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The Effectiveness of Mathematics E-Modules with a Contextual Approach on Geometry Matters to Improving Students' Learning Outcomes

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Abstract

This study aims to analyze the development of web-based mathematics teaching materials using Moodle from the Learning Management System (LMS) with a Contextual Approach to Geometry in the eighth grade of junior high school. This research is development research by adapting the Borg and Gall development model, consisting of expert validation, small group trials, and large group trials. It uses the t-test to measure product effectiveness. Data collection techniques used questionnaires and written tests. Data analysis was carried out quantitatively using descriptive and inferential statistics. The effectiveness test results show that the t-table value is 2,988, with a significant level of 0.012 smaller than 0.025 (0.012 <0.025). Based on these results, Ho is rejected, so there is an average difference between the experimental class and the control class. Based on these results, it can be stated that the product developed in the form of an E-mathematical module with a contextual approach effectively improves student learning outcomes in geometry material.

Keywords: *E-Learning, Moodle, Geometry*

1. Introduction

The rapid advancement of information and communication technology (ICT) and the widespread development of global information infrastructure have changed the patterns and ways of doing business, industry, trade, education, and government (Rodiawati & Komarudin, 2018). One sector that uses ICT systems in education is online distance learning or e-learning and collaborative learning between classical and online learning. One of the rapid developments in information and communication technology in education is the Learning Management System (LMS). LMS is defined as a system designed to facilitate teachers/lecturers in managing learning in schools/universities for students, especially to help teachers/lecturers and students with the administration of learning in schools. One of the famous LMS software is Moodle. Moodle is a useful software package for creating and administering internet-based courses/training/education. Moodle is provided free of charge as open-source software (Asrial et al., 2020). Even though it has copyright, Moodle users are still given the freedom to try, use, and modify it so that the results are easier to understand and clearer because it has been adapted to the needs of teachers and students (Zainal Abidin & Walida, 2017; K. W. B. Putra et al., 2017; Tirta, 2014).

LMS-based teaching materials are not new at this time. Perhaps their use is not yet widely used by students at several levels of education, such as elementary school (Feriyanti et al., 2019) up to senior high school level. The development of teaching materials using LMS is expected to make students more diligent in studying science without carrying many thick books (Ula & Fadila, 2018; Zulkarnain et al., 2015). The need for additional teaching materials through e-learning and, at the same time, the qualifications expected by students is one of the problems and challenges in today's world of mathematics education.

In the researchers' initial observations conducted at the Labschool Jakarta Junior High School, the researchers found that many students still had difficulties learning mathematics. Of the 15 subjects or subjects asked, 43 respondents answered more than one difficult geometry material. There are 226 answers by 43 respondents, which means that

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each respondent answered with a percentage of 11.06% of the circle material considered difficult to solve. In contrast, other materials based on the existing data, such as 8.41% answered that the triangle material was difficult to solve. The quadrilateral material 10.18%, one variable linear equations and inequalities 2.63%, Social Arithmetic 73%, transformation material 1.77%, algebraic factorization material 5.75%, Pythagorean theorem 8.41%, straight-line equation material 7, 8%, two-variable system of linear equations 3.8%, 9.73% flat side space, 8.41% curved side space, 5.75% set material, 2.65% integer material, statistics material 3.54%. From these data, it can be seen that it is not easy to solve among these materials, specifically geometry. These findings are reinforced by several surveys which state that, as in the United States, only half of the existing students take formal geometry lessons (Cuevas & Driscoll, 1993). In addition, the achievement of all students in problems related to geometry and measurement is still low. Furthermore, Hoffer stated that students in America and the Soviet Union both had difficulties in learning geometry. The same thing was also found in research on how many students had difficulties working on questions and materials about geometry at school (Hohenwarter & Jones, 2007).

