Development of Electronic Module Based on Project Based Learning using Virtual Laboratory

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ABSTRACT

The development of science and technology continues to bring new innovations, including in the process of learning activities with project-based learning models. To create learning activities that are active, critical and creative, it is necessary to improve the quality of interactive learning modules as a guide for students to carry out learning activities. Therefore, the development of e-modules using virtual laboratory is very important, especially as a guide in the practice of grounding system material. This research aims to make a prototype e-module based on project-based learning using a virtual laboratory. The method used in this research is Research and Development (R&D) using Pressman's paradigms prototype development model with the stages of Communication, Modeling Quick Design, Construction of prototype, and Deployment Delivery & Feedback. This e-module is developed in the form of a virtual laboratory using Adobe Animate CC software in Action Script 3 programming language. In the e-module using this virtual laboratory there are several navigation features, namely instructions for use, materials, simulations, quizzes in which there is the content of the learning module. With this, the development of a virtual laboratory as an electronic learning module is very effective for learning activities with an interactive project-based learning model.

Keywords: E-module, Pressman Prototype, Virtual Laboratory.

1. INTRODUCTION

The development of Science and Technology (Science and Technology) can produce new innovations that are more complex. The advancement of science and technology makes students able to utilize it, one of which is to see skills in learning [1]. The use of information technology itself can facilitate a lot of work. Various innovations in the field of information technology continue to emerge, both in the fields of industry, creative economy, government, MSMEs, agriculture, education and so on [2]. The development of science and technology today helps efforts to achieve national education goals. The purpose of education is a place to provide knowledge about meaning, understanding and life. Education is a round-the-clock learning opportunity for everyone in an environment [3]. One form of technological development is an interactive multimedia-based system. The use of learning models that are applied greatly affects the success of learning. Students have difficulty in understanding learning due to the lack of learning materials that can be used by students as a reference in learning and educators also have not adjusted the learning model applied in learning [4].

Project-based learning is one of the methods that can develop traditional learning activities into learning by doing or active learning [5]. Project-based learning is learning with an approach to students independently planning learning activities, carrying out projects collaboratively, and producing products to be presented [6]. In the PjBL method, the learning module plays an important role in learning. Teaching materials play an important role in influencing the effectiveness of learning. The unavailability of sufficient teaching materials will affect the quality of learning or learning lecture [7]. Learning modules began to be developed more interesting and interactive by utilizing learning media, namely electronic modules (e-modules). E-Modules are made with images, animations, video tutorials and audio that make students get new experiences and do not make students fixated on text like in printed modules [8]. Based on the project-based learning-oriented learning model, it is necessary to develop electronic modules using learning media that can support learning activities to be more effective and efficient.

Virtual Laboratory is a laboratory in the form of a software application with an interactive multimedia base, andruns on a computer [9]. In making virtual laboratory development can use application software, one of which is Adobe Animate CC. The Adobe company has developed the latest software called Adobe Animate CC, which was previously called Adobe Flash Professional. Adobe Flash Professional is software for creating animations, animated videos, interactive media, games, Android applications, websites, etc. [10]. The grounding system is a conductor system that connects systems, installations and electronic devices with the earth so as to secure humans and installation equipment from the danger of abnormal volta ge. A grounding system that has a small resistance value, the quality of the grounding system is getting the grounding system is a system that is grounded with a good point [11]. In the grounding system learning material with the Project Based Learning learning model which   prioritizes practice in the field because students will better understand the concept of grounding system science well. But many students do not understand the learning module provided because they think that it is not in a series of practices or do not understand the contents in the learning module. This has an impact on practical activities that are not in accordance with procedures so that learning becomes less than optimal because students do not understand procedures, materials, and   safety tools, besides that because the practice that is obtained in the field is very little because in grounding measurements cannot be done under certain circumstances. This is in accordance with the results of observations and observations from researchers during learning activities in the practical course of Electrical Lighting and Power Installation in the practice of grounding system material with students of the 2020 Electrical Engineering Education study program at Semarang State University.

Based on the explanation above, the author wants to develop e-modules to be more effective and efficient by making e-modules based on project-based learning using virtual laboratories with the aim of making e-module prototypes with virtual laboratories.

