Does the use of e-learning media with guided discovery method affect students’ understanding of mathematics concept?

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\section*{Abstract.} This study aims to discover whether the use of e-learning media with guided discovery method can affect students' understanding of mathematics concept. The design of this study is quasi-experiment using two classes, namely the experimental class and the control class. The research subjects in this study were 79 eighth grade students. The instrument used is multiple choice tests of understanding mathematical concept. Learning in the experimental class uses e-learning media with guided discovery method while learning in the control class used guided discovery method only. The test results reveal that the understanding of students in mathematics concepts in the experimental class was better than that of the control class. Thus, it could be concluded that the use of e-learning media with guided discovery method does affects the understanding of students' mathematics concept.

\section*{1. Introduction}

Technology is growing rapidly and will always continue to grow. Technology has been used in various fields of life, including educational sectors. The digital era requires the use of information and communication technology that extends in various areas of society and life, including school education [1]. Teachers, thus, are required to create learning innovations. One potential way to create learning innovations is to use learning media that are varied, good and appropriate for the situation of students. Besides learning strategies or models, learning media is one of the elements that is very essential for the success of the teaching and learning process. Teachers must be able to use media and learning approaches more effectively [2]. One learning media that can be used is learning media by utilizing Information and Communication Technology (ICT). The use of ICT can aid students in learning mathematics [3]. One of the uses of ICT in learning is using e-learning. E-learning is defined as a learning by utilizing computer technology combined with the telecommunications network [2].

In mathematics, one of the essential capabilities of the students is the ability to understand mathematical concepts [4]. Understanding mathematical concept refers to the ability of linking between mathematical concepts, representing mathematics, as well as identifying examples and not examples [5], [6], [7], [8], [9]. Understanding the concept of mathematics needs to be improved because when students have little to no understanding of the concept then the students will find it difficult to understand a problem and let alone to solve them. Students with good grasp and understanding of mathematical concepts will find it easier and become more creative in solving mathematical problems. Moreover, students who have good understanding of mathematics will be able to complete high-level tasks and are able to use various learning resources, for example using...
technology to solve mathematical problems[10]. Unfortunately, that understanding of the mathematical concepts by some students is still low [4], [11], [12].

The advantage of e-learning media with online systems for students in mathematics learning is that students can get additional knowledge, provided space for discussion, question and answer [13]. Mathematics learning using e-learning media is beneficial for students who struggle a lot to communicate and ask questions in class, to improve the relationship between teachers and students [13], and provide fun learning for teachers and students [3]. In Rohendi's [3] study, it was argued that students who use e-learning media in learning have better results in connecting math skills than students who use conventional learning.

Teacher and students can interact about learning wherever and whenever using e-learning media. Understanding of mathematical concepts can develop when students frequently have discussion with teachers another students. Collaborative activity between teachers and students can improve students' mathematical understanding by providing opportunities for students to build ideas for each other in order to construct better ways of thinking [14]. The integration of technology in learning benefits in promoting collaborative learning in distance learning environments, for example teleconferencing classes can invite students around the world to gather simultaneously for discussion of topics. Moreover, they may have opportunities to analyze problems and explore ideas and develop concepts so students do not only share knowledge, but also share learning experiences that are diverse from one another to express themselves and reflect on their learning [15]. Learning to use technology can improve student understanding in mathematics [16]. Therefore, using e-learning media in mathematics learning is expected to improve students' understanding of mathematical concepts.

There are three types of e-learning, namely enhanced, blended, and online [17]. Adopting from Allen, Seaman, and Garrett [18], web facilitated is learning that uses web media as learning support (1% to 29% online learning), blended is learning that combines face-to-face and online learning (30% to 79% online learning), online is the dominant online learning (80% to 100% online learning). In this study, enhanced e-learning learning will be employed using e-learning media only as an additional support in the learning (1% to 29% online learning). The e-learning media used is Schoology. Schoology is one of the web based e-learning media for K-12 to enable teachers and students to interact with each other.

