DESIGN OF DIGITAL LEARNING MEDIA FOR OPTIMIZING AUTOMATIC CONTROL SYSTEM LEARNING WITH PLTS POWER SUPPLY ON TRAFFIC LIGHTS AT BALI LAND TRANSPORTATION POLYTECHNIC

I Wayan Yudi Martha Wiguna[1*], Aris Budi Sulistyo[2], Rahmat Ahmad[2], I Made Sukmayasa[3]
[1]Road Transport Management, Politeknik Transportasi Darat Bali, Jalan Cempaka Putih, Desa Samsam, Tabanan, , Bali 82111, Indonesia
[2]Automotive Technology, Politeknik Transportasi Darat Bali, Jalan Cempaka Putih, Desa Samsam, Tabanan, Bali 82111, Indonesia
[3]Utrecht University, Heidelberglaan 8, 3584 CS Utrecht, Netherlands, Inggris
*wayan.yudi@poltradabali.ac.id

ABSTRAK

Becoming an educator is more challenging than imagined because educators must be adept at managing the classroom to ensure that learning activities are not repetitive or similar. If an educator relies on just one or two teaching methods repeatedly, it can make learning monotonous. It is important to consider a variety of teaching methods, such as group discussions, project assignments, problem-solving, simulations, or the use of diverse learning media. The education system in state vocational schools under the Ministry of Transportation implements a boarding school education system. In the boarding school education system, where students, in this case, Taruna, are involved in activities throughout the day, the learning process inside the classroom becomes less effective. Therefore, it is crucial to introduce engaging and effective learning media. The use of digital learning media is an appropriate method to address this issue. By utilizing digital learning media, it can enhance students' interest, clarify learning materials, provide variation in teaching methods, and involve students in the learning process. This research aims to design effective learning media for the SKO course by utilizing PLTS technology as a power supply for APILL in the learning process at the Land Transportation Polytechnic. In this research, the main focus is on students, the development of digital learning media, and the implementation of automatic control systems.

Keywords: automatic control system; cadets; digital learning media

INTRODUCTION

According to Law of the Republic of Indonesia Number 20 of 2003 on the National Education System, education is a conscious and planned effort to create a learning environment and learning process so that students can actively develop their potential. This aims for them to possess spiritual strength, religious devotion, self-control, personality, intelligence, noble character, as well as the skills necessary for themselves, society, the nation, and the state (Law of the Republic of Indonesia Number 20 of 2003, 2003).Being an educator turns out to be more challenging than anticipated. The ability to manage a classroom effectively is key to ensuring that learning activities do not become monotonous or repetitive. Monotonous teaching methods can negatively impact students' learning development; if learning is perceived as boring, students' motivation and compliance with lessons can decrease (Sardiman, 2012). Each student has their own unique conditions; therefore, as educators, we are responsible for identifying these differences. Learning is considered monotonous when most people are not interested, which can be caused by the teacher's failure to evaluate the daily learning process (Uno, 2011). Self-evaluation helps identify weaknesses in teaching methods, the lack of innovative media usage, and the lack of student engagement, all of which can lead to monotonous learning.

The education system in vocational schools under the Ministry of Transportation applies a boarding school approach. Although it provides classroom learning experiences, cadets and cadettes are also involved in various non-academic activities. However, specific challenges arise, such as the density of non-academic activities that can reduce students' concentration

and interest in learning (Mahfud, 2015). By utilizing the appropriate media, the learning process can become more effective. Computer-based digital learning media are tools that can be used to deliver subject material. These media offer visual, audio, and interactive elements that can capture students' attention (Arsyad, 2011). The use of images, videos, animations, and other multimedia elements can make learning materials more engaging and motivate students. Thus, digital learning media can enhance students' interest in the subject matter, overcome boredom, and encourage learning motivation. These media can also present information in various forms, enriching students' understanding (Heinich, Molenda, Russell, & Smaldino, 2002). Through media variety, digital learning can provide a richer and deeper learning experience.