2. METHOD

In this study using the *prototype* method. According to Pressman, in carrying out the design of the system to be developed, you can use the prototype method [12]. This method is used to develop products that can later be developed a ga in. In the process of making a prototype paradigm there are stages of the scheme, namely:
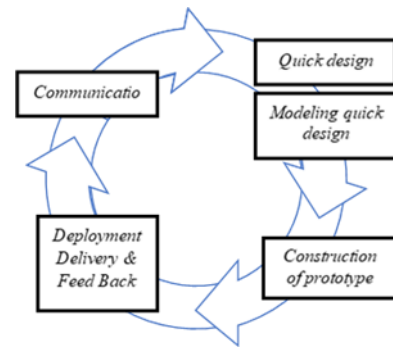
Figure 1. Schematic of the prototype development method paradigm Pressman 2012.

2.1. E-module Development Model

The development model of the prototype method development with 5 stages in development.
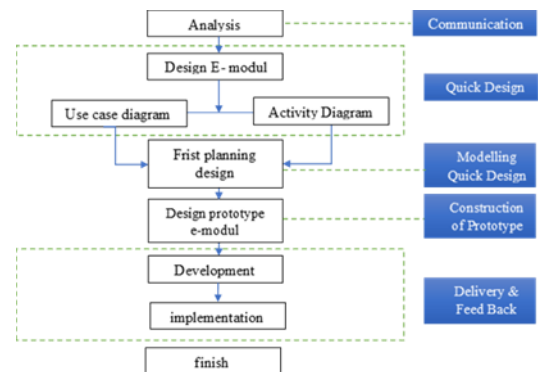
Figure 2. E-module development model.

1. Communication
   Researchers conducted communication and data collection as well as analysis of user needs to describe further definitions.
2. Quick Design
   Making a prototype navigation design in general in the form of a navigation design as an e-module navigation flow that will be developed in the form of a virtual laboratory.
3. Modeling Quick Design
   Creating a planning model using UML *tools*, namely *Usecase* to define the function of the system, *use case diagram*, *activity diagram* to describe the flow of the e-module process with a virtual laboratory.
4. Construction of Prototype
   Rapid design is the basis for starting the construction of a *prototype* based on a representation of the aspects of the software that will be visible to the user.
5. Delivery & Feed Back
   Developing e-modules using Adobe Animate CC 2022 with the Action Script 3 language is then implemented to evaluate the *prototype* that has been made and provide feedback that will be used to improve the requirements specification.

2.2. Data Collection

2.2.1. Observation Method

Observations were made by directly observing the field practice of grounding system material in the lighting and electrical power installation course majoring in Electrical Engineering Education at the Faculty of Engineering, State University of Semarang.

2.2.2. Literature study

The literature method is a method used by the author to collect data by reading and studying books and literature that have to do with making PjBL-based electronic modules using virtuallaboratories.

3. RESULTS AND DISCUSSION

3.1. Needs Analysis

Electronic modules with virtual laboratory applications that are used to assist students in doing practice with the need for students to simulate with the application to find out the material both theory and practice of the grounding system, then carry out simulations as student practice then do quizzes as an evaluation of the results of project-based learning. The following is the e-module requirement specification:
1.   Instructions page
     In this page students are expected to know K3 in practicing the grounding system.
2.   Material page
     The material page is divided into 4 items, namely learning objectives, theoretical basis, material tools, and learning videos.
3.   Simulation page
     On this page, learners perform practical simulations.
4.   Quiz page
     On this page, students take a quiz as an evaluation of learning outcomes.

3.2. E-module design

The user experience design process on the prototype involves the use of Unified Modeling Langua ge (UML) in modeling the e-module design, namely Use Case Diagram and Activity Diagram [13].

3.2.1. Use Case Diagam E-Module

Use case diagrams show the interaction between learners and activities. This diagram describes a complete model of what is done, who plays a role in it and who plays a role outside it. This describes the scope of the activity, so that it can be seen how the activity or who is in the system and where the limits are."[14]

Figure 3. Use case diagam of e-module.

3.2.2. Activity Diagram

Activity diagrams describe the work flow or *activity* of a system or business process or menu in the software [15].

Figure 4. Activity Diagram.

3.3. Development of e-modules

3.3.1. Intro / Log in

The intro display is the opening display in the e-module. In this display there is loading as the time to start operating the e- module.

Figure 5. Intro/Log in.

