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Development of moodle-based e-learning as a mathematics learning media to improve student learning outcomes in integral materials

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ABSTRACT This study aims to: (1) develop e-learning in mathematics, especially integral material for class XI students; (2) to determine the feasibility of e-learning products; and (3) to determine student achievement after using e-learning. This type of research is Research and Development (R&D), which is adapted from the Alessi and Trollips model. The development procedure includes planning, design, and development. This study shows the following results; (1) E-learning products can be developed by an online learning management system (LMS) created with Moodle application software; (2) e-learning products in mathematics have met the criteria and are suitable as learning media based on validation from media experts, material experts, and students. The average score of the media experts was 3.95 in the good category, the average score of the material experts was 4.5 in the very good category, while the average score of the students' assessment was 4.27 in the very good category; (3) the process of learning mathematics using e-learning can be considered more effective which is indicated by the increasing of student achievement. The increase in student learning achievement can be seen from the average scores of the pretest and posttest results, namely 66.57 and 90.57, with the percentage of student learning completeness of 100%.

1. INTRODUCTION

Based on PISA research, it states that the ability of Indonesian children in mathematics and science is still very low (Kurniawan et al., 2018; Rawani et al., 2019; Zain & Azwar, 2018). PISA is an international survey initiated by the OECD (Organization for Economic Co-operation and Development) to measure the cognitive skills of students in various countries (Pratiwi, 2019). Students' ability to understanding, communication, connection, problem-solving, and mathematics reasoning is still very low (Bernard & Rohaeti, 2016; Fatah et al., 2016; Hendriana et al., 2017; Kadir et al., 2017; Sumarmo et al., 2018). The teacher is the heart of implementing learning to improve the quality of education. However, teachers face many obstacles, one of which is increasing student interest in learning mathematics (Anwar et al., 2019). Students' interest in learning mathematics has decreased from year to year (Davadas & Lay, 2018; Tee et al., 2020). One of the factors affecting mathematics learning achievement is student interest and students' positive attitude towards mathematics (Azmidar et al., 2017; Yeh et al., 2019).

As a product of reform in education, professional teachers must have higher educational qualifications and be able to innovate in teaching and learning (Risdiyanti & Prahmana, 2020). Many schools have complete facilities, but teachers still use conventional learning, even though one of the factors that can increase student interest in learning is learning media (Anwar et al., 2019). This is due to the lack of teacher skills and limited time in making innovative and interactive learning media (Subandi et al., 2018). Innovative learning is better than conventional learning because it can significantly improve students' abilities (Shahrill et al., 2018).

Learning media is a tool that plays an important role in the teaching and learning process, both formal and non-formal (Amalia, 2018). Media is also a supporting aspect of student achievement in the learning process, including cognitive, affective, and psychomotor aspects (Lalian, 2018). Meanwhile, mathematics learning media is a tool in delivering material related to everyday life to better understand the use of mathematics (Rohaeti et al., 2019). Teachers who can design mathematics learning into real-life using learning media will improve student learning outcomes (Masniladevi et al., 2017). Learning outcomes result from the interaction between learning and teaching (Sulasteri et al., 2018).

One of the interactive media that teachers can use is e-learning. Currently, e-learning platforms are increasing, thanks to developments in information and communication technology (Alhawiti & Abdelhamid, 2017; Fernández et al., 2017). Based on the above conditions, the researcher will research the development of e-learning based on moodle as a medium for learning mathematics to improve student learning outcomes on integral material. So this research

aims to develop e-learning based on moodle to improve student learning outcomes in mathematics learning.

2. METHOD

This research method uses a research and development method called Research and Development (R & D), which produces a product in the form of e-learning media for interactive mathematics learning. This media is designed based on moodle with the help of the "examview" application in uploading multiple choice quiz questions. This research and development aim to develop e-learning products as a medium for learning mathematics in increasing students' understanding of integral material.

The development model used in this study was developed from the aspects of e-learning assessment proposed by Alessi and Trollip (2001, p.401) and supported by Atwell's opinion (2006, p.43) through the e-learning assessment criteria (Tumijan & Purwanto, 2018). The development model used in this study was developed from the aspects of e-learning assessment proposed by Alessi and Trollip (2001, p.401) and supported by Attwell's opinion (2006, p.43) through the e-learning assessment criteria.

