Development of prototype e-learning mathematics learning tools using Moodle

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Abstract. E-learning is very supporting the implementation of learning, because it uses teaching materials that are independent, so it can be accessed at any time. E-learning can improve students’ absorption of subject matter, active student participation, and the ability and quality of information that when using ordinary devices will be difficult. If carefully designed, e-learning can increase levels of learning interactions. Unlike the case with conventional learning, not all students can ask questions or express their opinions in the discussion, because the opportunities are very limited. Based on these assumptions, it is necessary to conduct a study of the e-learning prototype development strategy. Specifically, the purpose of this study was to develop a prototype of an electronic learning device using Moodle. This research is Research and Development with the Four-D development model. The results of the study were in the form of a prototype e-learning CASE-based Mathematics learning device. In conclusion, the prototype can be developed into a complete mathematics learning media.

1. Introduction

The development of science and technology is so rapid, so that it affects the world of education, especially in the ongoing learning process. The teacher has a great responsibility in shaping the character of students in order to have innovative, creative, and critical thinking abilities. In carrying out his profession, a teacher must have special abilities, among others, the ability to design and implement various learning strategies that are appropriate to the level of student development, including utilizing various sources and learning media to ensure the effectiveness of learning. The effectiveness of learning lies on the shoulders of the teacher. Therefore, the success of the learning process is largely determined by the quality and performance of the teacher. Likewise, the successful implementation of a learning strategy will depend on the skills and performance of teachers in using models, methods, media, tactics, and learning techniques.

There are five characteristics of good e-learning, namely: (1) Self-Instructional, through the module a person is able to learn themselves, not dependent on other parties, (2) Self-Contained, all learning material from one competency unit or sub-competency learned contained in one module as a whole, (3) Stand Alone, the module developed does not depend on other media or must not be used together with other learning media, (4) Adaptive, has a high adaptive power to the development of science and technology, and (5) User Friendly, every instruction and information exposure that appears is helpful and friendly to the wearer, including user convenience in responding and accessing as desired.

Furthermore, by delving into and paying attention to the description, it is necessary to develop e-learning that meets the requirements of five good module characteristics as stated above, and based on
this study, the formulation of the problem in this development research is: "How is the process of developing a prototype e-learning device learning mathematics using Moodle. "The purpose of this study is to develop a prototype of e-learning mathematics learning tools using Moodle.

2. Theory study
E-learning is a form of teaching materials that are in accordance with the characteristics of teaching materials that have been packaged in a single whole, and arranged systematically, independently studied, and more active by students according to their speed or ability without guidance from the teacher. E-learning is very support the implementation of learning, because it uses teaching materials that are independent, so it can be accessed at any time. If carefully designed, e-learning can increase levels of learning interactions. E-learning not only functions as a learning medium, but also is a tool or a complete learning tool that contains material, methods, boundaries, practice questions, assignments, and ways of evaluating that are designed systematically and attractively to achieve the expected competencies. Prastowo added that electronic modules are systematically presented teaching materials so that users can learn with or without a facilitator or teacher [1]. Whereas interactive electronic modules are creative, innovative, and adaptive teaching materials for technological developments and are able to enable students to learn with high motivation because of their interest in multimedia systems, and can make students happy and comfortable so that the learning process becomes effective, efficient, interesting, and challenging for students. According to Mills, online learning resources enable the learning process to achieve the achievement of "complex skills" needed in the global era while also enabling student centered learning [2].

According to Bakri and Mulyati, electronic module is the process of learning (learning) using/utilizing information and communication technology (ICT) as tools that can be made available whenever and wherever it is needed so that it can cope with the constraints of time and space [3]. One of the development of e-learning approach is to use MOODLE. While according to Cole and Foster, MOODLE is a web-based device that can be accessed through a web browser [4]. But according to Ismanto, MOODLE is the road to education without borders a pioneer that will build creativity and thought [5]. According to Sampurno et al., the development of technology based learning, computer media or e-learning such as MOODLE is an appropriate learning media development to be applied in accordance with the demands of the curriculum of 2013 [6]. MOODLE stands for Modular Object-Oriented Word Dynamic Learning Environment.

Moodle was created based on discussion between learners and active participation and knowledge among them. Teachers who implement Moodle in their teaching, do not require the use of social constructivism in the construction of the course, which Moodle supports it already. Moodle offers the choice of course material that the student can read, see and, but cannot interact with: text pages, webpages, images, educational movies, hyperlinks, educational folders [7]. Moreover, it can also add patterns of interactive course material such as: group chat, forums, individual and group projects, surveys on a particular subject, etc. These materials enable students to collaborate and share among themselves and their teachers to build and learn content [8,9].

