Digital Engineering Learning with Computer Assisted Instruction (CAI) Method

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Abstract
Digital engineering is one of the subjects taught at STMIK Budidarma Medan, where one of the materials discussed is logic gates. The learning process still uses the lecture method, namely delivering the material orally accompanied by the division of tasks and exercises. The absence of simulation is a problem for lecturers in delivering material. Computer Assisted Instruction (CAI) is a learning method that uses computers as a tool to support the teaching and learning process. This method has learning models such as: tutorials, exercises, simulations, and games. With the application of this method, the learning process becomes varied and attracts the attention of students. Based on that, Dames got the highest score out of ten with a score of 90 students working on practice questions. Simulation questions make learning more interesting.

Keywords: Digital Techniques, Learning, Applications, Computer Assisted Instruction.

INTRODUCTION

The data analysis used is to analyze the graph of the development of the learning method to determine the effectiveness, efficiency and quality of learning [1]. Education is important in the development of human resources. The use of computers in education has expanded and reached various interests. Among its uses, namely for the benefit of learning with the aim of assisting teachers in improving the quality of education [2]. Ideally a lesson should invite students to learn actively because active students are a sign that they dominate learning activities [3]. Computer-based learning is a learning activity that uses computers to display and manipulate text, graphics, video, and sound in an integrated display [4]. The learning process that involves more than one sense will be more effective so that the learning delivered will be remembered longer. With a display that combines these elements, it can be used as an effective learning medium to learn and teach relevant learning materials such as animation [5]. Learning can also be used as a means of conducting simulations to train certain skills and competencies [6]. Based on the author's observations during research, the teaching carried out by lecturers is still conventional or often referred to as the lecture method, namely the lecturer conveys material orally to students accompanied by the division of tasks and exercises [7]. During the learning process, it was found that several materials needed simulation, theoretical learning, the absence of practice or simulation became a problem for lecturers in delivering material which made these materials not conveyed clearly and optimally [8]. So the author intends to design a learning application that can assist lecturers in demonstrating a material in the form of a simulation.
to describe the workings of the materials in the digital engineering course which is expected to clarify the material being taught and improve student understanding [9]. Computer-based learning is known as a method called Computer Assisted Instruction (CAI). Computer Assisted Instruction (CAI) is one of the learning methods used as a learning method that uses computers as a tool. CAI provides varied learning, ranging from tutorials, drills (practices) in the form of questions, simulations, to instructional games that provide challenges to students. With such learning, students do not feel bored in learning, grow their learning motivation and increase students' understanding of the material being taught [10]. CAI serves to assist teachers in the learning process as a multimedia, a tool for presentations or demonstrations or aids in the implementation of learning. So, it does not eliminate the teacher's function in teaching and learning activities, such as a simulation model that still requires teachers to demonstrate it [11]. On the other hand, students can learn individually through tutorial models, practice questions, and play a game. Therefore, a learning application is designed that is expected to help lecturers in the learning process, such as multimedia, presentations, demonstrations, or as a tool in teaching and learning activities. implementation of the learning process [12]. Applications can be interpreted as a means/media for delivering more interactive learning materials. The learning application can contain text, images, sounds, animations, and videos. Learning contained in the Computer Assisted Instruction (CAI) method, a learning application designed to be varied and attract the attention of students [13]. Submission of learning materials using applications is one solution in solving the above problems. The learning application acts as a teacher companion in delivering material and students can also use it to study individually with the application.

**METHODS**

**Animated Apps**
There are several additions of new features that can improve the development of iOS and Android applications. This program is usually used to create animations, games, web pages, to be used in making animated films [14]. This software is indeed directed to create animations or internet-based applications (online). But in its development, it is widely used to create animations or applications that are not internet-based (offline). With Actionscript from 1.0 to 4.0 that it brings, Adobe Flash CS6 can be used to develop games and teaching materials, both desktop and smartphone-based, such as quizzes or simulations [15].

**Digital Engineering**
Digital in the big Indonesian dictionary is all that relates to numbers for a calculation or numbering system. Digital itself in general is the result of technology that converts signals into combinations of number sequences that have a value of 0 and 1 (binary numbers) contained in an electronic system. The word digital itself is taken from the Greek word Digitus, which counts the number of fingers as 10 [16].

**Digital Engineering Basic Learning Objectives**
1. Provide knowledge to students about the basics of digital engineering, including number systems, and reduction techniques.
2. Provide knowledge to students about basic gates, building digital components using basic gates.
3. Provide skills to students to design digital circuits using TTL ICs, using data sheets.
4. Provides the ability to analyze digital circuits to determine the correctness of the designed circuit.

**Learning**
Learning is an activity towards a better life systematically. The learning process consists of three stages, namely the stage of information, transformation and evaluation. What is meant by the information stage is the process of explaining, describing or directing the structure of knowledge, skills and attitudes. The transformation stage is the process of transitioning or transferring the structure into the learner. The transformation process is carried out through information. Meanwhile, learning is a process of interaction between students and educators and learning resources in a learning environment. Learning is a process of interaction between students and educators and learning resources in a learning environment. Learning can simply be interpreted as an attempt to influence a person's emotions, intellectuals, and spirituals to want to learn at their own will. Through learning there will be a process of developing religious morals, activities, and creativity of students through various interactions and learning experiences.