Based on the needs analysis results, additional teaching materials are needed to strengthen their mathematical abilities. Twelve teaching materials or 12 subjects were offered to them. All of them were selected 146 choices. If averaged to 43 respondents, each respondent chose an average of 3.39 choices of teaching materials. It means that each teaching material is complementary for the respondents because it has its strengths and weaknesses. It is just that if the five teaching materials selected by the respondents are sorted, namely e-learning media (27.2%), media (13.01%), summaries (13.1%), handbooks (8.90%), and student worksheets. (8.21%). The choice of respondents in the e-learning module aligns with their answers to the three alternative bases of teaching materials (text-based, e-learning, visual). The majority of respondents chose e-learning (49.27%). E-learning has characteristics, can be accessed anywhere and anytime, and can be studied more personalized and customized. Such characteristics of e-learning are likely to be their best choice for additional teaching materials. E-learning content and teaching materials that exist in the e-learning system (Learning Management System) can be in the form of Multimedia-based Content (shaped content or Text-based Content (text-shaped content as in ordinary textbooks). It can be stored in Learning Management System (LMS) to be run by students anytime and anywhere. Learning Management Systems (LMS) uses e-learning software (Utami & Jatmiko, 2018).

The advantage of LMS Interaction is that it is not real-time with mailing lists, discussion groups, newsgroups, and bulletin boards. With the above method, the interaction of teachers and students in the classroom may be replaced, although not 100%. Forms of material, exams, quizzes, and other educational methods can also be implemented on the web, such as teacher materials made in the form of presentations on the web and can be downloaded by students. In addition, LMS provides an alternative learning system that teachers can apply, which is useful for improving students' ICT skills and providing solutions for teachers who lack time in delivering material (Wijayanti et al., 2017). Moodle, if used correctly and systematically, will be very beneficial in the teaching and learning process and also increase student experience in using Moodle as a variety of learning media and suitable for all types of learning models (Brown et al., 2014; Martín-Blas & Serrano-Fernández, 2012; Zakaria & Daud, 2013). This study aims to develop an e-learning design using a web-based Moodle LMS for mathematics lessons for junior high school students. It focuses on the geometry chapter as mentioned above related to the material discussed. Among various branches of mathematics, geometry is the most touches almost all aspects of human life. Many objects around us that resemble geometric shapes (Siswanto & Kusumah, 2017; Yulistiyarini & Mahmudi, 2015).

2. Method

The web-based mathematics learning media development model in this study refers to a research model with ten stages of research (Borg & Gall, 1983). Research and collection of information that includes literature review, observation, making a research framework.

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Planning includes defining skills, formulating research objectives, determining research work procedures, determining learning sequences and small-scale trials, developing initial product forms, including preparing learning materials (preliminary draft product design). Conducting initial field testing (preliminary field testing), trying out a product draft to a limited area, and subject carried out on five subjects taken at random data collection by interviews, observations, questionnaires, and analysis. The initial product revision is carried out by the suggestions in the initial field trial. Conducting main field testing, namely testing the revised product to a wider area and subject using twenty to thirty subjects then revising the operational product according to those suggested in the main field trial results. Conduct operational field trials conducted on a wider range of subjects.

The research object in developing this product is the eighth-grade students at the Labschool Jakarta Junior High School. This product can be accessed and viewed in the web form with the address elabsmatematika.net. In this study, several types of data will be processed to obtain results regarding the evaluation of the product to be developed. The data was in the form of validation results of media experts, data from small group trials, field trial data, and socialization data. All validation results from both media experts and material experts will be analyzed and calculated based on these data, which will later become a reference for revising the products to be developed. Data collected by interview, observation, and questionnaire, and analyzed, final product revision (effective product revision) as suggested in operational field trials. The dissemination and implementation to make reports on products in the form of media collaborations or links. The product that has been developed was evaluated by two experts, namely material experts and media experts. The validator itself consists of 6 experts. The evaluation indicators carried out by experts are presented in Table 1.

