

Designing an Android-based E-Learning System using MVP Architecture for Student Learning Transformation

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ABSTRACT

This research focuses on the implementation of technology-based learning, particularly using e-learning platforms, at SMK Muhammadiyah 1 Prambanan Klaten. The aim is to change the traditional learning method where materials and assignments are delivered still using whiteboard, books, and ppt media. So, by providing easier and interactive access in the learning process and reducing the use of paper for assignments and material delivery. This research adopts the waterfall development method, with stages including requirements analysis, design, implementation, testing, and maintenance. The application is designed using REST API architecture design and Model-View-Presenter (MVP) methodology to ensure clear separation between interface, business logic and data processing. The results show that this android-based e-learning application has the potential to positively impact student learning by offering advantages such as time and cost efficiency, as well as speeding up the evaluation process. Overall, this research contributes to the understanding and utilization of android technology in the context of education as well as the transformation of student learning that keeps up with the times.

General Terms

Android, Architecture MVP, REST API, Application

Keywords

E-Learning, Waterfall, Learning Media

1. INTRODUCTION

Education has become a very important part of the development of today's society and technology. According to Yana [1], learning in the 21st century era is different from the learning approaches used in the past. In the past, the learning process did not consider certain standards, but now standards are an important requirement as a guide in achieving learning objectives. The rapid development of information technology in the current era of globalization has become unavoidable in influencing the education sector [2]. Advances in information and communication technology (ICT) have changed the learning landscape in significant ways. One of the recent innovations affecting the education sector is the E-Learning system, which allows flexible access to learning through electronic devices, including computers and smartphones. Several studies related to e-learning development were conducted to increase interactivity and creativity in the learning process by utilizing digital technology and supporting online learning [3].

E-Learning or Electronic Learning is a learning system through electronic media which can be interpreted as a form of utilization of information technology in education in the form of an online platform that allows it to be accessed anywhere. According to Rosemberg [4], e-learning is the use of computer

technology to improve the learning and teaching process. According to Jethro, Grace, & Thomas [5], e-learning refers to the utilization of the internet and technology in providing various alternatives to improve understanding and expertise. This definition illustrates that the use of e-learning aims to improve the insight and soft skills of individuals by utilizing the internet and technology [5]. E-Learning is built to facilitate the learning process at various levels of education. Through the development of information technology in the form of E-Learning, the interaction of learners and teaching staff does not need to meet directly in a class. Besides having advantages in terms of effectiveness and efficiency, online-based learning also faces challenges and disadvantages that must be faced by teachers and students [6].

In online-based learning, the internet has a very important role as expressed by Nurdiansah [6], who stated that the internet has advantages in large-scale data processing. He also underlined that the largest computer network in the world today is information technology, which can operate optimally if it is supported by quality hardware and software and involves skilled teachers and students. Therefore, there are still many obstacles faced due to several influencing factors, such as difficulties in finding signals or networks in some locations, not all students have communication devices, and more quota usage is needed to access learning applications and search on search engines [7]. The applied e-learning learning media provides several benefits, such as facilitating student access to subject matter as assignments and discussion materials from material at school, increasing student learning motivation, providing practicality, and increasing the effectiveness of teacher assessment which is quite high [8]. How to design an android-based e-learning application for the transformation of student learning media is the topic of this research.

Research on the design of android-based e-learning applications has been carried out in previous studies. In research conducted by [9], he created an Android-based e-learning application with the aim of overcoming limitations in terms of space and time in learning. This application utilizes an internet network that can be accessed by students anywhere and anytime. The test results show that the Android-based e-learning method they designed provides a more dynamic learning experience than conventional methods. In addition, students also find it easy to access learning materials through this Android platform, as well as the user interface presented in a simple and easy to understand display. In a study conducted by [10], they developed an android-based e-learning application that can assist schools in planning various daily learning activities, such as scheduling tests, exams, extracurricular activities, and so on. In addition, parents and guardians can connect directly through the application, allowing them to participate in supporting the learning process at home and monitoring learning activities at school.

Meanwhile, [11] have developed an Online Essay Exam Application and Course Material Download Upload System with the aim of increasing the efficiency of course material management for lecturers and students through online storage. In addition, the application also aims to make the essay exam process more effective, efficient, and reduce the use of paper. This research is also interesting because it uses the Cosine Similarity algorithm to assess the level of similarity of the tested documents.