**Computer Assisted Instruction.**
Computer Assisted Teaching is a computer application as an integral part of the learning system for the learning and teaching process which aims to assist students in their learning through a two-way interaction pattern through a computer terminal or multi-way which is extended through a computer network and also expanded its function through a multimedia interface [17]. There are 4 types of Computer Assisted Instruction, namely:

1. Tutorials
   The tutorial aims to convey or explain certain material where the computer equates the material,
2. Practice and Practice (Drill)
   The drill model is a model in learning by training students on the lesson material that has been given. With continuous practice, it will be ingrained and then it will become a habit.
3. Simulation
   Simulation is used to demonstrate a skill, so that students feel like they are in a real state. Simulations are widely used in learning material that is dangerous, difficult or requires high costs, for example training pilots of airplanes or fighter aircraft.
4. Games (Games)
   This type of game is appropriate if applied to students who like to play. In fact, if it is well designed as a means of playing as well as learning, it will further increase learning motivation.

**RESULTS & DISCUSSION**

Design in making digital engineering learning applications, is very necessary because with the design it will be easier to know the flow of the application to be built. The digital engineering learning application that will be designed is a desktop-based learning application, where the learning application will be run on a computer that has the Flash Player application installed.

The Digital Engineering learning application that has been built is a learning application that uses the Flash Actionscript 2.0 programming language, where to type program listings it is done in Adobe Flash CS6 which is software for making multimedia applications. This application can be run on a computer with a Windows operating system that has Flash Player installed. Digital engineering learning applications built with the Computer Assisted Instruction (CAI) method are useful so that students who use these applications can simulate the program material that has been given. The following are the results of the overall application design that has been built:
**Introduction page**
This page displays the title of the learning application along with the material to be taught, namely Logic Gates. There is a Start button, if you click it it will enter the main menu, starting a lesson. An image of the introduction page can be seen in the image below.

![Introduction page](image1)

Figure 1: Introduction page

**Main Menu Page**
This page contains learning models available in 4 options, namely tutorials, exercises, simulations, and games. And there is an Exit button to exit the application. The main page image can be seen in the image below.

![Main Menu Page](image2)

Figure 2: Main Menu Page

**Tutorial Menu Page**
This page is a page that contains tutorials on sub-sub material of the material being taught. There are several choices from these sub-materials. If you click on the main menu, it will return to the main menu. The tutorial menu image can be seen in the image below.

![Figure 3: Tutorial Menu Page](image)

**Sub Material**
This page appears when the sub material is clicked and displays the tutorial of the selected sub material. For example, selecting the understanding sub-material, it will display the tutorial page of the logic gate understanding sub-material. If you click the tutorial menu, it will return to the tutorial menu. The tutorial page for the sub material can be seen in the image below.

![Figure 4: Sub Material Tutorial page](image)
Exercise Page
This page displays practice questions from the material provided. The questions given are multiple choice. There are 10 questions that must be answered to completion. An image of the exercise page can be seen in the image below.

![Figure 5: Exercise Page](image)

Exercise Results Page
This page will appear when all the practice questions have been answered. Displays the number of correct and incorrect questions and the score obtained. If you click repeat, it will repeat the exercise again. If you click on the main menu, it will return to the main menu. An image of the exercise results page can be seen in the image below.

![Figure 6: Exercise Results Page](image)
Simulation Menu Page
This page is a page that contains a simulation of the sub-sub material of the material provided. There are several choices from these sub-materials. If you click on the main menu, it will return to the main menu. The image of the simulation menu page can be seen in the image below.

![Simulation Menu Page](image)

Figure 7: Simulation Menu Page

Sub Material Simulation
This page appears when a sub-material is clicked and displays a simulation of the selected sub-material. For example, selecting a simulation of the AND gate sub-material, it will display the simulation page of the AND-gate logic sub-material. If you click on the simulation menu, it will return to the simulation menu. The image of the sub material simulation page can be seen in the image below.

![Sub Material Simulation Page](image)

Figure 8: Sub Material Simulation Page
**Game Page**
This page displays a puzzle game that can be played through the game menu. There is a temporary score and time. If you click on the main menu, it will return to the main menu. An image of the game page can be seen in the image below.

![Game Page](image)

**Figure 9: Game Page**

**Game Over page**
This page appears when the user has completed the challenge given by the puzzle game. Displays the final score that has been obtained. If you click play again, it will play the game again. If you click on the main menu, it will return to the main menu

![Game Over](image)

**Figure 10: Game Over**
Table 1: Logic Gate Practice

| No | Name | True | False | Score |
|----|------|------|-------|-------|
| 1  | Jaka | 6    | 4     | 60    |
| 2  | Joni | 8    | 2     | 80    |
| 3  | Dames | 9    | 1     | 90    |
| 4  | Putra | 5    | 5     | 50    |
| 5  | Laura | 7    | 3     | 70    |
| 6  | Mutia | 4    | 6     | 40    |
| 7  | Yola | 7    | 3     | 70    |
| 8  | Nabila | 8    | 2     | 80    |
| 9  | Suci | 6    | 4     | 60    |
| 10 | Lion | 8    | 2     | 80    |

The selection of question forms aims to test students' knowledge in understanding the questions made, each correct question answered will get a score, this exercise model will attract students' attention to get high scores, simulation models provide students with knowledge of how digital circuits work. Dames got the highest score out of ten with a score of 90 students working on practice questions.

CONCLUSION

Based on this research, it is known that learning with the CAI method makes learning more interesting with the presence of games in learning so that the learning process is not saturated and more interesting. The existence of a score in this learning gives a sense of desire to answer questions with the highest score, the effect resulting from a high score results in higher knowledge of digital techniques. Dames got the highest score out of ten with a score of 90 students working on practice questions.

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