Mathematics learning of trigonometric triangles in vocational high school using online media

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Abstract. This research is a descriptive qualitative study that aims to describe the learning of trigonometric triangles using online media in class X students of SMK Negeri 6 Palembang. Information assortment methods use screen recordings of Zoom application, observation, and interviews. Screen recordings are carried out to observe student activities during the learning process and compare them with observation sheets and interview sheets. Meanwhile, the test instrument is utilized as supporting information to see understudy learning results after learning the wide trigonometric triangle in general. The outcomes indicated that during the learning process that lasted for two meetings, students could follow well throughout all stages of learning and get outstanding outcomes.

1. Introduction
Mathematics is one of the essential, necessary skills at every level of education. Mathematics trains a person to think logically and systematically in solving problems and making decisions. Mathematics greatly contributes to everyday life because the discipline of mathematics encourages meaningful learning and challenges a person to think.

Vocational high school students must be equipped with high intellectual skills through critical, systematic, creative, and productive thinking patterns [1]. This opinion is in line with the objectives of learning mathematics, namely 1) mathematical communication, 2) mathematical reasoning, 3) solving mathematical problems, 4) mathematical connections, 5) mathematical representations [2]. This opinion is in line with the idea [3]. Specifically, the goal of learning mathematics at the vocational high school level is to form students as individuals. It makes them have a broad and robust knowledge base to adopt or adapt to changes that occur in the social environment, work environment, and able to develop themselves under the development of science, technology, and art.

So it is hoped that after studying mathematics, students in vocational high school can form competency skills programs. By teaching mathematics, students are expected to be able to apply it in everyday life and develop themselves in the field of expertise and education at a higher level.

This research begins with the problems of learning mathematics in vocational high schools, especially on trigonometry material. Trigonometry is a part of physical arithmetic that manages the comprehension of ideas and their applications [4]. Issues in encouraging trigonometry are the connection among edges and sides in the triangle. The next issue is the trigonometric function. It is tied in with characterizing the estimation of a directional point to a genuine number set in secondary school and colleges [5]. The problems found were material that was new, there were too many formulas so that students tended to memorize, the teacher's lack of ability to relate trigonometric material to previous
materials, lack of provision of realistic problems by the teacher, dominant student textbooks presenting formulas without providing an understanding of trigonometry and the lack of opportunities and means for students to interact and build their knowledge during the learning process [6]. Moreover, we broke down the trigonometry theme since geometry is an indistinguishable part of arithmetic in secondary school. Trigonometry has, for quite some time, been a standard part of the optional school educational plan in all nations, generally in the last 50% of the auxiliary years [7].

The Corona Virus diseases (COVID-19) pandemic is a disaster for all inhabitants of the earth. All segments of human life on earth are disturbed, including education. Many countries have decided to close schools, colleges, and universities, including Indonesia. Since the outbreak of the COVID-19 in Indonesia, the government has taken many ways to prevent its spread. One of them is through a circular concerning the prevention of the reach of COVID-19 in schools and colleges [8].

E-learning means discovering that is empowered electronically [9]. Anyway, limited this definition down to mean learning the utilization of computerized innovations enables that [9]. One of the main goals of e-learning is to focus on the personal needs of students. Students have different learning styles and preferences [10]. Various media can also be used to support the implementation of online learning. For example, virtual classes use Google Classroom, Edmodo, and Schoology services, and instant messaging applications such as WhatsApp.

Online learning is more student-centered so that it can bring out responsibility and students in education [11]. With e-learning, students do not need to sit nicely in the classroom to listen to every word of a teacher directly. Baris [12] contended that e-learning, and particularly m-learning, can and ought to add to improving the nature of education. In this study, the researcher will describe the learning of the trigonometric triangle area using online media, namely using the Zoom Meeting application, YouTube, WhatsApp Group, and Google form.

2. Methods
The subjects of this study were students of class X SMK Negeri 6 Palembang. This research is a qualitative descriptive study that describes the process of teaching and learning activities, which are divided into the stages of preparation, implementation, and data analysis [13]. This research activity was carried out in class X SMK Negeri 6 Palembang Department of Beauty 1 in the 2019/2020 academic year. The subjects were 30 students.

In the preparatory stage, the researcher carried out, namely designing a research instrument grid, making a Student Activity Sheet (SAS) map that will be given through WhatsApp Group, making lesson plans, making learning videos that will be shared via YouTube, and test questions that will be shared via Google form. Student learning outcomes data were collected through observation, Student Activity Sheets (SAS), and formative tests.

At the research implementation stage, things that are done are carrying out learning using online media, taking the necessary data, and also carrying out documentation during learning activities. The research took place for two meetings, namely once for the learning process and one for the final test. At the first meeting, researchers carried out learning through Zoom meetings and continued with work. SAS gave to WhatsApp Group. Also, there are also learning videos that can be accessed via YouTube. Furthermore, at the second meeting, namely, giving quizzes in the form of formative questions that can be accessed via Google Form.

