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"Design and Development of an SDLC-Based E-Learning Application as a Learning Medium Using the Blended Learning Model"

Deni Ramadhan*, Zulham Sitorus, Melva Sari Penjaitan

Faculty of Science and Technology, Computer Systems Study Program, Univercity of Pembangunan Panca Budi, Medan, Indonesia
Email: [1],damanikfaza57@gmail.com [2],* zulhamsitorus@dosen.pancabudi.ac.id, [3]melvasaripenjaitan@dosen.pancabudi.ac.id
Email Penulis Korespondensi: deniipendoo18@gmail.com

Abstrac− Education in the digital era demands the application of innovative learning methods to enhance effectiveness and student engagement. This research aims to design the workflow of an e-learning application that integrates the blended learning model, with a focus on SMA Nurcahaya as a case study. The blended learning model combines face-to-face instruction with online learning, providing flexibility in the teaching and learning process and leveraging technology to enhance the student learning experience. The research methodology includes needs analysis, system design, and e-learning development. Needs analysis was conducted through surveys and interviews with teachers and students to identify specific needs and challenges. Based on these findings, the design and development of the e-learning system incorporated features such as interactive learning materials, discussion forums, online quizzes, and progress tracking. The design process utilized the latest technology to ensure optimal performance and accessibility. The design was evaluated by assessing its effectiveness in meeting the needs of SMA Nurcahaya and its ability to support the teaching and learning process while increasing student engagement. The evaluation results indicated that this e-learning design is effective in boosting learning motivation and facilitating access to learning materials. The research concludes that an e-learning design with a blended learning model can be an effective solution for improving the quality of education in the digital era.

Key: Blended Learning, Design and Devolepment, E-learning

1. INTRODUCTION

System design, commonly known as design and development, is a series of processes that translates the results of a system analysis into programming languages. The goal is to describe in detail how the components are implemented. On the other hand, the concept of system development refers to activities involved in creating a new system, replacing, or improving an existing system, whether in its entirety or in parts [1]. E-learning, or electronic learning, refers to educational methods that use digital technology to support, facilitate, and manage the teaching and learning process. E-learning encompasses various forms of online learning and can involve instructional materials, learning activities, and interactions between students and instructors through electronic devices such as computers, tablets, and smartphones. Overall, e-learning offers a flexible and efficient way to teach and learn, utilizing technology to overcome the physical and time constraints of traditional education. E-learning can serve as an alternative to issues in the education field, whether as an addition, complement, or replacement for existing learning activities[2]. For example, practice problems can be used to deepen understanding of the material [3].

Education is a cornerstone for enhancing the quality of human resources. Through education, individuals can discover new things that can be developed and acquired to face the challenges of the times [4]. Therefore, education should aim at developing individuals who are responsive to their environment and sensitive to change [5]. Real-time interactions facilitate communication between educators and learners, allowing learners to replace face-to-face interactions, although not entirely [6].

At SMA Nurcahaya, the teaching and learning process is conducted solely through face-to-face interactions. When delivering instructional material, teachers explain the lesson content using materials that have been prepared in written form on the blackboard. The blackboard is then used as a supporting medium for presenting the material. All material provided by the teacher is written down by students in their notebooks. During the teaching and learning activities, communication between students and teachers is essential. This communication process is difficult to achieve with the current system, where students only listen to and take notes on the material provided by the teacher, making them passive in class. Similarly, during exercises, students must complete all the questions given by the teacher on a sheet of paper, which is then collected after completion. When submitting assignments, students must hand them in at the start of the class before the teaching process begins. To know their exercise and assignment grades, students must wait until all exercises and assignments have been graded by the teacher.

To enhance the effectiveness of the teaching and learning process at SMA Nurcahaya, a design for an e-learning application is needed. This application design aims to facilitate teachers in delivering course materials, assignments, and exams to students. Conversely, students would be able to easily access course materials, follow the learning process, and view their grades through the application from anywhere, as long as they are connected to the internet.