Digital learning media allow for variation in teaching methods. In addition to direct instruction, these media can integrate educational videos, interactive quizzes, self-exercises, simulations, online discussions, and collaborative forums (Mayer, 2009). By providing varied teaching methods, digital learning media can accommodate different learning styles, increase student engagement, and facilitate student-centered learning. Active interaction can also be enhanced through student participation in interactive activities, collaboration in group projects, and discussions in online forums. This can increase engagement, build understanding, and promote student-centered learning (Bonk & Zhang, 2006). Based on the above explanation, there is a need for research on how to create interesting and effective learning media that can be used by lecturers and other educators, especially in the Automatic Control Systems (SKO) course. Therefore, the author intends to conduct research with the title "Design of Digital Learning Media for Optimizing Automatic Control System Learning with PLTS Power Supply on Traffic Lights at Bali Land Transportation Polytechnic."

METHOD

The research conducted employs a mixed-method approach, combining both qualitative and quantitative methods. The qualitative approach in the design of digital learning media is primarily focused on gaining a deep understanding of the users' experiences and perceptions. Qualitative methods such as case studies, interviews, observations, or content analysis are used to understand the needs, preferences, and issues that users face in relation to digital learning media (Creswell, 2014). This approach allows researchers or designers to gain profound insights into how digital learning media can enhance the learning process, increase student engagement, or address learning challenges (Yin, 2018). On the other hand, the quantitative approach in the design of digital learning media is more oriented towards the collection and analysis of numerical data that can be objectively measured. Quantitative methods such as surveys, experiments, or statistical analysis are used to gather measurable data and evaluate the impact of digital learning media (Creswell, 2014). This approach provides strong evidence regarding the effectiveness of digital learning media in achieving learning objectives, comparing variations in media design, or measuring changes in student behavior or understanding after using the digital learning media (Bryman, 2012).

1. Analysis

   In the analysis stage, the initial step involves analyzing the material according to the required competencies, specifically understanding the working system of the Solar Power Plant (PLTS) as the electricity source for the solar-powered Traffic Light Signal (APILL). This process involves a literature review to identify sources such as scientific journals, books, conferences, articles, theses, or official documents relevant to the research (Ridley, 2012). The evaluation of literature sources is conducted based on criteria of relevance and quality before entering the design stage (Hart, 1998).

2. Design
   The design stage for the learning media on PLTS as the Power Supply for the Solar-Powered APILL, based on Computer-Based Training at the Bali Land Transportation Polytechnic, includes determining the layout and functions to be implemented in the application. The design involves aspects of the material, appearance, flowchart, and circuit diagram of the practicum. The design steps include creating material based on needs analysis, designing the layout to illustrate the flow from one scene to another (Gagné, Wager, Golas, & Keller, 2005).
3. Development
   In the development stage, the multimedia plan is transformed into a tangible product. This process involves creating interactive learning media using Adobe Animate software, according to the previously planned production schedule (Alessi & Trollip, 2001). Educational materials, images, animations, sounds, videos, and other supporting materials are gathered and assembled into the final product (Clark & Mayer, 2016).
4. Interactive Quiz Creation
   Interactive quizzes are an essential part of digital learning media for assessing students' understanding and performance. The creation of interactive quizzes includes automated scoring, ease of tracking and storing students' results, and providing interactivity through images, audio, and video. These features make learning more engaging and interactive, helping students better understand the material (Mayer, 2009).
5. Testing
   The testing stage is carried out to ensure that all button functions in the interactive learning media work correctly, the program execution results align with the previously planned concept, and to detect any errors that need to be corrected. Respondents are also involved in testing to assess the understanding and usability of the learning media and to provide valuable feedback for improving its effectiveness (Tessmer, 1993).
6. Publishing
   In the publishing stage, using Adobe Animate, the file extension (.fla) is converted into formats such as video (MP4), HTML5 animation, Flash animation (SWF), or installer (.exe). This process produces the final product that can be accessed or installed by users (Alessi & Trollip, 2001).