The research was conducted at a State Senior High School (SMA) in East Java. Subjects or respondents involved in this research and development are class XI MIPA students in the academic year 2019/2020 semester 2. The determination of the subject is based on the consideration that the material taught is following the needs analysis and lessons in the even semester. The trial subjects in this study were divided into three parts, namely: (1) subjects for the needs analysis consisting of 35 students of class XI MIPA. The basis for consideration is that the results of the recapitulation of daily scores indicate that the class still has a predetermined average standard value, (2) the subjects for the alpha test are conducted by media experts and material experts. The media expert consisted of 2 teachers who were involved in developing moodle at the school. The subject matter expert consists of 2 mathematics teachers; (3) the subject of the beta test trial was carried out on 35 students of class XI; and (4) the subject in the final research (final product) involved 35 students of class XI.

The procedures in this development research are: (1) planning includes: defining the area/scope, identifying student characteristics, making planning documents, determining and collecting sources, conducting brainstorming; (2) The design includes: analyzing the concepts and material coverage, making flowcharts, developing layouts, collecting content sources; (3) Development includes: developing text content, combining sections (module content, video, and practice questions), preparing supporting materials, until e-learning is ready for use during the alpha test.

The type of data used in this development research is qualitative and quantitative data. Qualitative data were obtained from needs analysis and interviews during the pre-survey and the results of the e-learning product trials. Quantitative data were obtained from the results of validation by media and material experts (alpha test) and student learning motivation questionnaire (beta test), which were analyzed descriptively with a scale of 5. Also, quantitative data were obtained from the results of the pretest and posttest. This data is needed to provide an overview of the feasibility of e-learning and the quality of product display techniques and increase student understanding after using e-learning products.

The data research instrument in this study consisted of expert validation sheets, questionnaires, and tests, while the data collection techniques in this study were interviews, questionnaires, and learning outcomes tests. Interviews are used at the beginning when conducting pre-surveys to conduct a needs analysis. Questionnaires are used to assess the validity of media experts, materials and to find out student responses. Learning outcome tests were used for the pretest and posttest. The test is a data collection instrument to measure students' knowledge of the cognitive aspects of integrals. In this study, the instruments used were written tests in the form of pretest and posttest (pretest questions were the same as posttest questions). The written test is stated in the form of multiple-choice questions with alternative answers a, b, c, d, and e, with a true score of 10 and a false value of 0. The instrument validator validated all instruments. Meanwhile, the learning outcome test is validated by material experts.

The qualitative data in the form of suggestions and input from media experts, material experts, and student responses to the alpha and beta tests, then collected and concluded to improve the quality of the product being developed. Meanwhile, quantitative data in the form of questionnaire scores from media experts, material experts, and students were obtained from a questionnaire using a Likert scale that was converted into a scale of 5, namely very good, good, sufficient, lacking, and lacking. The developed multimedia product can be said to be feasible as a learning medium if the field trial assessment results are at least included in good criteria. The data conversion to determine the assessment category can be seen in Table 1 as follows:

The research used a descriptive form with a qualitative approach. The research was conducted at SMP Kepulauan Riau with the selection of subjects who have a low interest in learning mathematics. Selection of subjects according to the results of interviews with mathematics teachers at SMP Kepulauan Riau. The data from this study were students' interest in learning. Meanwhile, the data source comes from the results of the student interest in learning after using a traditional game guide book. The data collection methods from this study were questionnaires and interviews. This questionnaire aims to determine students' interest in learning after using traditional game guidebooks. This interview aims to strengthen the results of the questionnaire.

Exploratory research tries to provide answers to questions that have been formulated in problems that will be prioritized in future research. Therefore, exploratory research is preliminary research. Through exploratory research, social symptoms/phenomena will be linked and how the relationship forms. Therefore we need a good and correct research design following the objectives. The researcher prepares the questions that will be asked in the interview with the respondent, and the interview will be conducted in the place where the respondent is most comfortable. The researchers' information from the interview results was accompanied by the researcher's permission, and the respondent's consent was recorded with voice notes and transcribed verbally.

