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Electronic module of geometry based on inquiry

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Abstract. This research aimed at examining the influence of inquiry-based e-module for geometry lessons on the learning outcomes of college students of the elementary school education department. This research employed an experimental approach by using geometry e-module based on inquiry to find out and understand geometry concept. This study used a single-subject research approach involving students of Elementary School Education Department in Kanjuruhan University Malang. The data analysis technique in this study was used quantitative and qualitative descriptive procedures. Geometry e-module based on inquiry consisted of two topics, to be specific: two-dimensional and three-dimensional shapes. The results of this research indicate that the college students could determine the attributes of shape such as circumference and areas of two-dimensional shapes as well as nets, face areas, and volume of three-dimensional shapes. Therefore, this further confirms that geometry e-module based inquiry could be applied as an electronic instructional media for college students.

1. Introduction

E-module is one of the alternative instructional materials that are available currently in this globalization era. This genre of instructional material encompasses convenience in the aspect of education particularly during the rapid development of technology and information [1]. Currently, digital books as reading content are obtained by digitalizing printed books or it can be made by directly producing books in the form of an electronic one. Electronic books are effective to be used during learning activities [2]. It is available to be used through several hard wares using particular software and some are available to be accessed through cellular devices. The electronic book enables the reader to access the content anytime, anywhere, and any condition easily. It also allows them to send it via sharing applications [3]. Furthermore, the electronic book plays a role as independent reading materials offering contemporary and interesting reading experience as well as motivating the student to read more. On top of that, it allows the student to have an interactive reading activity [4].

Several studies related to the use of an e-module have confirmed some benefits and potencies. It was affirmed that digital books are different from the conventional textbook. The use of an e-module in the form of audio is beneficial for college students during an independent learning activity. It enables them to remember most of the information provided in the e-module [5]. In addition, the e-module is accessible and available for most people since it adopts interesting and effective technology [6,7]. Accordingly, it is important to develop an e-module which connects it with daily-life issues to facilitate college students to learn Mathematics.

The inquiry method constitutes one learning approach that offers procedures and practices to establish student's knowledge, discover new processes such as causal relationships, formulate a

hypothesis, and perform experimental examination. The stages within the inquiry method are the action of orienting, theory conceptualization to answer question or hypothesis, the action of investigating, writing the temporary answer to the problem from the discussion, and performing discussion to obtain appropriate answer [8,9]. This strategy strongly correlates with problems and then the student performs an investigation and/or observation to discover a possible solution(s) for the problem [10]. This method is different from the conventional method. In the conventional method, the student is allowed to directly discover the answer to the problem. However, the inquiry method allows the student to focus on the problem itself and encourages them to critically think in finding the solution. This method, additionally, offers an opportunity to the student to actively involve by providing feedback, possible questions and responses as well as providing evaluation and reward [11-13]. This method is used to encourage critical thinking among college students as well as increasing their active participation to experiment, prove the hypothesis, and draw a conclusion.

Several studies related to the implementation of inquiry-based learning have confirmed that it can encourage student's motivation, self-confidence, and interest in problem examination. Moreover, the studies affirm that the approach is successful in offering a challenge to formulate the given problem using their own words, perform comprehensive observation, draw temporary findings and conclusion and conduct a discussion based on the obtained facts [14-16]. This learning approach requires a comprehensive direction instead of memorizing the formula only. This approach allows students to propose and answer the question to the problem and shortly, this offers an increase in learning outcomes through cellular technology application [17,18]. One study also affirms that to obtain the highest average score of learning outcomes, inquiry-based learning could be combined with a satisfactory communication process that allows sufficient feedback [19].

In daily life, the student will commonly find the application of geometry lessons. The student commonly needs to deal with the mathematical characteristics and properties of geometry such as geometrical pattern, form, areas, surface, point, straight line, vertical line, volume, circle, and space. Also, the student will commonly deal with the measurement of geometry and problem-solving related to geometrical areas, space, and volume [20–22]. Moreover, in the geometry branch, student deals with a wide object, a visualized three-dimensional object which requires valid conclusion, critical thinking, and appropriate solution when measuring [23]. Geometry lessons enable the student to learn about the straight line, volume, points, areas, visualized three-dimensional object to obtain a certain solution.