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With the implementation of e-learning as a teaching medium, it is hoped that the learning process will become more conducive, increase interest in learning, and improve student learning outcomes. This is because e-learning requires students to interact with the internet, such as accessing extensive information, which can boost student engagement due to the challenges and availability of learning materials [7].
Therefore, the development of e-learning has become an urgent need to ensure a smooth, continuous, and high-quality learning process. A fast and efficient development system is required to build e-learning [8]. The difference between the e-learning system and the existing systems is that the e-learning system in this study can be customized according to user (school) needs, making the system more effective and easier to operate. It includes features such as notifications for any unfinished tasks and the number of tasks completed, as well as the ability to rename files when downloaded, which facilitates file management. These features represent a novelty in this research.
Life in the 21st century is marked by various forms of competition, and one key factor in competitiveness is the ability to apply new knowledge to create innovations with digital technology. Therefore, learners need to acquire core knowledge through education. Education is defined as a process for social beings or conscious human efforts that are well-organized and planned to bring about personal change, improving qualities such as behavior, attitude, and skills. Blended learning is an educational approach that combines face-to-face instruction with computer-based learning, both offline and online [9]. This means that blended learning is a face-to-face teaching method supported by electronic learning (both offline and online), so the learning process can be optimized as the strengths of both methods complement each other, addressing the shortcomings of each learning method.

2. RESEARCH METHODOLOGY

2.1 Design and Development

Design and Development refers to the process of designing a system or an activity/process conducted to illustrate how business processes operate by creating diagrams such as use case diagrams [10]. One well-known and widely used system design or development process is the System Development Life Cycle (SDLC). The SDLC consists of five stages: Investigation, Analysis, Design, Implementation, and Maintenance and Evaluation (Taufiq, 2018). Design and development is the process of building a system to create a new system or to replace or improve an existing system, either in its entirety or in part [11]. The term “design” refers to a set of procedures for translating the results of an analysis of a system into programming languages to describe in detail how the system components are implemented. It involves preparing detailed specifications to develop a new system [10]. The term “development” refers to the activity of creating a new system or replacing or improving an existing system, either in whole or in part. Thus, design and development is the activity of translating the analysis results into a software package and then creating the system or improving an existing system [10].

2.2 Application

An application is a unit of software designed to serve the needs of various activities such as business systems, games, public services, advertising, or any processes typically performed by humans [11]. An application is a ready-to-use program that allows users to execute commands with the goal of obtaining results that are more accurate in accordance with the application's intended purpose. An application represents a problem-solving tool that employs a specific data processing technique, often aimed at achieving the desired or expected computations and data processing [12]. An application is a program that can directly perform processes used by users on a computer. In the current digital era, every smartphone and computer user utilizes applications for various daily needs. According to Sanjaya (2015), an application is software developed by a computer company to perform specific tasks. Major examples of application software include word processors, spreadsheets, and media players. A collection of computer applications bundled together into a single package is typically called an application suite. Examples include Microsoft Office and OpenOffice.org, which combine word processing, spreadsheet, and other applications.
An application is a ready-to-use program that can execute commands from users with the aim of producing results that are more accurate in line with the application's intended purpose. It refers to solving problems using a specific data processing technique, usually aimed at achieving the desired or expected computations and data processing.

2.3 Education

The principles of learning are that students should be active, constructivist, cooperative, collaborative, and creative. The reinforcement in learning assessment includes: a) measuring levels of thinking from low to high, b) emphasizing questions that require deep thinking rather than mere memorization, c) assessing the students' work process rather than just the end results, and d) using student learning portfolios [13]. Learning is essentially a process of interaction between students and their environment, leading to changes in behavior towards improvement. During the learning process, the primary role of the teacher is to create a learning environment that supports behavioral change in students [14]. Computer-based learning often operates in this manner, but learning goals can also include understanding, not just memorization. However, it is important to note that learning goals have undergone a drastic change; learning objectives are now more ambitious, requiring that knowledge and skills be applicable in active use. Burton defines learning as "a change in

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behavior in an individual due to interaction between individuals and between individuals and their environment, allowing them to interact with their surroundings." The meaning of learning in Burton's view differs from the previous opinions. The key term in Burton's perspective is interaction. This interaction signifies a process. A person who is consciously engaging in activities to achieve specific behavioral changes is said to be learning. Such activities or processes are referred to as learning activities. Essentially, learning is a process [15].

2.4 E-Learning

E-learning is distance education that uses computer and internet technology, allowing the learning system to obtain materials from the internet or from the student's location without needing to have face-to-face interactions with the instructor in the classroom. E-learning is web-based learning (accessible via the internet). However, interactive learning processes can still occur either directly or with a time delay. Therefore, learning can take place via computer or internet at the office or at home, as long as there is an internet connection. This method allows students to manage their own learning time and the place where they access the knowledge they acquire [16]. E-learning is a learning system used as a medium for teaching and learning processes conducted without direct face-to-face interaction between teachers and students [17].

