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Design and Build E-Modules for Mobile-Based Computer Science Study Program Practicum Learning

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Abstract— The teaching and learning process in higher education does not only take place in the classroom but also requires a learning process outside the classroom or in the laboratory, so that students can practice the application of the theories they have learned in the classroom. The Computer Science Study Program, Faculty of Science and Technology UIN North Sumatra has courses whose learning is not only carried out in the classroom, but also carried out outside the classroom or laboratory, namely Practicum Courses which are carried out in the Laboratory. However, the learning of this Practicum Course has not been carried out optimally. As a result, students will have difficulty understanding practicum learning, so it is difficult to realize the vision and mission of UIN North Sumatra, which is to produce law graduates who excel in various fields of science, technology, and art studies with a *transdisciplinary paradigm*. Based on these problems, the idea of solving the issue is to Design and Build the E-Module for Practicum Learning for the Mobile-Based Computer Science Study Program through the preparation of Practicum Course Teaching Modules, consultation with the head of the study program, then coordinating with the lecturers who teach the practicum course, forming a management team and preparing modules, then making e-modules and designing interactively using applications that can operate on Android smartphones, as well as carry out socialization of E-Module Practicum learning.

Keywords: Practicum Learning; E-Module; Mobile Devices

1. INTRODUCTION

Article of Law Number 14 of 2005 concerning Teachers and Lecturers describes lecturers as professional educators and scientists with the primary task of transforming, developing, and disseminating science, technology, and the arts through education, research, and community service[1], [2], [3], [4], [5]. (1) Meanwhile, Article (72) Paragraph (1) states that a lecturer's workload includes several core activities, including: planning learning, implementing the learning process, and conducting educational evaluations[6]. In the learning process, several obstacles and problems naturally arise. In lectures at the Faculty of Science and Technology, UIN North Sumatra Medan, practicums and lectures form an integral part of the course. Practicums are learning activities that involve observing experiments[7] or tests in the laboratory, followed by analysis and drawing conclusions from the results of these observations. Practicums are best achieved when they include systematic and comprehensive learning modules. Learning modules are learning materials that students can utilize independently[8], [9]. A good module must be structured systematically[10], [11], engagingly[12], and clearly. Modules can be used anytime and anywhere according to student needs[13], [14], [15]. Currently, the practical learning process at UIN Sumatera Utara Medan uses printed modules, but their implementation is not optimal[16]. These modules are often neglected due to differences in the way lecturers provide standard modules[17]. Based on the explanation above, the practical learning process at UIN Sumatera Utara should have a standardized practical learning module and utilize current technology, including electronic modules (e-modules) for easy use and access by students[1], [18]. This will impact the learning process, requiring students and lecturers to adapt quickly[19] to the new learning system. Therefore, the learning methods implemented must be adapted to current conditions[20], [21]. This is where lecturers play a role in preparing learning by implementing engaging learning innovations so that the material is delivered effectively to all students without exception[22], [23]. The success of the practical learning process using e-modules at this time will depend heavily on the preparation carried out by the lecturers, especially those teaching the practical course. The success of the implementation of the learning process for practical courses is influenced by the selection of practical media that are expected to be user-friendly, open source, free, able to accommodate the entire series of practical course materials[24] and can be operated on all students' devices[25] considering that the specifications of students' devices are likely not the same and evenly distributed. In addition, the e-module usage guide is one of the important preparations for implementing learning, because the availability of the e-module usage guide can require students to be independent in carrying out practical work[26], [27].

2. RESEARCH METHODOLOGY

The first phase is the requirement stage, which is initiated to gather data regarding the fundamental concepts for the design and implementation of the practical learning e-module as a mobile application. This aspect necessitates that users be able to perform encryption processes on e-modules containing both text and images which can then be viewed within the app and shared across various communication platforms. Additionally, users can access these practical learning e-modules randomly based on courses, provided that the content sequence remains consistent across different users.

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Following this are the design and verification stages. In the system design process, the user is afforded the opportunity to engage with the practical module via a search system integrated within the developed mobile application. Meanwhile, in the verification stage, the messages intended for encryption must adhere to the specific criteria[28] defined in the requirement parameters. The ultimate goal of this phase is to produce an e-module that serves as an engaging and user-friendly educational tool.

The final phase is maintenance. This stage ensures that users have continuous access to the application for practical learning purposes. Maintenance activities encompass evaluating the performance of the algorithms and verifying the functionality of all features within the application to ensure optimal operation.