Model-View-Presenter (MVP) is one of the architectures that has proven to be very effective in implementing Android in application development. MVP is an approach that clearly separates the three main components of an application: model (business logic), view (display or user interface), and presenter (controller between model and view) [12]. By using MVP, developers can create applications that are modular, easy to maintain, and able to better respond to changes [13].

This research aims to design and implement an Android-based E-Learning system using REST API & MVP architecture. The focus of this research is to bring about a significant change in students' learning experience, enabling easier, interactive, and effective access to learning materials. This transformation will hopefully make a positive contribution to modern education, bringing learning closer to students, and facilitating better self-directed learning.

2. RESEARCH METHODOLOGY

Waterfall methodology is one of the project management approaches that has been widely used in software development. Waterfall is a sequential methodology consisting of several stages that must be passed sequentially, such as planning, analysis, design, development, testing, and implementation [14]. According to [15], Waterfall Methodology is suitable for projects with clear requirements and does not change too much over time. In designing an Android-based e-learning system, the Waterfall approach helps in careful planning. The planning stage is crucial in determining user needs, learning objectives, and required resources. In addition, the analysis stage allows the identification of all features and functions needed in the e-learning application.

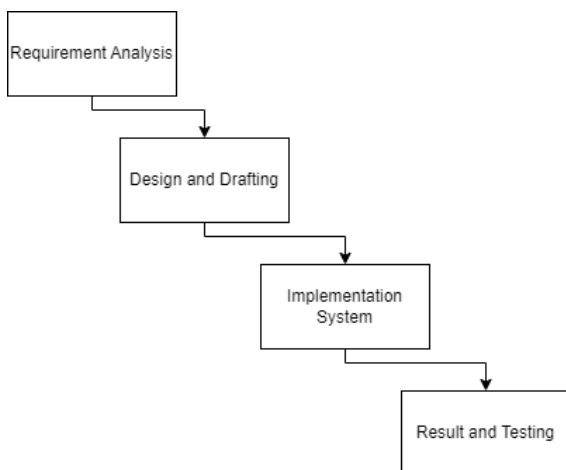


Fig 1: Waterfall Method

2.1 Requirement Analysis

An e-learning application system for student learning media using MVP architecture is developed for the transformation of existing learning media into a more modern one. During the development, information is provided about the functional requirements that must be met by the e-learning application

system. The following are the functional requirements of the e-learning application system:

1. The application can process login when the user (student, teacher, & admin) enters the username and password with the aim of entering the system.
2. The application can process a subject search by a student when the student enters the subject name in the search field in the home menu.
3. The application can process adding subjects by students when students click the add button on the selected subject.
4. The application can process material files by students when students download material files on the material page.
5. The application can process getting the assignment file when the student downloads the assignment file on the assignment page in the home menu.

The application can process assignment uploads, when students input and send pdf files to the REST API.

2.2 Data Flow Diagram Design

DFD are used to describe the sources and destinations of a process that creates a flow of data storage, or the interaction between data stored in the process.

Describes the relationship of all processes that occur in the system to data storage tables, along with feedback from the relationship. As well as the admin who processes master data, teacher data, student data, subject data and more details can be seen in Figure 2 below.

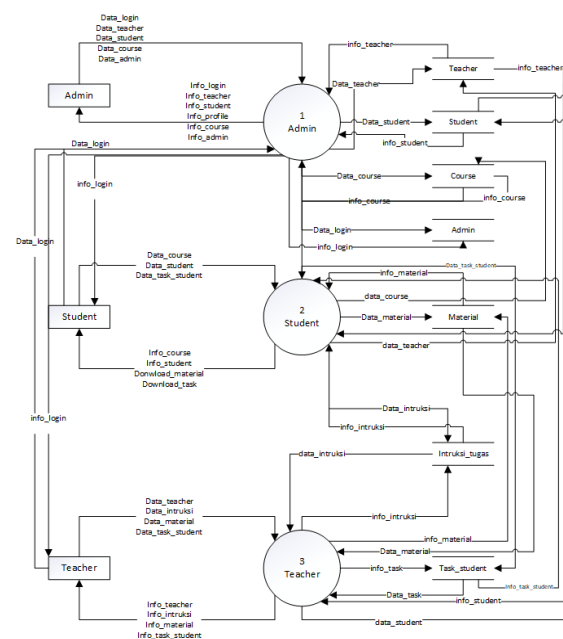


Fig 2: DFD Admin Process

Describes the continuation of level 1 students, namely in this process students can log in received from the admin, then students can register courses / subjects that are already available, then students can download the material available in each subject added, then students can download assignments contained in each subject and can upload the results of the assignment and more details can be seen in Figure 3 below.

