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Influence Inquiry-Based Geometry E-Module for Primary School Teacher Education Students

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Abstract. This research was conducted to develop independent electronic module instructional materials that can guide students to acquire geometric concepts. The purpose of this study was to determine the effect of using inquiry-based geometry e-modules on the learning outcomes of Primary school teacher education students. This research method used an experimental approach with the design Nonequivalent Control Group Design. The subjects of this study were students of Primary school teacher education at Kanjuruhan University Malang, which consisted of an experimental class and a control class. Data were collected through tests and analyzed using statistical tests with SPSS 21.0 for Windows. The results of this study indicate that there is a difference in the average score between students who used e-modules and students who did not use e-modules. This means that there is an effect of using inquiry-based geometry e-modules on student learning outcomes. Thus, the inquiry-based geometry e-modules can be used as electronic instructional materials on geometry topics which include two-dimensional and three-dimensional shapes.

Keywords: E-Module, Geometry, Inquiry

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INTRODUCTION

E-Module is one of the infrastructure needed in the learning system. E-modules are widely used as modern instructional materials in the current era of globalization which has an impact on the educational aspects, especially in science and technology (Suastika & Wahyuningtyas, 2020). This is in line with a statement explaining that E-Module is a form of multimedia learning supported by images and sound as a form of effective use of technology in the learning system in the form of a person's integrity with certain content (Sayeski et al., 2015). The advantages of using E-Modules during learning can improve students' critical thinking systems in the learning process, especially mathematics (Hoyles, 2018). In addition, teaching and learning activities using E-Modules can be accessed using various devices, by using communication tools such as cellular or laptop with certain application facilities (Letchumanan & Ahmad, 2010). The application of current instructional media can improve the quality of learning by combining current technology to attract and motivate students with various digital applications that can facilitate learning (Stover, Yearta, & Harris, 2016). Based on this, the E-Module is a very practical instrument in the learning process that is connected to various applications supported by software and hardware as educational infrastructure.

The preliminary study states that the use of E-Modules is a means of teaching and learning infrastructure that is widely applied in the current educational context because it has practical benefits to help students understand most of the concepts and theories that have been taught which are supported by visual and audio (Dore et al., 2018). E-Modules can be used as digital books combined with sound and images to increase student motivation that can be accessed via tablets, computers and other software supported by suitable learning applications (Sung, Hwang, & Chen, 2019). In addition, other advantages of learning using E-Modules can be reached by all students both within the classroom and outside the classroom because it adopts the latest technology in accordance with the times (Jin, 2014; Wahyuningtyas, Yuniasih, & Irawan, 2018). Based on this, it can be seen that the E-Module has a positive impact on learning with the help of images and sounds in accordance with current learning applied with certain applications. The learning content on the E-Module can be connected to several learning models with certain materials, especially Mathematics, which can make it easier for students to learn.

The inquiry approach is one approach that is widely applied in Mathematics learning. Inquiry can be defined as collaboration between teachers and students by applying learning methods based on the knowledge and experience gained to find a new process in the form of cause and effect, formulating hypotheses, and conducting experimental tests with certain steps including orientation, new theoretical concept systems, experiments , data collection so as to produce results with valid conclusions in accordance

with the learning objectives (Kori, Mäeots, & Pedaste, 2014; Lepareur & Grangeat, 2018; Pedaste et al., 2015). This strategy is adapted to a collaborative learning system between teachers and students to carry out joint investigations and research to find valid answers (Lepareur & Grangeat, 2018). The method of inquiry is known as a method that focuses on student experiences by collaborating latest problems according to student learning and experiences which require students to think critically and creatively organized with four dimensions including: question formulation, investigation and evaluation, and solutions in solving (Brugar, 2019). The method of inquiry is different from conventional learning method. The difference between the inquiry method and the conventional method is the difference on how to solve problems. If the conventional method is used only to find solutions to problems, on the other hand, the inquiry method focuses on problems and independent study to require students to think critically in finding solutions and formulating answers to problems (Alameddine & Ahwal, 2016; Pavlína, 2015; Tosati, Lawthong, & Suwanmonkha, 2015). This method is particularly important in shaping the character of students to think critically and creatively in solving problems in a valid and structured manner. This method is carried out by students actively to figure out hypotheses, conduct experiments, and complete conclusions.