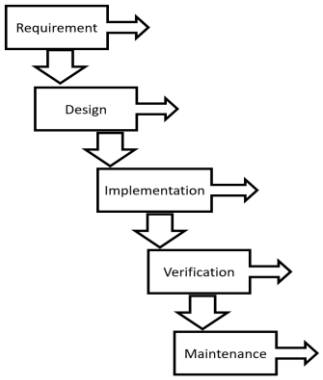

Fig 1. Implementation Model of Mobile-Based Computer Science Study Program Practicum Learning

The algorithm planning stage begins by determining the collection of necessary practical module materials. Once collected, the modules are analyzed and standardized into a uniform format to facilitate identification. The results of collecting and formatting materials from each course are then merged to produce an e-module that meets the established standards. Following the planning phase, the process moves to the modeling and design stage. In this phase, the system workflow is described technically using use case diagrams. The final step is the simulation and analysis of simulation results, where the creation of the practical learning e-module can be observed and executed directly through the designed mobile application. Consequently, the entire usage process can be run efficiently using said application.

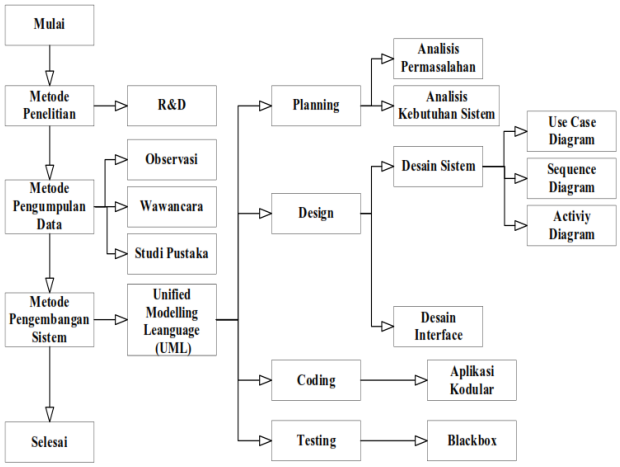

Fig 2. Framework Model of Mobile-Based Computer Science Study Program Practicum Learning

3. RESULT AND DISCUSSION

Previously, practical learning in the Computer Science Study Program at UIN Sumatera Utara was conducted conventionally using printed modules and PDF files distributed via basic platforms such as WhatsApp or Google Classroom. Consequently, students faced difficulties in accessing materials flexibly, the modules lacked interactivity, and lecturers were unable to optimally monitor student learning progress.

Based on the analysis of the current practical learning system, the author determined a solution to overcome the aforementioned problems. The author designed and built an Android mobile-based practical learning e-module for the Computer Science Study Program at UIN Sumatera Utara. This e-module is expected to assist lecturers in delivering practical material more effectively and interactively, as well as making it easier for students to access learning materials

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anytime and anywhere. Furthermore, this e-module allows students to learn independently via an Android smartphone, with both online and offline access capabilities.

3.1. Design

The application design to be built uses the Unified Modeling Language[29] (UML) model which consists of Use Case Diagrams, Sequence Diagrams, Activity Diagrams, and Class Diagrams as a reference in describing the flow, interactions, and structure of the system.

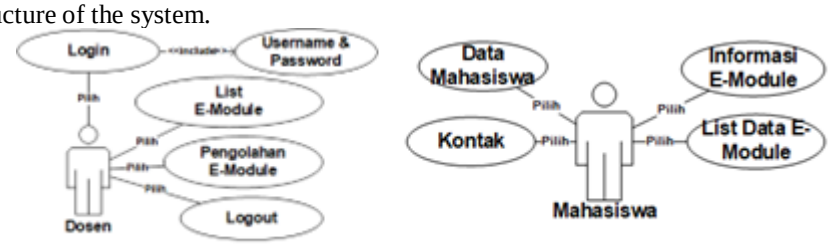

Fig 3. Use Case Diagram of Mobile-Based Computer Science Study Program Practicum Learning

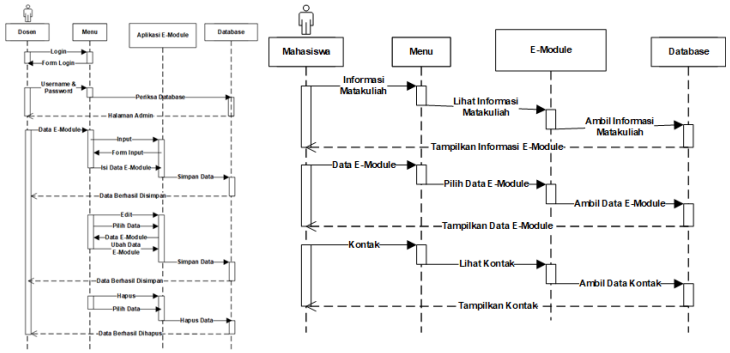

Fig 4. Sequence Diagram of Mobile-Based Computer Science Study Program Practicum Learning