To find a solution to a geometrical problem, college students could use the existing concept by operating certain formulas, taking a given example, and performing a proofing process to find an answer to geometry which is visualized with the element combination [24,25]. Furthermore, another study has confirmed that through self-confidence and high presentation, college students are able to comprehensively observe and reason to find geometry solutions [26,27].

Geometry lesson by using technology-assisted learning approach resulted in a significant learning outcome compared to the lesson which did not use technology or conventional learning [28,29]. Through an inquiry-based learning approach, students will be more motivated and desired to perform an experiment, formulate a purpose in learning, as well as actively involves in raising questions and responding to the discussion. Then, the learning process will be more meaningful. Not to mention, when studying Mathematics, particularly visualized Geometry, students will be able to inquire about a concept related instead of memorizing the pre-existing formula only [30–32]. The focus of this research was to enhance college students understanding about the concept of circumference, areas, and volume of geometry through the application of geometry e-module based on inquiry.

2. Methods

This research was an experimental research that focused on the application of geometry e-module based on inquiry to find out the circumference and areas of two-dimensional shapes as well as face areas and volume of three-dimensional shapes. This research took 70 college students of Elementary School Education Department from Kanjuruhan University Malang to be participated as the subject.

The instrument used in this research was pre-test results to identify the initial ability of students, post-test results to identify the final ability of students. The data analysis of this research used qualitative procedure to analyse the learning process of finding out sphere face areas and volume. While quantitative procedure was used to analyse the results of pre-test and post-test of students. The implementation of geometry e-module based on inquiry took place within four sessions and each session spent 100 minutes.

2.1. Geometry e-module based on inquiry

Geometry e-module based on inquiry constitutes an electronic instructional media in the form of module. The process of creating geometry e-module was first, designing a system arrangement in the form of system flowchart that includes system interface design and database. The second stage was undertaking a coding process based on the created design. This application used https://youtube.com as the third-party site and the database used was MySQL. The components made were the components of the html and php programming languages and the programming languages used were html and php. The third stage was testing by inputting content. The fourth stage was implementing the system to the users. The e-module can be accessed through http://e-modulgeometriunikama.com/login.

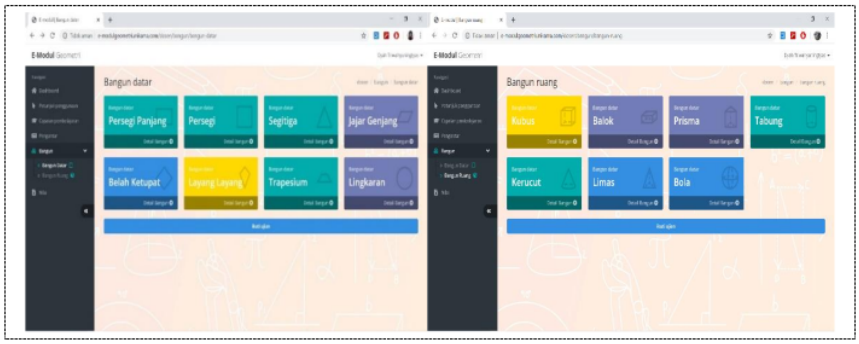

Figure 1. E-module.

The e-module consists of two primary materials; two-dimensional and three-dimensional shapes. This geometry e-module consisted of two topics: two-dimensional and three-dimensional shapes. The two-dimensional shapes topics consisted of rectangle, square, triangle, parallelogram, rhombus, trapezoid, and circle. The three-dimensional shapes topics covered cube, rectangular prism, prism, cylinder, cone, pyramid, and sphere. The test consists of ten multiple-choice items. The students are given 50 minutes to complete the tests. After the student completing each item of the test, then the result or the answer will automatically be shown.