RESULT AND DISCUSSION

Digital Learning Media Display for CBT APILL Surya

Here are some displays of the CBT APILL Surya Digital Learning Media that have been created:

1. Initial Display

   The initial display of the main menu page starts with showing a flash screen of the digital learning media application. The flash screen contains the application name, which is "CBT Automatic Control System APILL Solar Power."

Figure 1. Flash Screen View

After the flash screen, the application will transition to the main menu or home page. The home page contains several main menus or clickable icons, which include:

- Help or instructions
- Material
- Simulation
- Quiz
- Profile

In addition to these main menus, the home page also features images representing the identity of the application, such as pictures of the Traffic Light Signal (APILL) and the Solar Power Plant (PLTS), as well as several icons, including: a back button, an ON/OFF music button, a maximize/minimize button, and a close or exit button, as illustrated in the following image:

Figure 2. Home Display

2. Main Menu Testing
   Tests are carried out to determine that the input and output commands of the animation are running as expected. Testing will be done from the main menu page to the author's profile page.

Table 1.
Main Menu Testing

Input	Output	Test Results
	Main Menu Page	
Material Select Button	Displays one of the selected materials	Appropriate
Exit button	Exit/ Close Application	Appropriate
Backsound	*The backsound is clearly heard.*	Appropriate
	Content Page	
Input	Output	Test Results
Submaterial button	Show other sub-material selection	Appropriate
Backsound button	Enables and disables available backsounds	Appropriate
Minimize and maximize button	Enlarges and diminishes the resolution of the program	Appropriate
Next button	Show next page	Appropriate
Back button	Show previous page	Appropriate

3. Material Page Display
   Once a material is selected from the main menu page, the display will directly navigate to the chosen material. The material page will show options for sub-topics related to the main topic. This page is equipped with a back button to return to the main menu.

(a) (b)

Figure 3 (a), (b): Material Page Display

4. Quiz Display
   Below is the display of the created quiz:
   a. Quiz Question Display
      This display shows the screen when the user is taking the quiz. The questions are presented in multiple-choice format, with a time limit for answering. After selecting an answer, the user receives feedback indicating whether the answer is correct or incorrect, along with the score or points earned.

Figure 4: Interactive Quiz Menu Page

b. Information Display
This page explains the instructions that users need to know and do before starting to work with queries. There is a start button to start working with questions.

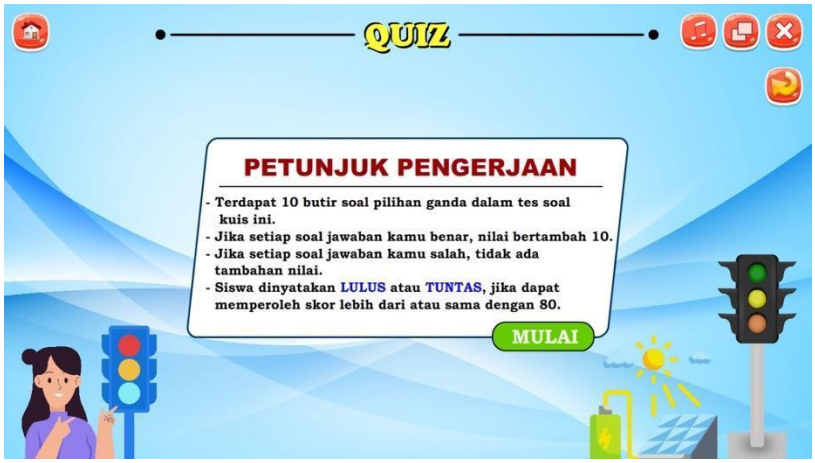

Figure 5 Quiz Instruction Page

5. Interactive Quiz Testing

Tests are carried out to see if the commands in the designed quiz are running as expected. Testing will be done from the main menu page to the final page.