There are several studies related to the methods of inquiry. The study of the inquiry approach adapted to existing learning materials may increase student motivation to learn in order to foster a confident approach to solving problems that arise by making observations, solving problems on their own, and writing results and conclusions (Hotchkiss, Ecke, Fleron, & von Renesse, 2015; Serafín & Havelka, 2015; Villardón-gallego, 2016). The method of inquiry is also known as a means of developing an independent approach to solving personal problems in accordance with the level of education taken, supported by methodological and research activities in order to evaluate the results of the data and the evidence of data collection in order to reach a conclusion (Conole, Scanlon, Littleton, Kerawalla, & Mulholland, 2010). It is certainly necessary to support the infrastructure in line with current educational developments. Mobile communication is one of the technologies that is widely used to support learning systems and encourages students to think critically and creatively about the times and ages of students (Thys, Verschaffel, Van Dooren, & Laevers, 2016). It can be concluded that technology can support the learning system by using the inquiry model to provide feedback and high communication on what is learned in order to improve students ' ability to think at a high level (Alexander, 2018). Several studies have shown that technology-based learning activities can improve and support student learning systems. It is therefore necessary to apply technology to the learning system and to study learning models, in particular mathematics with a specific field, namely geometry.

Geometry is mathematics learning that combines shapes, characteristic analysis and manufacturing structures with everyday experience as a benchmark for learning (Panaoura, 2014). Geometry has the most applications in student life to determine the application of shapes, formulas, analysis of building structures according to mathematical properties with patterns, shapes, planes, dots, straight lines, perpendiculars, volumes, circles, or spaces related to volume and space area (Purnama, Andrew, & Galinium, 2014; Verner, Massarwe, & Bshouty, 2019; Vidermanova & Vallo, 2015). Therefore, geometry is known as studying mathematics, which solves problems in the form of shape, scale, volume, area shown to get the correct result (Chan & Leung, 2014). On this basis it can be concluded that geometry is a mathematical learning which provides instructions on the shape, area and volume displayed in pictures to solve the existing problems.

Students begin to make calculations in geometry learning with a number of experiments carried out, followed by phases in the inquiry learning model, including the problem stage, analysis stage, data collection, research and conclusions, in line with the content of the lesson (Guven & Baki, 2010). The concept of learning geometry is adapted to the combination of form elements and is applied to everyday life to the critical and creative improvement of student thinking processes (Panaoura, 2014). Learning process using technology can have an impact on student thinking activities, particularly in the field of mathematics, geometry content, combining forms through visualization and auditory activities supported by certain applications (Ubuz & Aydınyer, 2019). It is therefore necessary to encourage learning by using software applications to intensify mathematics content, in particular geometry, in order to attain maximum results and to encourage students to think critically (Chan & Leung, 2014; Stols, 2012). Based on these findings, it can be inferred that work on the impact of using technology in the form of an E-Module focused on an inquiry model of mathematics learning with the theme of geometry applied to Primary school students needs to be pursued.

Support for carrying out this research is the use of E-Module in mathematics learning, which is very practical to use wherever and can be studied whenever students want. In addition, the module allows students to be autonomous and innovative during the learning process through an interactive vizualization and auditory presentation (Suastika & Wahyuningtyas, 2020). The inquiry approach presented in the E-

Module will motivate students to build their knowledge and skills in solving problems tailored to the context they take thus students become active in asking questions or proposing statements or responding to them. Accordingly, the learning process becomes more interesting, especially in learning geometry which does not only emphasizes on memorizing formulas, but also it is supported by daily problems with visualization and auditory facilities presented in the recent technology in the form of E-Modules (Hähkiöniemi, 2017; Kandil & Işıksal-Bostan, 2019). The focus of this study is to determine the importance of the influence of the use of inquiry-based E-Modules on two-dimensional and three-dimensional shapes learning outcomes of Primary School Teacher Education students..

METHODS

The research method used was an experimental approach in which data was collected quantitatively—in the form of numbers or data processed using valid statistics calculation (McMillan & Schumacher, 2014). The subjects of this study were 70 students of Primary School Teacher Education at the University of Kanjuruhan Malang who were divided into two large groups. The subjects were divided into two major groups: the experimental class and the control class. The experimental class used an inquiry-based E-Module on geometric content while the control class was a conventional class that did not use E-Module, only used traditional books. Based on this, this study adapted the Nonequivalent Control Group Design to determine the influence of inquiry-based E-Modules for two-dimensional and three-dimensional shapes on learning outcomes of Primary School Teacher Education students.

The instrument used in this research was a test. Furthermore, a posttest was administered to identify the difference of students' learning outcomes between those who used e-module and those who did not use e-module. It was then examined by using T-test. The collected data were then processed by using statistical examination with SPSS 21.0 for Windows.

