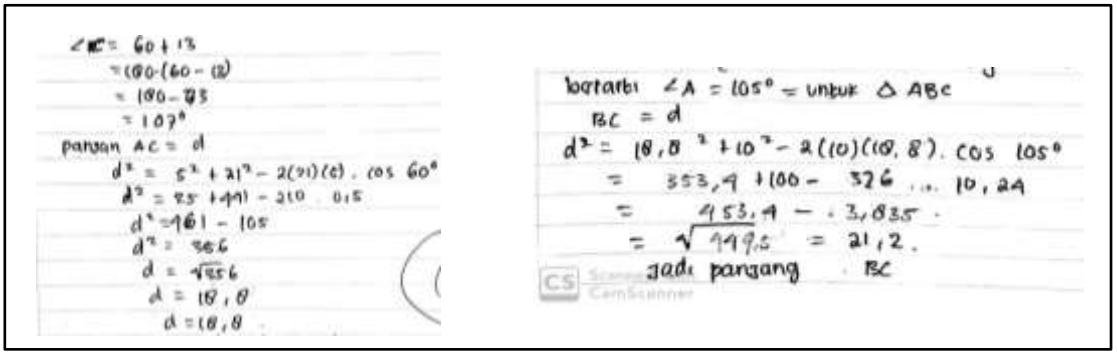


Figure 8 The fourth student answer

On the fourth student answer sheet, it is known that this student already has a picture to solve the problem using the cosine rules. However, there was an error in calculating the sum of squares

of the AD and CD sides. This mistake causes students to be mistaken for obtaining great AC results. The result is also wrong in obtaining the length of the BC side.
The fifth student answer:

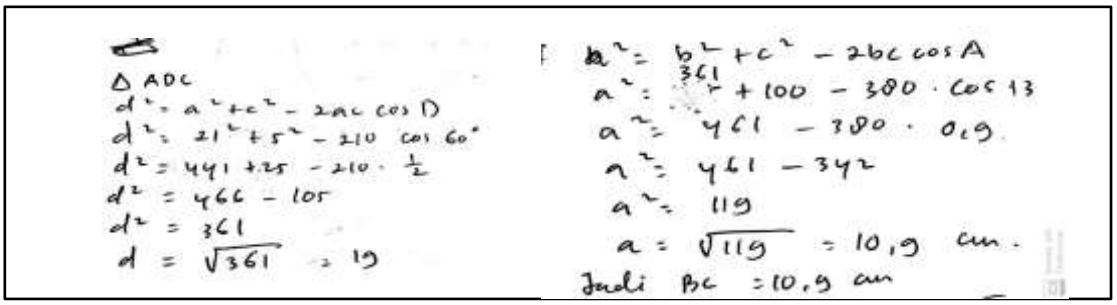


Figure 9 The fifth student answer

The fifth student has been able to get the AC length with the correct cosine rules and procedures. However, this student made a mistake when looking for the length of the BC side. The mistake was caused by rounding one digit behind the comma for the cos value 13. Finally, the final answer obtained was wrong.

2. Discussion

The mistakes experienced by students and their causes could be seen in the following points:

Students do not know the purpose of the problem. It can be seen from the existence of students who just do random answer. Some are not doing it at all. Students are mistaken when reading questions. Student accuracy is low, and it appears when wrong in placing an angle based on the problem. A minimal understanding of the concepts of trigonometry is the cause of this error. The results of this study are in line with Tanjungsari et al. (2012) revealed that the difficulties experienced by students include lack of planning ability (strategy knowledge) and less able to solve problems (algorithmic knowledge) indicated by not working on problems, not finished, or lack of thoroughness of work.

Students are wrong in using the formula used because, in the process, students do not know the right completion step. In question no.2, there are even students who use the Pythagoras rules. The use of this rule is due to students' lack of understanding of the rules of trigonometric comparisons and the lack of mastery of the trigonometric formulas that must be used. For example, if both sides and one corner are known, one side and one angle are known, and the other. This is in line with research conducted by Sucipto and Mauliddin that students are difficult to determine the start of proof, difficult to implement theorem in constructing proof, so students experience difficulty in determining the correct proof of steps.

Students are not thorough in basic operations when solving problems based on an appropriate formula. The factors which causes difficulties for students in solving math, namely intrinsic factors and extrinsic factors. Adolphus (2011) concluded that the factors that caused the problem were the mastery of the geometry of lecturers is weak, teaching and learning environment that is not conducive, lack of basic facilities and infrastructure for teaching and learning, students are not enthusiastic about learning, lack of will and readiness for learning, lack of motivation from teachers in learning and learn. It is also supported by the results of research Ganal and Guiab (2014) who concluded that performance was poor mathematics is caused by personal problems, like: abilities and attitudes, psychological (emotional) problems, problems learning (teachers and students), family problems (finance and relationships), college life adjustments, peer problems (adjustments for classmates), and co-curricular activities.

E. Conclusion

Several factors cause students to wrong when working on trigonometry problems. The first one, students do not understand the questions given. Second, the lack of accuracy in basic

mathematical operations when working on problems. The last one is the lack of mastery of the concepts of trigonometry students have.

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