The data collection techniques used in this study were observation, documentation, and interviews. Then, all the data collected will be analyzed descriptively, including reducing, displaying, and concluding the data that has been collected. The indicator of success in this study is being able to describe the learning process using online media on the area of the trigonometric triangle based on the level of understanding of students.

3. Result and discussion
Learning activities were carried out for two meetings, at the first meeting using the Zoom meeting application, where researchers have designed material in the form of PowerPoint slides that were shared
with students. At the first meeting, the researcher reminded students of the triangle area that had been learned from elementary school. Researchers also present images of various triangular shapes in everyday life, like figure 1.

![Figure 1](image1.png)

**Figure 1.** Examples of triangles in everyday life.

Then the researcher linked the area of the triangle with the trigonometric material that the students had previously studied.

![Figure 2](image2.png)

**Figure 2.** Any triangle.

From figure 2, the researcher leads students to find the formula for the area of a triangle if there are two sides and the angle of the flaps. Furthermore, dialogue one was done via the Zoom application that can be seen in figure 3.

![Figure 3](image3.png)

**Figure 3.** Learning with the Zoom Application.

Figure 3 shows face-to-face online learning with the zoom application. It was previously scheduled for mathematics learning by providing a zoom application link, so students just need to join the link given. Besides, the dialogue between teacher and student can be seen as follows.

Teacher : previously, we studied trigonometric comparisons. From figure 2, can we find the formula for the area of a triangle?

Student : can be, $\text{Area} = \frac{1}{2} \times \text{base} \times \text{height}$

Teacher : what if the height of the triangle is not known? There are only two sides to know and the angle of the wedge as shown in figure 4.

Student : how do you do it?
Teacher: relate to the trigonometric ratios we have studied

Student: area = \( \frac{1}{2} \times 6 \times 8 \sin 30^\circ \)

Teacher: how can it be like that?

Student: it because the area of the triangle is \( \frac{1}{2} \) x the base x the height. For example, the size of the triangle is drawn CD line, the angle in front of the CD line = 30. So use the sine formula, because the sinuses are obliquely front.

Teacher: so, the height of the triangle is changed?

Student: yes, mam, the height of the triangle becomes a sine of 30. So the area of the triangle \( L = 6 \times 8 \times \sin 30 \).

Teacher: what if the number in the triangle is not known?

Student: just replace it with the symbol. So \( L = \text{side} \ a \times \text{side} \ b \times \sin 30 \).

Teacher: likewise, if you know the other sides and angles of the wedge, yes, kid.

From the discussion, it can be known that students can find their understanding of the triangle area concept if two sides and the angle of the flank are known. Here the researcher can link the previous material with the trigonometric material so that student find their understanding of the triangle area concept. In addition, the triangle with that condition can be seen in figure 4.

![Figure 4](image-url)  
**Figure 4.** The triangle is given the two sides and the angle of the flank.

As seen in figure 4, it shows a triangle if there are two sides and one angle of the flank. In the explanation provided in dialogue 1, students are asked to find the area of the triangle if it is known by both students and one angle of the flank.

In this first explanation in dialogue 1, it seems that there is no problem because the student still remembers the formula for the area of the triangle and the trigonometric ratio well so that student can relate it to the area of the trigonometric triangle if the two sides and angle of the flank are known. This is in accordance [14] that mathematics isn’t just material moved by the instructor to understudies. For this situation, understudy ought to be given the possibility and be guided into circumstances to rehash arithmetic ideas utilizing their particular manner. The importance of scientific ideas will likewise assist educators in creating intelligent scientific concepts in their instructing [15].

Furthermore, students discussed the triangle area if it is known that the size of the three angles and one of the sides. The researcher asked students looking back at figure 2, and the formula for the area of a triangle was obtained \( L = \frac{1}{2} \times a \times b \times \sin C \). Then the researcher reminded him of the previously studied sine rule formula \( \frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C} \). Then the researcher asked the student to link the two formulas as in dialogue two below.

Teacher: we have studied the formula for the area of a triangle given two sides and one the angle of the wedge, i.e., \( L = \frac{1}{2} \times a \times b \times \sin C \) and the formula for the sine rule, i.e., \( \frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C} \). Now try from the modified sine rule formula to find the value of side b and only.
Student : $b = \frac{a \times \sin B}{\sin A}$

Teacher : modified sine rule formula $\frac{b}{\sin B} = \frac{c}{\sin C}$ To find side c values only.

Student : $c = \frac{a \times \sin C}{\sin A}$

Teacher : try substituting the sides c and b values for the area of a triangle $L = \frac{1}{2} \times b \times c \sin A$

Student : how do you do it?

Teacher : the value of side b and side c is replaced with the amount that has been searched earlier

Student : $L = \frac{1}{2} \times b \times c \sin A$

$$L = \frac{1}{2} \times \frac{a \times \sin B}{\sin A} \times \frac{a \times \sin C}{\sin A} \times \sin A$$

Student : like this, mam?