The Application of Inquiry-based E-module

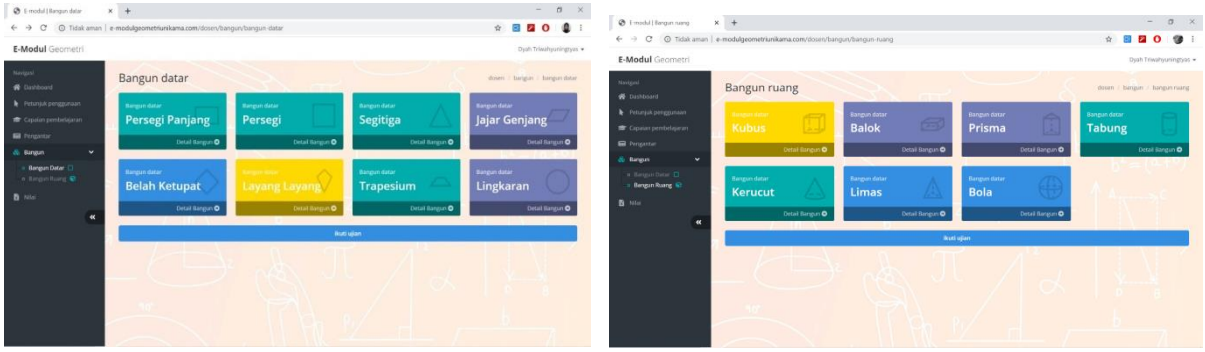

Figure 1. *The Application of E-module*

Figure 1 is a display of the learning application using the E-Module which is used and can be accessed via http://e-modulgeometriunikama.com/login. The E-Module used has two main lesson contents, they are two-dimensional and three-dimensional shapes. The exam consisted of ten question where students must complete all questions in 50 minutes. The questions given were presented after the lesson contents were delivered, thus the students would complete the questions after reading the lesson contents.

After students completing the questions, a true or false statement will appear in the picture. If the question is answered correctly, a true statement will appear and vice versa. After a true or false statement appears, a student cannot repeat the previous question they answered. The menu will go directly to the next question. The final score will appear when all answers have been answered with a valid score.

RESULTS

The Mathematics lesson by using E-module was implemented on students of Primary School Education at Kanjuruhan University Malang. The Mathematics lessons presented, geometry topic, were adjusted to the student's course at that time. The students were suggested to use their smartphone and/or personal laptop to apply the inquiry-based e-module developed by the researchers. The students used the instructional media independently based on the instructions provided in the e-module.

Students can carry out these learning activities using cellphones or laptops to open the application. Students use their cellphones to access learning in the e-module in the form of exercises, teaching resources

and videos. E-modules are prepared with photos and videos that are supported by sound thus students can study independently in the application. The E-Module is expected to increase the motivation of students to learn independently.

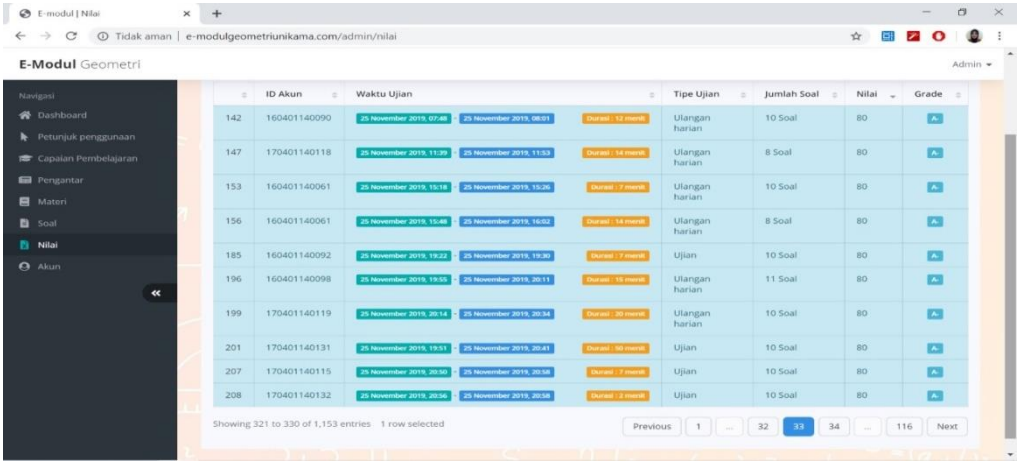

Figure 2. *The Recapitulation of Daily Test and Final Test of Students After Using E-module*

Figure 2 is the result of a recap of daily test scores and student final test scores using the E-module with time and exam ID details. These results are presented using a table of figures for easy assessment. There are several columns in the recapitulation of student results, including student identity, date of implementation, processing time, working time , type of exam, number of questions, grades and grades. The results of the research conducted show differences in results between the control class and the experimental class, where the experimental class obtained higher post-test learning outcomes than the control class.