These e-learning tools allow students to continue learning outside the school environment. Hence, a teacher is still necessary to facilitate the planning and preparation processes. Moodle is one of the preferred types as a method of learning based on electronic media which is designed using sound pedagogical principles, helping educators create effective online learning communities [10]. Based on this description, it can be stated that e-learning is a module in the form of digitize which is packaged more interactively, and functions as a medium of independent learning because in it has been equipped with instructions for self-study. E-learning can be filled with material in the form of pdfs, videos, and animations that can make users learn actively. Therefore, special skills are needed to develop interactive electronic modules in the world of education to improve the quality of learning and student learning outcomes. Based on this study, the research will develop a prototype e-learning mathematics learning tool using Moodle.
3. Research methods
The development of the e-learning prototype was carried out at the Informatics and Computer Engineering Education Laboratory of the Faculty of Engineering, Jakarta State University. Tools needed are: web server, Apache HTTP Server, MySQL Database, PHP and Perl programming languages, Moodle application tools, Mathematics Learning Program Plans, and research instruments for experts. After the prototype development is complete, the next step is to collect data based on the instruments that have been made. The data analysis technique was performed using content validity test by experts using the CVR formula from Law She, with the criteria of Content Validity Ratio as follows:

\[
\begin{align*}
M_p & < \frac{1}{2} M \quad CVR < 0 \quad (bad \ grains) \\
M_p & = \frac{1}{2} M \quad CVR = 0 \quad (not \ good \ grain) \\
M_p & > \frac{1}{2} M \quad CVR > 0 \quad (good \ grain)
\end{align*}
\]

The data analysis technique used to score the student respondents' test data is the Descriptive Analysis Technique, with the following criteria:

- Between 0.80 and 1.00 = very high
- Between 0.60 to 0.79 = high
- Between 0.40 and 0.59 = enough
- Between 0.20 to 0.39 = low
- Between 0.00 and 0.19 is very low

This research is a development research. The benefit of the results of development research is to bridge the gap between researchers who produce educational theory and practitioners. This development research uses the Four-D model which is proposed with four stages, namely: the stages of define, design, develop, and disseminate. Respondents from this development research were students of the Informatics and Computer Engineering Education Study Program, Faculty of Engineering, Jakarta State University, totaling 100 students and five lecturers. Data collection in this study was done by: (1) questionnaire, (2) literature review, and (3) documentation. The questionnaire was used to collect data on identifying student needs and identifying lecturer needs in the preparation of e-learning based prototypes. The data analysis technique used is quantitative and qualitative analysis techniques.

4. Research results and discussion
The results of the research and development of the prototype e-learning mathematics learning tool based on Moodle can be described as follows: The model used is Four-D (Define, Design, Develop, and Disseminate). At the Define stage, instruments are used to capture data as a preliminary analysis to find out how far the needs and utilization of e-learning are for lecturers and students. In addition, a literature review was also conducted on the learning process, e-learning, Moodle and various references relating to the development of e-learning based learning media. The next study is to analyze the characteristics, interests, and motivations of students in mathematics. In addition, task analysis is also needed to measure student progress in the learning process, concept analysis to determine competency standards, basic competencies, indicators, learning objectives, materials, and assessments.

Respondents of this development research were students of the Informatics and Computer Engineering Education Study Program, Faculty of Engineering, Jakarta State University, totaling 100 students and five lecturers. The research instrument was in the form of a questionnaire given to all respondents. Based on the results of data analysis, the design and development of prototypes was then carried out. Based on the analysis of instruments obtained 70% of respondents had difficulty learning mathematics teaching material through classical and conventional learning media, 80% of respondents liked interactive learning media based on e-learning, because it could develop respondents' creativity in finding teaching material and could interact directly at any time with lecturer. 80% of respondents
strongly support the development of interactive learning media based on e-learning. 20% of respondents do not support the development of interactive media due to constraints in the availability of facilities and infrastructure. Based on the analysis of instrument data distributed to lecturers, it is found that 80% of lecturers still use classical learning systems is teacher centered learning, but gives a positive response and supports the development of interactive learning media based on e-learning. Based on the data in the field, it can be stated that it is necessary to develop interactive learning media based on e-learning. But given that there are still respondents who have not mastered computer technology, then this interactive learning media is designed as simple as possible in its use. Thus, it can be stated that interactive learning media based on e-learning needs to be developed because it can facilitate the learning process and can form independent character and develop student creativity, but in practice the role of teacher / lecturer is still needed and cannot be replaced.