Teachers must be able to apply technology in learning using guided discovery methods [19]. Discovery method is one method that reduces the role of the teacher and enables students to build their own knowledge [20] and also to help students understand mathematical concepts [20], [21]. There are three types of discovery methods, namely pure discovery, guided discovery, expository instruction [22]. Discovery method is less effective if there is no direction from the teacher. In other words, guided discovery is more effective than pure discovery [22], [23]. Learning that gets little direction from the teacher will be less effective for students [24]. Although students get little guidance from the teacher, guided discovery methods remain as a student-centered learning method [25]. Therefore, researchers decided to use guided discovery methods as a learning method in class. Steps are guided discovery learning method that is motivation, exploration, presentation, wrap up, practice, and evaluation [25].

There are some previously conducted studies found in the literature on the use of technology in learning. Online learning has a positive effect on the development of students' understanding of the concept in fourth, fifth, seventh, and eight grade [26]. The use of e-learning media has a positive effect on students' conceptual understanding of physics learning [27], [28]. The e-learning using Edmodo affects the ability to understand the mathematical concepts of high school students [29]. The use of Mathematics e-learning software Version 5.1 has a positive effect on increasing the understanding of the concept of eighth grade junior high school students [30]. From these studies, it can be seen that e-learning media is useful to improve the concept understanding of students in mathematics learning.

The studies on learning with discovery learning methods that have been carried out include aiming to train students’ understanding of concepts in physics lessons by using guided
discovery learning models [31]. In addition, study to develop guided discovery learning in integral calculus materials and to identify the effectiveness of guided discovery learning in improving students’ understanding of integral calculus material [32] and aims to determine the effect of discovery learning models on thinking skills critical and cognitive abilities of junior high school students [33].

From the description of studies above, it can be seen that there are still only few studies that combine the use e-learning media with guided discovery methods which aim to improve the ability to understand mathematical concepts of eighth grade students. Moreover, the use of e-learning media and guided discovery methods in learning have their own advantages to improve the ability to understand students' mathematical concepts so that using e-learning media combined with guided discovery methods in learning is expected to be better in improving the ability to understand students' mathematical concepts. Therefore, this study is conducted in regards to the effect of e-learning media with guided discovery method on understanding students' mathematical concepts is critical to strengthen empirical evidence from the results of the studies described previously.

2. Method

This research method is quasi-experimental. Meanwhile, the subjects of the research were 79 eight grade students with age range of 13-15 years old. Data were collected from two classes; 40 students from the experimental class and 39 students from the control class who have studied the lines and angles and the Pythagoras theorem and have not studied circular matter for eight grade. The instrument used in this study was the pretest and posttest understanding of the mathematical concepts given to the experimental class and the control class. Pretest and posttest understanding of the mathematical concepts consists of 10 items in multiple choice form. The test included circle material in eight grade.

The validity of the test instrument understanding of mathematical concepts in this study was obtained with content validity from expert judgment. Based on expert judgment, the pretest and posttest understanding of the mathematical concepts is considered valid and can be used. Estimation of reliability of test instruments in this study utilized alpha Cronbach. Coefficient α in the pretest instrument is 0.67 while the coefficient α in the posttest instrument is 0.63 so that both instruments can be said to be reliable.

Learning in the experimental class used e-learning media with guided discovery methods. Learning was conducted inside and outside of the classroom. Students were given a pretest at the first meeting before they were given a treatment. Learning in the classroom used guided discovery method steps, there are motivation, exploration, presentation, warp up, practice and evaluation and e-learning media were used only as enhancement or additions to classroom learning. At the motivation step, the teacher assisted students to remember information to link the prior knowledge with the newly gained knowledge. In the exploration step, students worked in groups and were assisted by the teacher to discuss all the issues on the Student Worksheet (SW). At the presentation step, one group member was asked to present and discuss their answers. In the warp up step, the teacher asked students questions to know the extent of students’ understanding of the material. At the practice step, students completed the question of the day (QoTD) given by the teacher where the QoTD is available in the Schoology application. After students completed the QoTD, students would immediately see the score they got in Schoology. The evaluation step was carried out at the end of the learning material, where the teacher gave posttest to students. Learning outside the classroom was done after learning in class and did not use the learning time allocation where the teacher and student could discussed circle material in the discussion forum in Schoology. The discussion in Schoology did not have a specified schedule so students were free to discuss anytime and anywhere.