Table 2 Interactive Quiz Testing

Input	Output	Test Results
	Main Menu Page	
Start button	Show to quiz page	Appropriate
Exit button	Exit/ Close Application	Appropriate
	Information Page	
Start button	Continue to the quiz page	Appropriate
	Question Page	
Double selection button / option coice	Show answers and proceed to the next topic page	Appropriate

6. Interactive Simulation Page View.
Here's an overview of the interactive simulation:

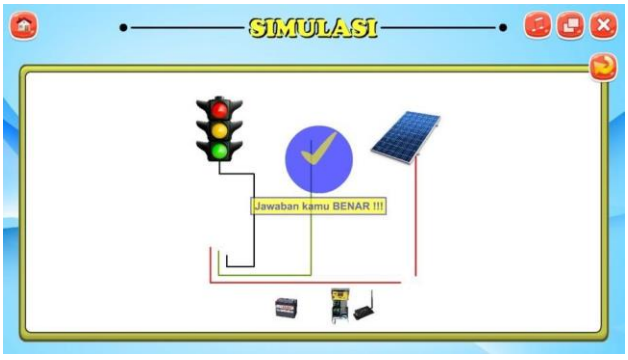

Figure 6. Simulation Page View

In the simulation section, users can practice assembling a Solar-Powered Traffic Light Signal (APILL). The program will provide feedback indicating an incorrect placement if users position the Solar Traffic Light components incorrectly. Conversely, if users place the components correctly, the program will confirm that the placement is correct.

7. Interactive Simulation Testing
   Testing is conducted to verify the functionality of the components in the simulation display, ensuring that it is suitable for implementation as a learning aid.

Table 3.
Interactive Simulation Testing

Input	Output	Test Results
Solar APILL component selection button	Solar APILL component icons can be moved and installed in the provided location	Appropriate
Exit button	Exit/ Close Application	Appropriate
Home button	Showing the main menu page again	Appropriate

8. Author Profile Page Display
   Below is the author profile page. This menu can be accessed from the main menu of the CBT program.

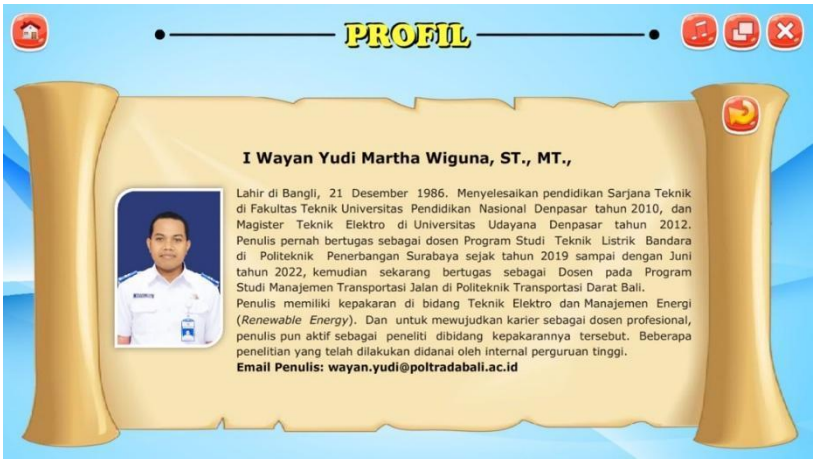

Figure 7. Writer Profile View

9. User Satisfaction Survey for the CBT APILL Surya Application
   The satisfaction survey for the CBT APILL Surya digital learning application was conducted by the author through data collection and feedback from users of the digital learning application. The aim of the survey was to evaluate how well the application meets the needs and expectations of the students. This survey helps the author understand user perspectives, identify areas for improvement, and measure user satisfaction with the digital learning experience provided.