Table 1. Expert Evaluation Instruments

No.	Aspect	Indicator
1	language	The clarity of the instructions to use the E-learning module
		Ease of understanding the flow of material through the use of language
		The accuracy of the terms used
		Ability to encourage students' curiosity
		Politeness of using language
2	Presentation	The clarity of the instructions to use the E-learning module
		Ease of understanding the flow of material through the use of language
		The accuracy of the terms used
		Ability to encourage students' curiosity
		Politeness of using language
		The clarity of the instructions to use the E-learning module
		Ease of understanding the flow of material through the use of language
3	Effect of Strategy on Learning	Ease of use
		Media support for a contextual approach to the discussion of geometry
		The ability of media to improve students' metacognitive in learning Mathematics
		Media capabilities
		Increase knowledge
		The impact of using media E-learning module-based mathematics teaching materials on teachers
4	Contextual	Media meets the requirements of Constructivism theory
		Learning media is Inquiry (Finding)
		Learning media is Questioning (ask)
		Learning media is a learning community
5	Overall view	The attractiveness of design in the e-learning module
		Ease of reading text/writing

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The next stage is the small group trial, which is carried out using a sample of 10 students. The next is a large group trial using 30 student samples. A product effectiveness test will be carried out using 60 samples consisting of experimental and control classes in the final stage. The instruments used for evaluation are questionnaires and evaluation test questions which experts have validated. Effectiveness test is done by giving pre-test and post-test according to the previously validated instrument. The test method used is an online test that is directly assessed using the developed Moodle. Data analysis in this study was carried out qualitatively and quantitatively. Qualitative analysis was carried out using suggestions, comments, and expert input as the basis for revising the product. Quantitative analysis was performed using descriptive and inferential statistics. Descriptive statistics are used to describe the results of expert evaluations, product trials, and effectiveness tests. Meanwhile, inferential statistics are used to draw hypotheses related to product effectiveness

3. Result and Discussion

Results

The initial step is media validation by experts. The media validator consists of three experts who have been selected and are considered relevant both from their field of expertise and scientific fields. The results of the validation of the two validators are presented in Table 2.

Table 2. Results of the media validity test results

No.	Aspect	Percentage	Category
1	Content Eligibility	91,5 %	Very good
2	Linguistic eligibility	90%	Very good
3	Serving eligibility	91,75%	Very good
4	Feasibility of strategy effect on learning	90%	Very good
5	Overall view eligibility	92,5%	Very good
6	Eligibility of contextual aspects	62,5%	Good
7	Software engineering feasibility	87,5%	Good

After getting some input from the validator, the researcher then made improvements to the main points, such as the feasibility aspect of the contextual aspect, which got a fairly low score. After the repair is done, it will go to the next phase. The next stage of this research is a small group trial that evaluates the product to be developed. In this trial conducted by ten respondents, the assessment was carried out by giving questionnaires to respondents. At this stage, the respondent is given six days to fill out the questionnaire that has been given. The results of the small group trial of students are presented in Table 3.

Table 3. Small group test results

No.	Aspect	Percentage	Category
1	Interest	75 %	Good
2	Material	72%	Good
3	Language	75%	Good
4	Appearance	75%	Good
5	Effects of learning on students	72,55%	Good

There are still many shortcomings in the small group trial in several aspects, such as the display aspect and the control function. According to the eighth grade SMP Labschool Jakarta findings, improvements will be made based on the small group trial results. The trial was conducted using the developed product, namely web-based mathematics teaching materials using Moodle from the Learning Management System (LMS), by accessing the

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elabsmatematika.net site. Furthermore, students will be given a questionnaire that has been prepared and given one week to collect it. The data from the test questionnaire results are presented in Table 4.

Table 4. Large group test results

No.	Aspect	Percentage	Category
1	Interest	92,5 %	Very Good
2	Material	85%	Very Good
3	Language	91,25%	Very Good
4	Appearance	78,5%	Good
5	Effects of learning on students	86%	Good

The large group trial results showed a statistically significant change in the questionnaire results obtained in several aspects such as an improved display, improved animations, and templates to be more attractive to student learning. The final stage of this research is the effectiveness test used to determine the effectiveness of the products that have been developed. The results of the different test results for the control group and the experimental group are presented in Table 5.

Table 5. T-test results of the effectiveness of the model

T-test Sample	Sig 2 Tailed
2,988	0,012

At this stage of the T-test, the researcher used the Independent Sample T-Test technique using the SPSS series 21 application. From statistical calculations, the average post-test result for the experimental class was 70, while the post-test average for the control class was 90. Meanwhile, the T-test was 2.988, with a significantly smaller level of 0.012. of 0.025 (0.012 <0.025), based on these results, Ho is rejected, so there is an average difference between the experimental class and the control class.