The Design Phase includes: the design of the media used to improve the quality of learning and student learning outcomes. The design of learning media is adjusted to the indicators and learning objectives. Based on the purpose of this development research, the media used by e-learning-based interactive media use Moodle. While the development of teaching materials is based on CASE (Creative, Active, Systematic, and Effective). Creative means designing the learning media with strategies to lead students to learn with problem solving. Active students are required to actively look for references other than those already available in the prototype, Systematic, the sequence of learning material from opening to evaluation is systematically arranged so that it is easily understood by students. Furthermore, Effective, the development of teaching materials is arranged as effectively as possible in order to facilitate students in using the interactive media.

The design of instructional media is arranged in accordance with the Semester Learning Plan, starting from the introduction, guidelines for using interactive media, description of material, prerequisites, learning objectives, learning activities which include: a description of the material and examples of questions, practice exercises, summaries, competency tests, practice answers, feedback, and bibliography. The interactive learning media is designed based on CASE. In the initial stage, product development is carried out, based on the results of the design step. In this research development interactive learning media prototype was arranged in an interesting and independent way. This prototype was developed using the Moodle application program that can be operated offline. The final result of this development research study is the preparation of a Moodle-based mathematical e-learning prototype. Furthermore, after completing the development of this prototype, then a limited trial was carried out to 40 respondents. The trial results show that the overall average value is 85, which means that respondents can use this e-learning prototype properly.

This development research provides the result that in order to use Moodle, a web server must be installed first. One way is to use localhost facilities provided by XAMPP. This localhost consists of Apache HTTP Server, MySQL Database, and language translators written in the PHP and Perl programming languages. XAMPP’s Web Server is also easy to use and the XAMPP program package is included in Open Source. In the initial step of using Moodle e-learning, users are required to be able to use each service in the Moodle application. To be more neatly arranged, each learning material should be grouped into certain categories, for example grouped by class or department. The next step is to create topics, include teaching and test materials, manage student assignments, check and grade and comment on student assignments, and create and view exam results online.

The results of the content validation carried out by material experts and media experts suggest that this prototype is worth developing as a model for developing the next pursuit media. The validity of the contents is needed to show the extent of the validity of the contents of this material from the prototype, so that it can be further developed. Calculation of content validity uses the Content Validity Ratio, where each expert is asked to examine the prototype as a whole. In this study, experts consisted of material experts and media experts. The formula used is the Law She formula, as follows:
Based on the results of examinations through CVR, values obtained from material experts were CVR = 0.80 and from media experts CVR = 0.90 was obtained. Thus the prototype e-learning is worthy of further development.

5. Conclusion
This development research uses the Four-D model with four stages, namely: Define, Design, Develop, and Dessiminate stages. (1) Conclusions at the Define stage: The results of the analysis of student needs based on research instruments, it was found that 75% of students prefer learning media based on e-learning, because it can increase student active participation, ability and quality of information which when using ordinary devices will be difficult to do, and can also increase the level of learning interaction, especially for students who are less brave to ask questions or express opinions without feeling watched or under pressure from classmates, so it is necessary to develop learning media based on e-learning. (2) Conclusions at the Design stage: E-learning based learning media are designed systematically and completely in accordance with the order of writing textbooks and in accordance with the learning plan covered in the RPP / RPS, which includes: Competency Standards, Basic Competencies, Indicators, Learning Objectives, Teaching Materials, Teaching and Learning Activities, Assessment Instruments, Feedback, and References. (3) Conclusions at the Develop stage: The development of Moodle-based e-learning in this study uses localhost facilities provided by XAMPP. This localhost consists of Apache HTTP Server, MySQL Database, and language translators written in the PHP and Perl programming languages. XAMPP’s Web Server is also easy to use and the XAMPP program package is included in Open Source. The development of e-learning prototypes is based on CASE to produce learning media that are developed with high creativity, are interactive, systematically arranged in accordance with the principles of instructional media development, and are effective. (2) Conclusions at the Dessiminate stage: Before being disseminated as an interactive learning media, a trial is conducted to obtain input in the media revision process. The trial results showed that 80% of respondents considered that the Moodle-based e-learning prototype was good and was feasible to be developed as an alternative learning media based on Information Technology. Furthermore, the results of content validation carried out by material experts and media experts also suggest that this prototype is worth developing as a model for compiling the next pursuit media.

6. Suggestions
Based on the results of this development research, it is recommended that: (1) prototype e-learning mathematics learning devices using Moodle can be further developed into interactive learning media for all subjects, (2) the development of Moodle-based e-learning must be adjusted to the characteristics of the subjects, readiness of infrastructure, and conditions of the learning environment, and (3) ongoing training needs to be held on the use of e-learning for instructional media developers, teachers / lecturers, and students / students, in order to produce interesting and varied interactive learning media, so as to improve the quality of the learning process and the quality of Human Resources.

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