   The respondents of this survey were students from the DIII Road Transport Management program, levels III, classes A and B, totaling 48 participants. Below is a list of questions or statements used in the user satisfaction survey for the CBT APILL Surya application:
   1. The CBT APILL Surya application is easy to use. This question aims to evaluate how comfortable and easy users find the application to use. A positive response indicates a user-friendly interface.
   2. The CBT APILL Surya application makes it easier for me to find the learning materials I need. This question assesses the application's effectiveness in facilitating

the search for learning materials. A positive response suggests that the application meets users' information needs.

3. The content provided by the CBT APILL Surya application is easy to understand. Focuses on the comprehension of the application's content. A positive response indicates that the materials presented in the application are well understood by users.
4. The CBT APILL Surya application is user-friendly. This question evaluates the overall usability of the application. A positive response reflects that users find the application's functionality and layout comfortable.
5. The operation of the CBT APILL Surya application is stable and smooth. Assesses the technical stability and performance of the application. A positive response indicates that the application runs without significant issues or disruptions.
6. The CBT APILL Surya application provides content that is highly relevant to my needs. Evaluates the relevance of the content provided by the application to users' needs. A positive response suggests that the application delivers materials aligned with users' learning needs.
7. The CBT APILL Surya application provides digital practice facilities. Inquires whether the application offers facilities for digital practice. A positive response indicates that the application provides an interactive way for users to practice.
8. The CBT APILL Surya application provides quiz facilities. Assesses whether the application features quizzes. A positive response indicates that users can test their knowledge through this feature.
9. I prefer learning with e-learning applications like CBT APILL Surya over conventional learning media (books/modules). Evaluates users' preference for learning methods. A positive response suggests that users prefer learning through the application rather than conventional methods such as books or modules.

For each question or statement, users are to select the most appropriate option from: "Strongly Disagree, Disagree, Agree, and Strongly Agree."

The results from the design of the Digital Learning Media CBT APILL Surya and the testing conducted demonstrate the success and quality of the application. During the design phase, every aspect of the application was detailed, including design, content structure, and media selection, with consideration given to the established learning objectives. The content development process was meticulously carried out, resulting in diverse, relevant learning materials that meet user needs.The testing phase included a comprehensive series of steps. Functional testing ensured that every function in the application, such as navigation, interactivity, and other features, operated as expected. Compatibility testing involved checking the application's availability across various platforms and devices, ensuring broad accessibility for users. Navigation testing assessed the clarity and effectiveness of the user interface, while performance testing evaluated the application's responsiveness and speed.The results from these tests show that all components of the CBT APILL Surya application function well and meet the established standards. Users can smoothly access learning materials, interact with practice and quiz features, and experience application stability during operation. Overall, the success of the design and testing results indicates that CBT APILL Surya not only meets expectations but also provides an effective and satisfying digital learning experience for users.

Discussion of User Satisfaction Survey Results for the APILL Surya Digital Learning CBT

For this user satisfaction survey of the APILL Surya digital learning application, the author took systematic steps by collecting data and feedback from respondents, specifically third-year students in the DIII Road Transport Management Study Program, classes A and B, totaling 48

people. The list of questions and statements in the survey was designed to measure how well the application meets the needs and expectations of users and to provide in-depth insights into their digital learning experiences.Kemudahan

a. Ease of Use and Navigation: Questions one to five about ease of use, searching for materials, understanding content,system usefulness, and operational stability evaluated the application's interface and functionality. Positive results from these questions can reflect success in creating a user-friendly and accessible application.
b. Content Relevance: The sixth question assessed the relevance of the content to the user's learning needs. Positive responses indicate that the learning materials were presented in accordance with the needs and understanding level of the users.
c. Practice and Quiz Facilities: The seventh and eighth questions highlighted the digital practice features and quiz facilities provided by the application. Positive answers indicate that the application provides an interactive way for users to test their knowledge.
d. Preference for E-learning: The ninth question evaluated the user's preference for learning methods, with positive results indicating that users prefer learning through the application compared to conventional methods such as books or modules.