Discussion

Based on the findings of the statistical calculation results on the effectiveness test and synchronization with hypothesis testing, it can be stated that the hypothesis proposed in this study rejects the null hypothesis, which means that there is a mean difference between the variables in the experimental class and the control class. Students received instruction through the developed product in the experimental class compared to the control class that did not receive treatment for the developed product. There was a significant difference in their learning outcomes. In addition, with the help of these web-based teaching materials and combined with a contextual approach to make the mathematics learning process easier to understand and a pleasant experience for students, Geometry occupies a special position in the mathematics curriculum because of the many concepts contained in it (Hidayati, 2017; Mardiyanti et al., 2018). From a psychological point of view, geometry is an abstract representation of visual and spatial experience, such as planes, patterns, measurements, and mappings.

Meanwhile, from a mathematical point of view, geometry provides approaches to problem-solving, such as drawings, diagrams, coordinate systems, vectors, and transformations. Geometry is also an environment for studying mathematical structures (Burger & Shaughnessy, 1993: 140). Several studies show that geometry has a greater chance of being understood by students than other mathematics branches. Students had known geometry ideas since before they entered school, for example, lines, planes, and spaces.). From the existing reality, it can be said that the use of learning media in solving geometry problems is in line with research that states that the use of learning media in

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geometry material is quite effective in improving learning outcomes (Putra et al., 2014). Therefore, the development of Moodle based on LMS is one solution.

Based on research, the use of problem-solving-oriented e-modules will lead students to find problem-solving independently. It will provide a concrete experience in problem-solving to grow and train higher-order thinking skills, including critical thinking skills, and stimulate the growth of students' pedagogic abilities if used properly. It is also by research (Muin & Ulfah, 2012). Learning with the Moodle application makes it easier for students to interact both individually and with other friends. Students who study with the Moodle application look happier than students who study with PowerPoint. Thus it can be interpreted that the Moodle application can improve students' mathematics learning outcomes compared to using PowerPoint. It can be said that the difference in learning outcomes in the two classes is the effect of the treatment, namely the use of Moodle applications in the experimental class and PowerPoint in the control class. According to (Mutaqin & Syamsuri, 2016), students' habits in using LMS will increase their knowledge and literacy about internet use and increase efficiency in learning. If only conventional teaching methods and providing fun in learning can be used as a variation in the learning process (Conde et al., 2014; Islam & Azad, 2015). Therefore, it can be said that the development of LMS-based moodle is effective in overcoming problems for geometry material, especially in middle school to college later.

Based on this, it is necessary to pay attention to the teacher to provide a geometry learning experience according to the students' thinking stage (Lestariyani et al., 2014; Sholihah & Afriansyah, 2017; Siswanto & Kusumah, 2017). Although, actually not every student has the same ability in solving geometry-based problems (Pribadi et al., 2015; Siregar, 2016). As an effort to influence students' mathematical problem-solving abilities. It is deemed necessary to implement a learning that can help students understand learning material, be active in learning implementation, can motivate students, and present applications of the material learned in everyday life to facilitate the learning process for children (Zaenal Abidin et al., 2011; Amperawan et al., 2018; Sugiarti & Arcana, 2018; Uno, 1996). In this case, apart from the learning model (Rahman & Yunita, 2018). It is closely related to the previous survey about why lessons are not good because of the way the presentation is less attractive. In this case, e-learning can represent this because e-learning is one of the innovations in the world of learning with a design and visual appearance that will attract interest and facilitate the learning process of students (Rădulescu, 2014; Yulistiyarini & Mahmudi, 2015).

4. Conclusions and Suggestions

Web-based learning media for mathematics teaching materials using Moodle from the Learning Management System (LMS) on circle material is declared valid by the validator and effectively improves student learning outcomes on geometry material. It is hoped that researchers can use multimedia as a medium to convey material, especially geometry. So that later, it will be easier for educators. Besides, media that can be interactive can also make students feel happy, attract attention, and do not make students bored in the learning process. Future research hopes that this Moodle LMS will be developed again and can be integrated into existing software.

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