Learning in the control class only used guided discovery methods and learning was only inside the classroom. The activities at each step of the guided discovery method in the control class were almost the same as the activities at each step of the guided discovery method in the experimental class but the
difference was in exploration and practice activities. In the exploration step, students worked in groups and were assisted by teachers to discuss problems with the SW. At this step of practice, students in the control class was not given QoTD but students only solved problems on SW provided by the teacher. Learning mathematics using e-learning media with guided discovery method was said to have an effect on understanding of students' concepts only if there are differences in the average score of the experimental class and the control class, and the average score of understanding the concept from experimental class is higher than that of the control class. Hypothesis testing was performed on pretest and posttest data using the Mann-Whitney test. Hypothesis testing on pretest data was conducted to determine whether the experimental and control classes have the same conditions or abilities before treatment. Meanwhile, hypothesis testing on posttest data was conducted to determine which average score was more superior between the experimental class and the control class. If significance value is less than 0.05 then there are differences in the average score of the experimental class and the control class.

Before testing the hypothesis, the assumption of normality and homogeneity were tested as well. Normality test used values of Shapiro-Wilk significance. If the significance value of the Shapiro-Wilk is more than the significance level 0.05, then it can be concluded that the experimental class and the control class comes from a population that is normally distributed. Homogeneity assumption test using the results of Lavene's Test. If the significance value is Lavene's Test higher than the significance level of 0.05 it can be concluded that the experimental class and the control class have the same of variance or homogeneous.

3. Result and Discussion
Data on understanding mathematical concepts obtained from pretest and posttest on the experimental and control classes are presented in Table 1.

| Table 1. Data on Understanding Students’ Mathematical Concepts |
|----------------------------------|-----------------|-----------------|-----------------|----------|-------------|
|                                  | N               | Theoritic Score | Observation Score | Mean    | Std. Deviation |
|                                  | Min. | Max. | Min. | Max. |          |                |
| ExperimentClass                  |        |      |      |      |          |                |
| Pretest                          | 40    | 0    | 100  | 40   | 70       | 56.25          | 10.30          |
| Posttest                         | 40    | 0    | 100  | 70   | 100      | 86.50          | 8.34           |
| Control Class                    |        |      |      |      |          |                |
| Pretest                          | 39    | 0    | 100  | 40   | 70       | 52.05          | 11.51          |
| Posttest                         | 39    | 0    | 100  | 60   | 90       | 74.87          | 9.70           |

The data in Table 1 shows that there is an improvement in the average score in the fina condition in the experimental class and the control class. The average posttest score in the experimental class is 86.50. The average posttest score shows that an increase of 30.25 points from the average pretest score is 56.25. While the average posttest score in the control class is 74.87. The average posttest score showed that there was an increase of 22.82 points from the average pretest score is 52.05.

| Table 2. The Analysis of Pretest Data |
|--------------------------------------|-----------------|-----------------|----------|
|                                     | Shapiro Wilk    | Lavene's Test   | Mann-Whitney |
| Experiment Class                    | 0.00            | 0.35           | 0.81      |
| Control Class                       | 0.00            |                |           |

The analysis of pretest data can be seen in Table 2. From the Table 2, the significance value of the Shapiro-Wilk is more than 0.05, then it can be concluded that the experimental class and the control class are not normally distributed. The significance level of Lavene's Test is higher than 0.05 so it can be said that the experimental class and the control class have the same variance or homogeneous. Because the pretest data is not normal distribution then to test the hypothesis the Mann-Whitney hypothesis test is used. The results of the Mann-Whitney hypothesis test, a 2-tailed
significance level is higher than 0.05 so it can be concluded that there is no difference in the average pretest scores in the experimental class and control class so that students in the experimental class and control class have the same ability or understanding of the concept before treatment.

Table 3. The Analysis of Posttest Data

|                | Shapiro Wilk | Lavene's Test | Mann-Whitney |
|----------------|--------------|---------------|--------------|
| Experiment Class | 0.00         | 0.25          | 0.00         |
| Control Class   | 0.00         |               |              |

The analysis of posttest data can be seen in Table 3. From the Table 3, the significance value of the Shapiro-Wilk is more than 0.05, then it can be concluded that the experimental class and the control class are not normally distributed. The significance level of Lavene's Test is higher than 0.05 so it can be said that the experimental class and the control class have the same variance or homogeneous. Because the pretest data is not normal distribution then to test the hypothesis the Mann-Whitney hypothesis test is used. The results of the Mann-Whitney hypothesis test, a 2-tailed significance level is higher than 0.05 it so can be concluded that there are difference in the average score pretest the experimental class and class control. From Table 1 shows that the average score of understanding concepts in the experimental class is higher than the control class so it can be said that e-learning media has an effect on understanding students' mathematical concepts.