Through these questions, the survey provides a holistic overview of the user experience and allows the author to understand perspectives, identify potential improvements, and measure the level of user satisfaction with the APILL Surya digital learning CBT application. Positive results from this survey can provide a strong foundation for further improvements or development to enhance the quality and effectiveness of the application.

CONCLUTION

The design of the CBT APILL Surya digital learning media demonstrates a high level of success and quality. The testing results show that all components of the application function well and meet the established standards. Users can smoothly access learning materials, interact with practice features and quizzes, and experience stability during application operation. The user satisfaction survey conducted with students from the DIII Road Transportation Management Program yielded positive results. Users provided favorable feedback regarding ease of use, navigation, content relevance, practice facilities, and quizzes. The survey also indicated a positive preference for learning through the application compared to conventional methods such as books or modules.

REFRENCES

Alessi, S. M., & Trollip, S. R. (2001). Multimedia for Learning: Methods and Development (3rd ed.). Boston: Allyn and Bacon.

Arif Widiyatmoko et al. (2022). “Penggunaan Media Pembelajaran Digital dalam Kurikulum Merdeka”Jurnal Pendidikan Dasar, Universitas Negeri Semarang1.

Arsyad, A. (2011). Media Pembelajaran. Jakarta: Rajawali Pers.

Bonk, C. J., & Zhang, K. (2006). Introducing the World is Open: How Web Technology is Revolutionizing Education. San Francisco: Jossey-Bass.

Bryman, A. (2012). Social Research Methods (4th ed.). Oxford: Oxford University Press.

Clark, R. C., & Mayer, R. E. (2016). E-Learning and the Science of Instruction: Proven Guidelines for Consumers and Designers of Multimedia Learning (4th ed.). Hoboken, NJ: Wiley.

Creswell, J. W. (2014). Research Design: Qualitative, Quantitative, and Mixed Methods Approaches (4th ed.). Thousand Oaks, CA: Sage Publications.

Gagné, R. M., Wager, W. W., Golas, K. C., & Keller, J. M. (2005). Principles of Instructional Design (5th ed.). Belmont, CA: Wadsworth.

Hart, C. (1998). Doing a Literature Review: Releasing the Social Science Research Imagination. London: SAGE Publications.

Heinich, R., Molenda, M., Russell, J. D., & Smaldino, S. E. (2002). Instructional Media and Technologies for Learning. Upper Saddle River, NJ: Merrill/Prentice Hall.

Law of the Republic of Indonesia Number 20 of 2003. (2003). Undang-Undang Republik Indonesia Nomor 20 Tahun 2003 tentang Sistem Pendidikan Nasional.

Mahfud, C. (2015). Pendidikan Karakter: Konsepsi dan Implementasi Pendidikan Karakter dalam Pendidikan. Surabaya: Airlangga University Press.

Mayer, R. E. (2009). Multimedia Learning (2nd ed.). Cambridge: Cambridge University Press.

Reigeluth, C. M., & Carr-Chellman, A. A. (2009). Instructional-Design Theories and Models: Building a Common Knowledge Base (Vol. 3). New York: Routledge.

Ridley, D. (2012). The Literature Review: A Step-by-Step Guide for Students (2nd ed.). London: SAGE Publications.

Sardiman, A. M. (2012). Interaksi & Motivasi Belajar Mengajar. Jakarta: Rajawali Pers.

Tessmer, M. (1993). Planning and Conducting Formative Evaluations: Improving the Quality of Education and Training. London: Kogan Page.

Uno, H. B. (2011). Teori Motivasi dan Pengukurannya: Analisis di Bidang Pendidikan. Jakarta: Bumi Aksara.

Yazdi, Mohammad (2012). E-Learning Sebagai Media Pembelajaran Interaktif Berbasis Teknologi Informasi. Jurnal Ilmiah Foristek Vol. 2, No. 1, Maret 2012

Yin, R. K. (2018). Case Study Research and Applications: Design and Methods (6th ed.). Thousand Oaks, CA: Sage Publications.