Broadly speaking, the approach in qualitative data analysis can use a thematic analysis. Explaining the purpose of thematic analysis is to identify themes, namely patterns that are important or interesting from data, and use these

themes to discuss or answer a problem. To get findings through analysis, researchers compile several questions to ask as material to explore and obtain information from respondents. The following are the questions that the researchers ask:

1. How many grades VI students and teachers are there in SDN 01 Sape Bima Regency?
2. Explain how the impact of Covid19 on student learning?
3. How do you think about the current learning process?
4. Since when was the current learning method (e-learning) implemented?
5. Is the current learning process effective in achieving the expectations of student learning activities?

3. RESULTS & DISCUSSION

The product produced in this study is the development of e-learning based on moodle as a medium for learning mathematics to improve student learning outcomes on integral material.

Learning activities arranged in the "Integral" course consist of modules, learning videos, assessments, and quizzes in the form of multiple-choice tests. Each activity is given instructions so that students can work independently.

Modules are prepared in pdf format. The module content is a detailed explanation of Integral material, which consists of the sub-material Integral Indefinite, Certain Integral, and Substitution Integral. To access the module, students are first asked to download the module file. Meanwhile, Integral learning videos in mp4 format are provided to make it easier to learn independently. The video content is an explanation of the material and sample questions for each sub-material

Quizzes aim to test students' abilities. Multiple choice test questions are arranged based on the question grid that has been made. Questions are uploaded one by one through the e-learning portal, then the rules for handling the questions are made, such as (1) time duration to work on, (2) scrambling questions, (3) students are allowed to repeat the exam if they get a score below the KKM (Completeness Criteria At a minimum, (4) provides feedback after students have finished working on the questions The following in Figure 6 is a display of the e-learning portal for multiple choice questions when used for tests

The final stage of the development process is Alpha testing. Alpha testing is carried out by people who are not involved in development but have experts in their fields. In this development research, alpha testing is carried out by material experts and instructional media experts.

2 experts conducted media testing in the field of learning media and e-learning. The testing instrument by media experts was carried out using a media evaluation questionnaire covering five aspects. The evaluation results by the media expert 1 obtained an average score of 3.83 in the "Good" category. While the evaluation results by media experts, 2 obtained an average score of 4.06 in the "Good" category. The details of the evaluation results conducted by media experts are listed in Table 1.

After e-learning was developed, it was followed by an evaluation by 2 material experts. The technique of collecting data from the test results was carried out by using a validated material evaluation questionnaire covering five aspects. The results of the evaluation by the two material experts can be seen in table 3. The evaluation results by the material expert 1 obtained an average score of 4.41 in the "Very Good" category. While the evaluation results by material expert 2 obtained an average score of 4.6 in the "Very Good" category. The details of the evaluation results that have been carried out by material experts who have been converted based on table 1 are listed in Table 2.

The next step is a beta test conducted by students as potential users. Beta testing is carried out at the implementation stage, namely by testing the use of e-learning portals in learning. Participants who did the beta test totaled 35 students consisting of class XI students. The results of the beta test data analysis can be seen in Table 2.

Based on the beta test data recapitulation results on moodle-based e-learning, an average score of 4.27 was obtained. The results of the analysis of the data and the percentage of the results of the assessment of the trial subjects on the beta test, it is known that the quality of moodle-based e-learning as an innovative effort to improve mathematics learning outcomes on integral material for class XI students in a high school in East Java is categorized as very good and feasible for use in the process learning.

Furthermore, to determine student learning outcomes in the first stage, a pretest was carried out, then treated in the form of the application of Moodle on the integral material, then a posttest was conducted. The student learning outcomes in the form of competency tests obtained through the pretest and post test can be seen in Table 3.

Based on the analysis of student learning outcomes, the pretest average was 66.57 and the posttest average was 90.57. After analyzing there is an average difference of 24. This learning outcome data is a recommendation for developers to conclude that the development of e-learning based on moodle can improve student learning outcomes.