Teacher : yes, right, try to simplify.

Student :

$$L = \frac{1}{2} \times \frac{a \times \sin B}{\sin A} \times \frac{a \times \sin C}{\sin A} \times \sin A$$

$$L = \frac{1}{2} \times a^2 \sin B \sin C$$

$$L = \frac{a^2 \sin B \sin C}{2 \sin A}$$

Teacher : very good. So this is the formula for the area of a triangle if we know the third corner and one side, yes.

In this second explanation, students still need teacher guidance to find the formula for the area of the triangle because students forget how to substitute the two existing formulas. However, the student can find the formula themselves with the help of the teacher. This is following the student-centered nature of online learning so that it can bring out student responsibility in learning

Next, what will be discussed is the area of a triangle if the three sides are known. The researcher reminded the student to find the value of s, that is $s = \frac{a+b+c}{2}$. Then the researcher tried to relate it to the trigonometric identity formula because trigonometric identities were not studied in class X SMK, so researchers had difficulty explaining this material. So that researchers suggest students watch explanations from YouTube to make it more straightforward. So that students know the formula for the area of a triangle if the three sides are known, namely $L = \sqrt{a(s-a)(s-b)(s-c)}$. The following is a display of YouTube learning and can be accessed at https://www.youtube.com/watch?v=Au52zJEuxFl&t=37s. Utilizing YouTube recordings to show classes as valuable material will provide students with excellent comprehension and information on their talks. What's more, it is prone to make the learning procedure more fun and significant. Besides, it gives understudies the chance to remember their exercises all the more without any problem [16]. Furthermore, the learning activity of students through Youtube and student answers can be seen in figure 5. Of the three discussions from the first meeting, the researchers provided practice questions to do at home in the form of a student activity sheet, which would be given to the WhatsApp Group. The following are the answers from the student activity sheet that have been done by students.
Figure 5. Learning activity using youtube and student answer.

In addition, the second meeting was the test held using the google form application, and one of those questions can be seen in figure 6.

Figure 6. Example questions on Google form.

Figure 6 shows one of the questions on the google form. The questions that the researchers have created have been validated by the school's senior math teacher. These problems raise questions about the area of a triangle if you know the two sides and the angle of the triangle, the area of the triangle, if you know the three angles and one of its sides, and the area of the triangle if you know the three sides. There are ten multiple-choice questions on the test, and on the google application form, the questions can and the answer choices can be randomized so that each student can be different. The processing time has also been determined, which is 45 minutes. Nevertheless, their development remains a time-consuming task. It can get simpler at the point when some composing apparatus and a bank of inquiries can be utilized to create the tests [17]. By using the google form application, we can find out the student's score after the test is given, as shown in table 1.

| Question Number | Percentage of Correct Answers (%) |
|-----------------|----------------------------------|
| Problem 1       | 86                               |
| Problem 2       | 78                               |
| Problem 3       | 82                               |
| Problem 4       | 81                               |
| Problem 5       | 86                               |
| Problem 6       | 86                               |
| Problem 7       | 81                               |
| Problem 8       | 85                               |
| Problem 9       | 74                               |
| Problem 10      | 81                               |
From table 1, it can be seen that question number 2 and question number 9 have a small percentage of other questions, where the problem is a question to find the area of a triangle if the three sides are known. The results obtained indicate that there is a difference in the percentage of students' conceptual understanding. The diversity of these results shows that online learning can be used to measure the understanding of mathematical concepts of vocational students properly. Learning activities that are created have decent quality, on the off chance that it can gauge all the deliberate capacities, from the most minimal to the most elevated (immaculate score) [18].

If the three sides of the triangle area are known in the online learning process, the researcher has difficulty relating to the previous material because the previous material was not studied in SMK. Student learning outcomes are categorized as good because the percentage of student learning outcomes incorrectly answering formative questions is above average.

After the test was given, the researcher gave questions related to online learning, what applications were more attractive to students as seen in figure 7.

![online learning](image)

**Figure 7.** Online learning application.

From figure 7, it can be seen that students prefer learning through the Zoom application after being asked by students because students can interact directly with other students and teachers even though they are online. Youtube media is also preferred because students can watch learning videos repeatedly and at any time, any place. With the utilization of 21st-century learning advancements, school educators can make settings that advance testing mathematics in a safe online learning condition [19]. It also shows that understudies in the mixed state had minimal accomplishment in the course, while up close and personal understudies performed more ineffectively when contrasted with online understudies [20].

### 4. Conclusion

The results showed that in learning mathematics, the area of the trigonometric triangle using online media, the learning contains material that can be accessed via YouTube and questions in the form of google form. The learning process is also carried out with the Zoom Meeting application, where the student can interact online with teachers and another student. It can be concluded that students' activeness in the learning process is categorized as useful. It also can improve students' conceptual understanding where the student can find for themselves the broad concept of the trigonometric triangle. Learning that took place for two meetings using online media described that online learning was also able to improve students' understanding of ideas even though they did not learn face-to-face.

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