Understanding the concept of the experimental class is higher than that of the control class, because students in the experimental class have more opportunities to improve their understanding of the concept by practicing to answer QoTD in e-learning media (see Figure 1). Practice solving the problems in QoTD enable te students to improve their conceptual understanding.

Discussion activities that exist in e-learning media can also influence students' understanding of the concepts. Students are able to practice their understanding of concept. The discussion available in e-learning media enable the students to improve their conceptual understanding. Students in the experimental class get more opportunity to discuss with both teacher and peer outside of the classroom than those students in the control class. The opportunity given to discuss with teacher and fellow students can only be facilitated by e-learning media. As revealed that collaborative activity remains a major topic in mathematics education for better understanding [14]. Correspondingly, interactions within groups can help students develop understanding of the concepts [34]. The benefits of using ICT in learning are promoting collaborative learning in distance learning environments, students may have the opportunity to develop concepts, so that students not only acquire shared knowledge, but also share diverse learning experiences with each other to express themselves [15]. Students can exchange ideas on the discussion activities so that they can improve their concept understanding. Examples of discussion activities conducted between students can be seen in Figure 2 and examples of discussion activities conducted by teachers and students can be seen in Figure 3.
Figure 1. Question of The Day pada Media E-Learning (Schoology)

Figure 2. Examples of Inter-Student Discussion in Schoology

Figure 3. Examples of Teacher and Student Discussions in Schoology

From Figure 2, one student starts the discussion activity by asking questions “Does apothem coincide with radius?” And then, the other students respond to the question by answering “I think it can’t, because apothem is perpendicular with chord.” The other students answer “No, it can’t because apotema is a line segment that is pulled from centre perpendicular in a chord.” Even though the responses from his friends were incorrect, the students were able to practice understanding concepts by expressing their ideas in discussion activities. The teacher provides feedback after students express their opinions on discussion activities. From Figure 3, the teacher starts the discussion activity by giving a question “What is the difference between diameter and chord?” One of the students
answer the question by answering “Chord is straight line in circle that connects the sides of a circle, whereas diameter is straight line in circle that devides right in the center point.” Then that students continues her respon “In conclusion the diameter is chord but chord doesn’t mean diameter.” Students are trained for express his ideas by responding to questions from teachers so that he can train students' understanding of mathematical concepts.

In addition, SW arranged according to guided discovery characteristics also facilitate students to develop an understanding of the concept. In SW, students are given which ones include examples and not examples then mention which ones are included as examples and not examples. After that, students are given the opportunity to conclude the definition of the material.

The learning steps in the guided discovery method can facilitate students in developing an understanding of the concept, especially in the steps of motivation and wrap up. At the motivation step, the teacher helps students remember information from their own experiences to relate the material previously learned with new subject matter. This stage is very important to attract students' attention and to help connect the knowledge possessed by previous students in order to absorb new material so that they can develop an understanding of the concept. In the wrap up step, the teacher asks students questions to find out how far students understand the material.

Based on the description above, it can be concluded that learning using e-learning media with guided discovery method can be considered superior to learning using the guided discovery method only in terms of the understanding of students' mathematical concept.

4. Conclusion
This study uses two classes, one class for the experimental class and one class for the control class. Learning in the experimental class used e-learning media with guided discovery methods. Learning in the control class only used guided discovery method. From the results of research and discussion, the results of the pretest showed that both classes had the same ability. The results of the posttest showed that the average score of understanding concepts in the experimental class is higher than the control class. Therefore, it can be concluded that e-learning media with guided discovery method affects the understanding of students' mathematical concept. The are relevant literatures to support this study. Online learning has a positive effect on the development of students' understanding of the concept [26]. The use of e-learning media has a positive effect on students' conceptual understanding [27], [28]. The use of Mathematics e-learning software Version 5.1 has a positive effect on increasing the understanding of the concept of eighth grade junior high school students [30].

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