E-learning refers to information and communication technology used to enable students to learn anytime and anywhere [18]. One area significantly impacted by this technological development is education, which fundamentally involves communication and information from educators to learners containing educational information. This includes educators as sources of information, media as means of presenting ideas, concepts, and educational materials, and the learners themselves [19]. Some of these elements have been enhanced by information technology media, leading to the emergence of the concept of e-learning [20].

2.5 Blended Learning

The blended learning model, which combines face-to-face and online learning, certainly has its own characteristics, including (a) the learning process that integrates various teaching models, student learning styles, and utilizes different technology-based learning media, (b) a blend of online learning with face-to-face interactions with teachers, (c) effective learning through methods of delivery, learning approaches, and learning styles, and (d) teachers acting as facilitators and parents playing the role of motivators [21].

In addition to its unique characteristics, the blended learning model also includes elements such as (a) face-to-face classroom sessions, (b) self-directed learning, (c) utilization of applications, (d) tutorials, (e) collaboration, and (f) evaluation (Wahib Abdullah, 2018). The role of the teacher is limited to being a facilitator and mediator in managing these learning elements. Teachers conduct face-to-face instruction at school by explaining the material to students, and besides maintaining a safe distance, teachers can leverage advanced technology for task collection or as a supportive learning medium. Driscoll [21], states that there are four concepts in blended learning: (a) blended learning is an approach that combines various technologies to achieve the established goals.

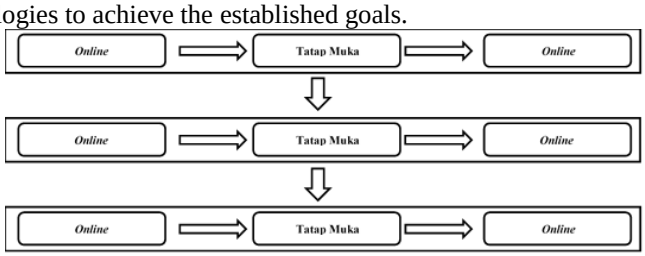

Figure 1. *Desain* Blended Learning

2.6 System Developmet Life Cycle

The SDLC (Systems Development Life Cycle) Waterfall is a sequential software development process where the process flows downward like a waterfall. The stages in the SDLC Waterfall must be completed sequentially, one after another, and cannot proceed to the next stage until the previous stage is fully completed.

Figure 2. Waterfall Model of the SDLC

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3. RESULTS AND DISCUSSION

3.1 System Analysis

System analysis is the process of breaking down an entire information system into its component parts to identify problems and obstacles so that improvements and requirements can be evaluated and proposed. Conducting an analysis of the current system serves as a basis for designing or improving an existing system. The analysis helps to identify the weaknesses and shortcomings of the current system and allows for the development of a more effective and efficient system. Based on the survey results, to improve the outcome or quality of education at SMA Nurcahaya, an additional learning system is needed to assist the current face-to-face learning process between teachers and students.

3.2 Implementation of Blanded Learning

In designing this learning plan, the learning materials can be delivered by the teacher through both online and conventional methods. Online learning includes downloadable materials, discussion forums, and self-directed learning based on the SDLC model. Meanwhile, conventional learning is conducted through face-to-face meetings in the classroom. If the teacher is unable to attend in person due to external duties, teaching can still take place via online face-to-face sessions or e-learning once the teacher's commitments are completed. E-learning is not only used when the teacher is away but also follows a schedule that has been prepared according to the subject syllabus. Additionally, teachers can provide learning materials independently to students through posts on a web-based platform.
Based on the analysis of student needs, situational analysis, and content analysis, a blended learning formulation for the subject matter has been developed, as presented in the table below:

Table 1. Formulation of Blended Learning Strategy

Meeting	Subject matter	Strategy Formulation
1	Introduction, Syllabus Explanation	Face to Face
2	National Education Objectives Competencies	Face to Face
3	Face to face in class	Face to Face
4	Implementation of e-learning	Online Learning
5	Material evaluation	Online Learning
6	Analysis	Face to Face
7	Face to face in class	Face to Face
8	Implementation of e-learning	Online Learning
9	Material evaluation	Online Learning
10	Solition	Online Learning

Table 2. Blended Learning Syntax

Fase – Fase	Educator Behavior
Fase 1 : Conduct orientation about the problem to students	The teacher conveys learning objectives and motivates students.
Fase 2 : Coordinating students for the learning process	Teachers help students define learning tasks related to their problems.
Fase 3 : Directing self-contained and group systems	Teachers encourage students to get the right information, implement it, and seek explanations and solutions.
Fase 4 : Increase the Level of Understanding	Teachers help students plan the learning process to improve understanding of others.
Fase 5 : Analyze and evaluate	Teachers help students solve problems and find solutions.