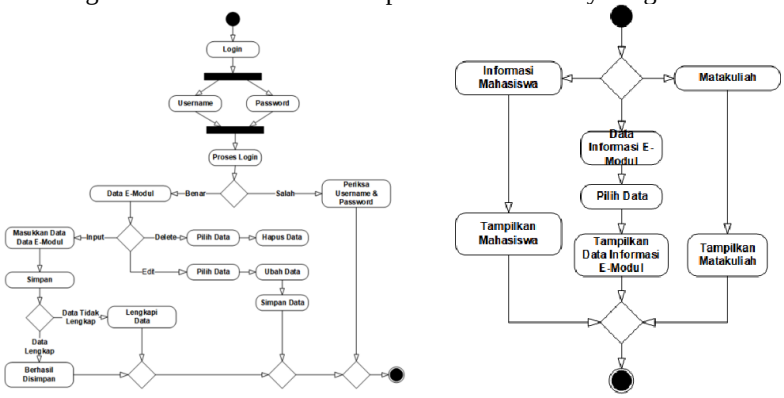

Fig 5. Activity Diagram of Mobile-Based Computer Science Study Program Practicum Learning

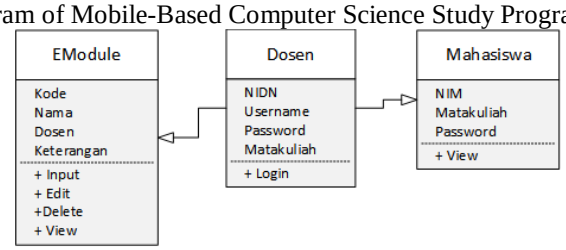

Fig 6. Class Diagram of Mobile-Based Computer Science Study Program Practicum Learning

Use Case Diagrams are applied to map the interactions that each actor—lecturers (who act as administrators) and students—can have with the system. Next, Sequence Diagrams are used to outline the steps of user interaction with the application to obtain or manage required information. These diagrams specifically show how lecturers interact to manage e-module content, while students interact to access learning materials. In addition, Activity Diagrams are used to visualize the flow of activities or work processes of a system in carrying out specific functions. These application activity diagrams are divided into two types: Lecturer Activity Diagrams and Student Activity Diagrams, each of which shows its own unique activity steps. Finally, Class Diagrams are used to map the relationships between each class or table that makes up the application's database structure. The data structure of this e-module application essentially

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consists of a lecturer table, a course information table, and a student table, which represent the overall system data structure.

3.2. Application Page

The flowchart illustrates the system flow in the Practical Learning E-Module application. The process begins from the Main Page which provides several main menu options. If the user selects the Course menu, the system will display a list of available courses. Next, if the E-Module menu is selected, the system will display a list of E-Module data. Users can select one E-Module to then view the details of the module's contents. If the menu selected is Student, the system will display student data. In addition, there is a special menu for Lecturers. When a lecturer selects this menu, the system will display a login page that requires the lecturer to enter a username and password. If the data entered is correct, the lecturer is directed to the E-Module management page. On this page, the lecturer has several main functions, namely input data, edit data, and delete data. When inputting, the lecturer can enter new E-Module data. If the data is complete, the system will save it in the form of an E-Module table. If the data is incomplete, the system will ask the lecturer to complete the information first. For the data editing process, lecturers first select the E-Module data they wish to change, then update the information as needed before saving it back to the table. Meanwhile, for the data deletion function, lecturers must also select the E-Module data they wish to delete, then the system will delete it from the table. All of these management flows lead to the E-Module table, which contains a collection of practical learning module data ready for students to access. Thus, this flowchart illustrates two main types of access: student access to view the list of courses, modules, and related information, and more complex lecturer access because it includes module data management functions such as adding, updating, and deleting data. This flow ensures that the E-Module application is not only a learning tool for students, but also provides content management features for lecturers as providers of learning materials.