The experimental class was a class that used the E-Module treatment while the control class only used the conventional method in learning. The learning outcomes for the posttest scores of the experimental class showed higher scores than the control class. The experimental class obtained a score of 85.57 while the control class obtained a score of 78.57. The results of the normality test in the experimental and control classes have a significant average value of 0.09 thus the data has a normal distribution since it obtained a score of more than 0.05. These results indicate that this study obtained normal results and was in accordance with the research objectives. The results of the homogeneity test in the experimental and control classes for learning activities using the E-Module obtained a significant score of 0.964 which indicates that the data was homogeneous data where the data obtained a score greater than 0.05. Then, we can see how the effect of learning activities using the E-Module on the treatment of the control class and the experimental class by testing the hypothesis on the Independent Samples t-test to test two averages on two independent data groups with using SPSS 21.0 For Windows. The hypothesis test used can be applied to the results table on the computer screen as shown below:

Table 1 : *The Results of Hypothesis Testing by Using SPSS 21.0 For Windows*

Independent Samples Test							
		Levene's Test for Equality of Variances		t-test for Equality of Means			
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference
Learning outcomes	Equal variances assumed	.002	.964	3.121	68	.003	8.000
	Equal variances not assumed			3.121	66.817	.003	8.000

Table 1 is the result of the Hypothesis Testing on the inquiry-based E-Module Effect for Geometry lesson with the topic of two-dimensional and three-dimensional shapes on student learning outcomes of Primary School Teacher Education, University of Kanjuruhan Malang. The results of the Hypothesis Testing in Table 1 show that the Levene Test for Equal Variance is significant, with a homogeneity of 0.964>0.05. This proves that pre-test and post-test questions have homogeneous data variants and tend to be the same. The second data was a significant result (2-tailed) showing the number 0.003. The value of this figure was 0.003 < 0.05 thus the hypothesis is validly accepted. Decision making on this research was based on the hypothesis testing through Independent Samples t, resulting that the research hypothesis is accepted. Therefore, it confirms that the application of the E-Module in learning geometry have an impact on the learning outcomes of students of Primary Education department on two-dimensional and three-dimensional shapes. It can also be concluded that the use of E-modules can make the learning process easier for students to become more motivated and to better understand what is taught.

DISCUSSION AND CONCLUSIONS

Geometry lesson assisted by inquiry-based e-module allows students to improve their independency in learning and motivation (Kulm, 2014). The development of the E-module in this study is accompanied by enticing audio and visuals, making it easier for students to recall and understand what they are learning (Bode, Khorami, & Visscher, 2014). Furthermore, the geometry lesson assisted by inquiry-based e-module enables students to acquire comprehensive knowledge about two-dimensional and three-dimensional shapes which does not only rely on the memorization of formulas. Instead, it allows students to understand how to formulate a formula with proper context (Hegg, Papadopoulos, Katz, & Fukawa-connelly, 2018; Yang & Wang, 2017). This is in accordance with the principles of the inquiry model where a student solves problems according to their own experience and learning or a supportive environment (Kuhn et al., 2017). Therefore it is necessary to have learning activities that are integrated with inquiry-based technology thus students can learn independently and critically.

The results of research on the effect of learning using E-Module instructional media show that the media developed can improve student learning outcomes and direct them according to learning objectives. This is in accordance with the statement that the effectiveness of technology can improve learning therefore the audience can more easily understand lesson content provided and increase students' confidence in learning (Liou & Kuo, 2014). The above statement supports that the college students will better acquire and understand the lesson content, particularly about geometry topic, and relate it with the real-life context by using e-module (Bode et al., 2014). The use of technology in the digital era can make students understand and bring about a positive setting in the context of education (Brown & Brown, 2010). In addition, the use of technology-assisted E-Modules can foster student attitudes to be critical and creative in solving learning and problems according to the student's level of thinking (Karagiannis, Markelis, Paparrizos, Samaras, & Sifaleras, 2006). This activity has been proven in this study that student learning outcomes have increased since the implementation of technology-based learning activities. Therefore it is necessary to have learning activities related to technology thus students are more capable and critical in solving problems related to geometry. The use of technology in the education era can improve student learning in a positive direction according to the application of inquiry-based e-modules which can improve student learning outcomes of Primary education school students.

Technology-based learning can increase student creativity in accordance with the development of science and technology. One example of current instructional media is the E-Module. E-modules can be applied to mathematics learning activities and offers a practical and easier approach, particularly for two-dimensional and three-dimensional shapes lessons. The use of inquiry-based e-modules helps students to build the appropriate concepts. This encourages students to learn independently in solving daily-life problems about geometry. Based on the results of the Independent Samples t Test or the two-mean difference test used to test two means on two independent data groups using SPSS 21.0 For Windows, it shows that inquiry-based e-module affect the results of learning outcomes about two-dimensional and three-dimensional shapes. To sum up, it confirms that the use of inquiry-based e-module significantly improve students' learning outcomes. Therefore, the developed inquiry-based e-module is applicable for Mathematics lesson, particularly geometry topic, for Primary Teacher Education students.

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