3.3 System Design Methods to be Developed

Design is the depiction, planning, and creation of sketches aimed at carrying out the initial stages of designing a system. Design is also a development process that follows analysis and focuses on a specific planning format. System design is carried out after obtaining a clear understanding of what needs to be done. Generally, system design is done using UML (Unified Modeling Language). Below is the use case diagram of the application design that will be developed.

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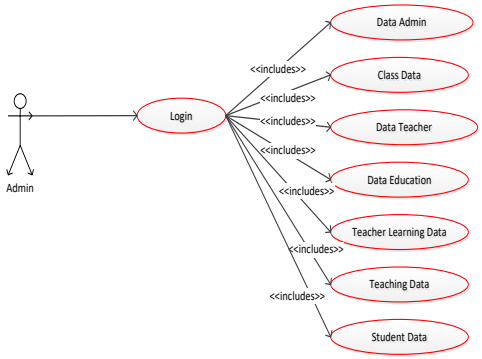

Figure 3. Procedure Analysis

3.4 Interface Design

User interface design is intended to facilitate the creation of a design for the desired system. Below, the user interface design for the admin entity will be displayed.

Figure 4. Login Data Input Design

The system designed for teaching and learning using the E-learning media can be explained according to the needs of SMA Nurcahaya. The e-learning menu design is one of the conceptual data models used as a system for learning, which will be utilized by both teachers and students. This design can be seen in the image below.

Figure 5. E-learning Data Input Design

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The flowchart of the e-learning system data processing design represents the flowchart used during data processing in the SDLC-based learning system. The admin can add forum data, edit data in the e-learning system, save, and delete data.

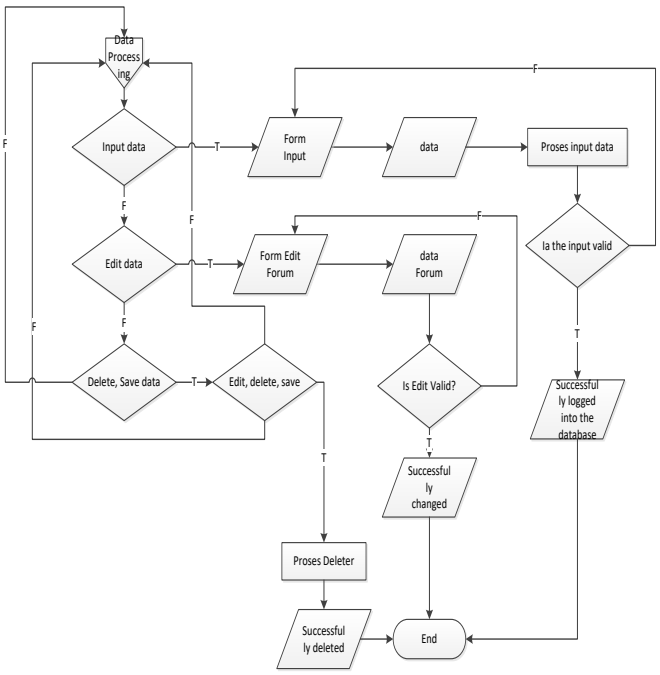

Figure 6. Design of the E-learning System

4. CONCLUSION

This research successfully designed and developed an e-learning application at SMA Nurcahaya that integrates the blended learning model, following the System Development Life Cycle (SDLC) methodology. Based on the research and development conducted, several key conclusions can be drawn: The blended learning model, which combines face-to-face learning with online learning, has proven effective in enhancing student engagement and motivation. The developed e-learning application supports active interaction between students and learning materials, as well as between students and instructors. The SDLC methodology provides a systematic and structured framework for the design and development of the application. The stages of SDLC, from planning, requirements analysis, design, development, to testing, have been thoroughly applied, ensuring that the e-learning application meets user needs effectively. The designed e-learning application includes various important features such as interactive learning materials, discussion forums, online quizzes, and progress tracking. These features support a dynamic learning experience and can be tailored to different learning styles of students. Although the application has met its initial objectives, there is room for further development, such as adding new features, improving the user interface, and integrating with additional learning tools. Feedback from users can be used to continuously enhance the application to better meet their needs and expectations. Overall, the SDLC-based e-learning application with the blended learning model offers an effective and adaptive solution for improving educational quality in the digital era. The implementation of this application is expected to serve as a reference for further development in the fields of e-learning and blended learning.

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