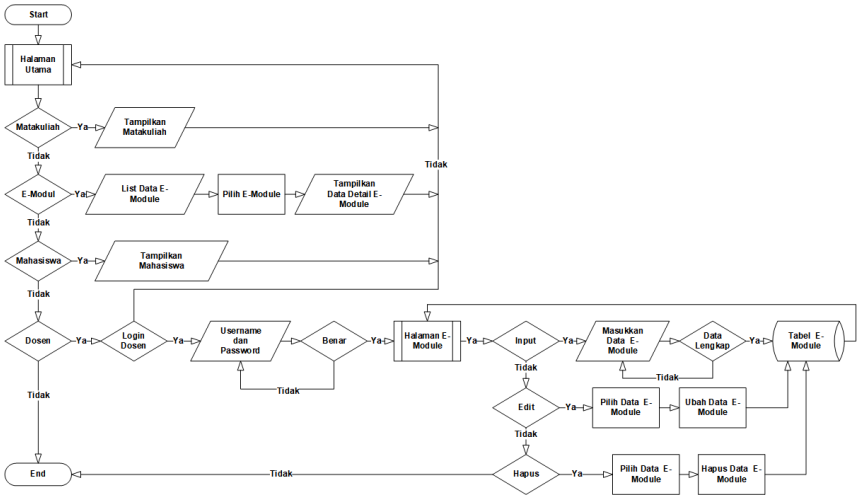

Fig 7. Flowchart of Mobile-Based Computer Science Study Program Practicum Learning

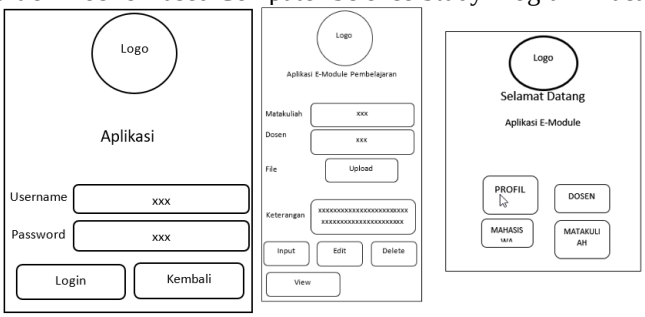

Fig 8. Planning of UI for Mobile-Based Computer Science Study Program Practicum Learning

The page design of the application to be built is divided into two types of design, namely input page design and output page design.

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Fig 8. Implementaion of Mobile-Based Computer Science Study Program Practicum Learning

This application comes with several key features that are simple yet functional. On the first page, students are prompted to authenticate through the login menu by entering their Student Identification Number (NIM) and password. This login process is crucial to ensure that only registered students can access the practicum modules. After successfully logging in, students are directed to the semester selection page. There is an option to select odd or even semesters, ensuring the displayed course list is more relevant to each student's academic schedule.

Next, the application displays a list of practicum courses for the selected semester. The display lists the course names and their respective lecturers. Examples of available courses include Algorithms and Programming Practicum, Digital Systems Practicum, Data Structures Practicum, Assembly Language Practicum, and Programming Language Practicum. This list allows students to quickly select digital modules for each course to study.

The implementation of this E-Module application offers numerous benefits for both students and institutions. For students, the application provides easy access to materials without the need to carry printed modules and allows for flexible study outside of class hours.

Technically, the application is built using the Android platform with the Java or Kotlin programming language through Android Studio. For data storage, the Firebase database can be used, while the interface design is designed with XML that suits the needs of mobile applications. With this technology, this application can be developed into a stable, easily accessible, and highly usable learning system. Therefore, the design of the mobile-based Practicum E-Module in the UINSU Computer Science Study Program is an innovative step in supporting a more modern and flexible teaching and learning process. The presence of this application is expected to improve the quality of practicum learning, expand student access to teaching materials, and foster learning independence that is in line with the development of digital technology.

Tabel 1. Text BlackBox for Mobile-Based Computer Science Study Program Practicum Learning

Modules tested	Testing ProcedurGagale	Input	Exodus	Conclusion
Login Dosen	- Open the app Select Admin Login Menu Enter the	Username "taufik" and Password "admin"	Lecturers can enter the application and can process E-Module data	Succeed
Data E-Module	- Open the app Login Enter the complete	Complete E-Module Data	E-Module data successfully added	Succeed
Data lesson	- Open the app Login Clear	E-Module dataincomplete	E-Modul datafailed to be added	Succeed

conducted tests from the E-Module application that has been built. Testing is carried out on every process contained in the E-Module application with successful and failed conditions

4. CONCLUSION

This research successfully designed and implemented a mobile-based practical learning e-module, providing students with the ease and flexibility to access materials anytime and anywhere, while simultaneously promoting increased interactivity and more effective independent learning. The implementation of this digital solution demonstrably overcomes the limitations of conventional printed modules, which are often impractical and non-uniform. Overall, the findings of this study indicate that utilizing mobile technology in developing practical e-modules successfully supports the enhancement of learning quality within the Computer Science Study Program, and can serve as a foundation for developing more innovative digital learning media in the future.

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