3. Results and discussion

Geometry e-module based on inquiry could be accessed by students using smartphone and/or laptop. E-module application consisted of user guidelines, learning objectives, introduction to geometry topic, core geometry topic covering two-dimensional and three-dimensional shapes and evaluation. The activities in the e-module direct students to find out comprehensively the attributes of shape such as circumference and areas of two-dimensional shapes as well as net, face areas, and volume of three-dimensional shapes. The two-dimensional shapes topics consisted of rectangle, square, triangle, parallelogram, rhombus, trapezoid, and circle. The three-dimensional shapes topics covered cube, rectangular prism, prism, cylinder, cone, pyramid, and sphere.

To determine the circumference of the two-dimensional shapes, it requires to sum up all the side length. To determine the perimeter of a circle, it should follow 2 x π x r formula. To determine the areas of two-dimensional shapes, the formulas used are as follows:

$$Rectangle\ area = length\ x\ width \quad (1)$$

$$Square\ area = side\ x\ side \quad (2)$$

$$Traiangle\ area = \frac{1}{2} x\ base\ x\ height \quad (3)$$

$$Paralleolgram\ area = base\ x\ height \quad (4)$$

$$Trapezoid\ area = \frac{1}{2} x\ (two\ bases) x\ t \quad (5)$$

$$Diamond\ area = \frac{1}{2} x\ diagonal\ 1\ x\ diagonal\ 2 \quad (6)$$

$$Rhombus\ area = \frac{1}{2} x\ diagonal\ 1\ x\ diagonal\ 2 \quad (7)$$

$$Circle\ circumference = \frac{1}{2} x\ \pi\ x\ r^2 \quad (8)$$

To determine the face areas of three-dimensional shapes, it requires to sum up all face areas.

To determine the volume, the formulas used are as follows:

$$Square\ volume = side\ x\ side\ x\ side = s^3 \quad (9)$$

$$Rectangular\ prism = length\ x\ width\ x\ height \quad (10)$$

$$Prism\ volume = Base\ area\ x\ height \quad (11)$$

$$Cylinder\ volume = Base\ area\ x\ height = \pi\ x\ r^2 x\ t \quad (12)$$

$$Pyramid\ volume = \frac{1}{3} x\ Base\ area\ x\ t \quad (13)$$

$$Cone\ volume = \frac{1}{3} x\ base\ area\ x\ t = \frac{1}{3} x\ \pi\ x\ r^2 x\ t \quad (14)$$

$$Sphere\ volume = \frac{4}{3} x\ \pi\ x\ r^3 \quad (15)$$

The pre-test results of this research affirmed that the learning outcomes of the experimental class using inquiry-based e-module were higher than the control class which did not use the e-module; the average score of the experimental class was 60 and the control class was 59.71. Then, the post-test results of this research affirmed that the learning outcomes of the experimental class using inquiry-based e-module were higher than the control class which did not use the e-module; the average score of the experimental class was 86.57 and the control class which did not use the e-module was 78.57.

In addition, based on the testing results, the application of independent e-module utilizing audio narration enables students to acquire more information [5]. Moreover, students are enforced to operate the existing formula of geometry along with the process of proofing; the outcomes are not only in the form of formula memorization [24,25]. Students will be able to have a critical thinking and better analysis process about geometry which indicates a high level of academic achievement of college students [26,27]. Not to mention, the application of technology improves the effectiveness and validity of studying geometry lesson [28,29]. Students do not only require to memorize the formula of the geometry, but also, they need to be able to postulate questions, provide answers, and critically think, particularly when it is applied using technology (in this context is the e-module) [18,33]. The application of recent technology nowadays brings a positive impact on the education aspect [34].

4. Conclusion

This paper explains that an e-module is available to be applied during Mathematics learning, particularly geometry subject. The application of the e-module assists students to acquire the concept of geometry through the inquiry process. The college students could determine the attributes of shape such as circumference and areas of two-dimensional shapes as well as nets, face areas, and volume of three-dimensional shapes. To sum up, the inquiry-based e-module is available to be applied during the geometry lesson of college students of elementary school education department.

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