One alternative so that learning is not boring is by using interactive media (e-learning) to learn independently and develop critical and creative thinking skills (Ratnaningsih & Patmawati, 2016). E-learning plays an important role in the development of education in this world and also as an opportunity for developing countries to improve their education development (Behera, 2013; Umek et al., 2015). Moodle-based e-learning products are said to be feasible if they meet the eligibility of e-learning and are effective at increasing student learning outcomes so that they are complete according to the established KKM. The feasibility of e-learning in terms of the media and material fields obtains a score that is in the good category. The effectiveness of Moodle-based e-learning media is assessed from 2 aspects, namely as many as 80% of students achieve learning outcomes> 75 and student responses are at least good.

The results of the alpha test through validation by media experts 1 obtained an average rating of 3.83 with the "good" category and validation by media experts 2 obtained an average rating of 4.06 with the "good" category, so the total average assessment results from Media experts are in the good category with an average score of 3.95. While the results of the alpha test through validation by material expert 1 obtained an average rating of 4.41 in the "very good" category and validation by material expert 2 obtained an average rating of 4.6 in the "very good" category, so the total results the average assessment of material experts is in the very good category with an average score of 4.5.

TABLE 1. Data on Media Expert Evaluation Conversion Results and The Conversion Result of Material Expert Evaluation

Assessment Aspect	Media Expert 1	Media Expert 2	Average Score	Criteria
Media Expert Evaluation Conversion Results				
1. Course Introduction	3,5	4,5	4	Good
2. Interface	4,2	4,1	4,15	Good
3. Media Quality	4,07	4	4,04	Good
4. E-Learning Features	3,86	3,71	3,79	Good
5. Accessibility	3,5	4	3,75	Good
Average	3,83	4,06	3,95	Good
The Conversion Result of Material Expert Evaluation				
1. Suitability of Learning Objectives	4,5	5	4,75	Very Good
2. Quality of Learning Materials	4,5	4,625	4,56	Very Good
3. Learning Activities	4,25	4,75	4,5	Very Good
4. Assessment Methods (Assessment)	4,8	4,6	4,7	Very Good
5. Quality Feedback (Feedback)	4	4	4,0	Good
Average	4,41	4,6	4,5	Very Good

TABLE 2. Student Evaluation Results Data

Assessment Aspect	Average Score	Criteria
Usefulness	4,204	Good
Ease of Use	4,4	Very Good
Ease of Learning	4,06	Good
Satisfaction	4,42	Very Good
Average	4,27	Very Good

TABLE 3. Results of the pretest and posttest analysis

Data	Score	
	Pretest	Post test
Highest Score	90	100
Lowest Score	50	80
Total	2330	3170
Average	66,57	90,57

Student learning outcomes can be seen from the pretest and post-test results, which have reached the class classical completeness limit of 80% after the learning process. In this study, the results of the quiz evaluation on the use of moodle-based e-learning to improve student learning outcomes in mathematics learning in class XI showed that there was an increase in student achievement of learning outcomes by 36.05%. The pretest average score of 66.57 with the highest score of 90 and the lowest score of 50, increased in the posttest to 90.57 with the highest score of 100 and the lowest score of 80. Therefore, student learning outcomes after the learning process using moodle-based e-learning showed that classical completeness of the class reaches 100% with learning outcomes> 75. As stated (Rahmatia et al., 2017) in their research, they concluded that there was an effect of e-learning media on students' mathematics learning outcomes on fraction material in class IV SDN 20 Banda Aceh, the ability of students to solve test questions was 78.12%.

In this study, students also gave positive responses and considered that moodle-based e-learning was quite effective because it made it easier in the learning process, especially on integral material and it could also improve student learning outcomes. This is evident from the response to the beta test results through validation by e-learning users, namely 35 students of class XI, who obtained an average rating of 4.27 with the "very good" category. E-learning learning can train students in higher-order thinking such as problem-solving, decision making, and so on (Alwi et al., 2014).

4. CONCLUSION

This study examines the development of moodle-based e-learning to improve mathematics learning outcomes in integral material. Moodle-based e-learning products are suitable for use because they meet the criteria determined based on the results of the alpha test and beta test and the entire series of research and development activities. Learning outcomes that are measured through the pretest and posttest indicate that there is an increase in the achievement of student learning outcomes. This can be indicated by the difference between the pretest and posttest average scores of 24 with an increase in student learning outcomes by 36.05%. The pretest average score of 66.57 increased in the posttest to 90.57 with the percentage of student learning completeness of 100%.

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