3.3.2. Home

Home view is the main view in navigation in the e-module. In this display there are 4 scenes namely (instructions, material, simulation, quiz).

Figure 6. Home Page.

3.3.3. Scene Instructions

The instruction display is the first display in the home in the e-module. This display explains the instructions for using the e-module using a virtual laboratory.

Figure 7. Instruction Page.

3.3.4. Scene Material

The material display is the second display in the home e-module. In this display explains the theory of grounding systems.

Figure 8. Material Page.

(1) Learning Objectives

The learning objectives display is the first display in the e-module material scene. In this display explains the objectives, KI, KD, syllabus of the grounding system .
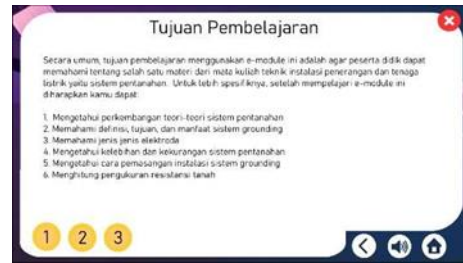
Figure 9. Learning objectives page.

(2) Basic Theory

The basic theory display is the second display in the home e-module. In this view explains the theory of the grounding system. In this display there are sub-materials.
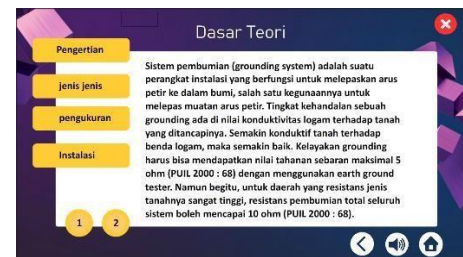

Figure 10. Page theoretical basis.

(3) Tools and Materials

The tools and materials display is the third display in the home e-module. In this view explains the tools and materials for practicing the anchoring system.
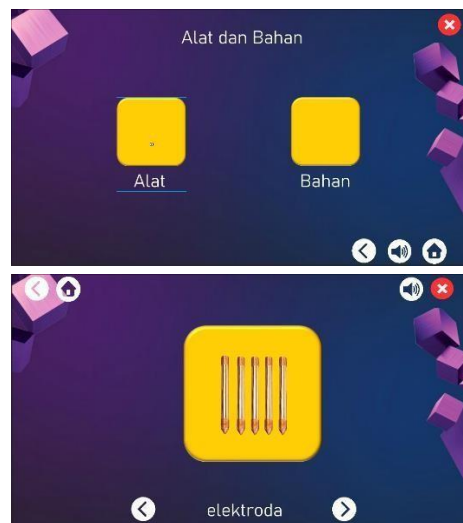

Figure 11. Tools and materials page.

(4) Learning Video

The learning video display is the fourth display in the home e-module. This display contains a video of grounding measurement practice.

Figure 12. Learning video.

3.3.5. Simulation Scene

The simulation display is the third display in the home e-module. In this display, you can simulate grounding measurements with an earth thester.
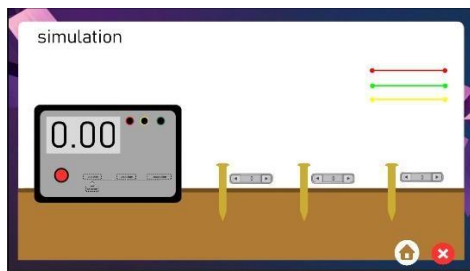

Figure 13. Simulation page.

3.3.6. Scene Quiz

The quiz display is the fourth display in the home e-module. In this display, an evaluation of the learning results is carried out.

Figure 14. Quiz.

3.4. Implementation

The results of the development of electronic modules based on project-based learning using virtual laboratories were implemented to 30 Electrical Engineering Education students majoring in Electrical Engineering, Faculty of Engineering, Semarang State University. In research developing modules to be effective in supporting learning activities.

4. CONCLUSION

This research produces an e-module in the form of a virtual laboratory, which helps lecturers to practice effectively and makes it easier for students to learn simulation practice at any time. With the development of this e-module, learning grounding systems can create interactive learning.

The disadvantage of this application is the need for educators and students not to be connected in carrying out learning activities. For more improved and useful results, it is necessary to develop e- modules using virtual laboratories with a wide range. Suggestions in this study so that it can be continued with the development towards the utilization of the internet so that educators and students can be connected.

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