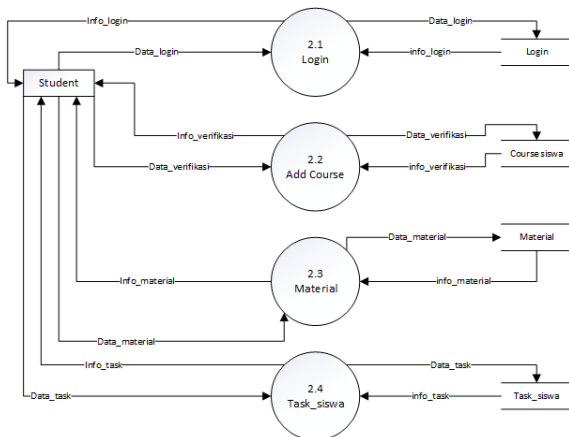


Fig 3: DFD Student Process

Describes the continuation of level 1 teachers. That is, the teacher can log in which has been registered by the admin, then the teacher can add the course / subject taught, then the teacher can upload the material, then the teacher can instruct assignments for students by uploading assignment files, and the teacher can download assignment data that has been collected by students and more details can be seen in Figure 4 below.

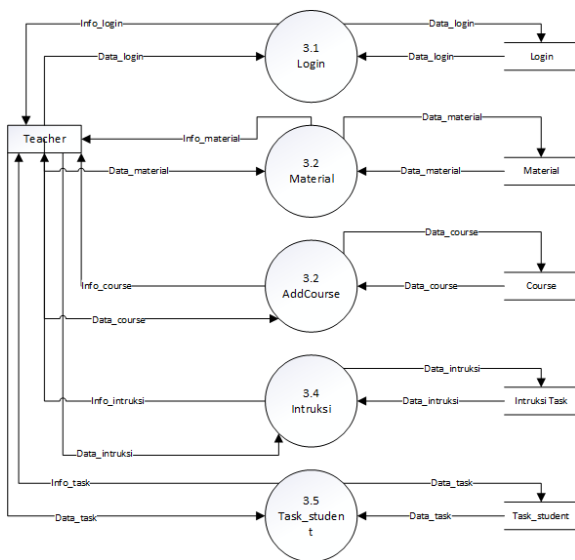


Fig 4: DFD Teachers Process

2.3 Model View Presenter (MVP)

MVP (Model-View-Presenter) architecture is one of the useful architectural approaches in Android app development. It separates the app into three main components: Model, View, and Presenter. The Model contains the business logic and data management [16]. In the development of an e-learning system, the Model will be responsible for managing lesson data, user information, and exam results. View is the display or user interface, serving to display information to users and receive input from them [16]. In an e-learning application, View will include the display of learning materials, exams, and user interface. The Presenter acts as the link between the Model and the View. It organizes the business logic, processes input from users, and updates the view according to changes in the Model [16]. In e-learning applications, the Presenter will organize the learning process, evaluate exam answers, and provide feedback to users. The use of MVP architecture allows e-learning applications to be more modular and easier to test.

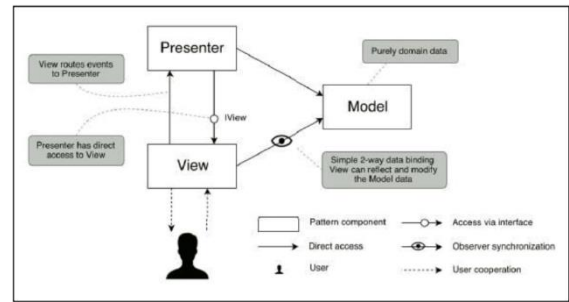


Fig 5: MVP Architecture

Implementation of the MVP architecture pattern for course features, material features and tasks. By using the MVP architecture pattern, course data, material data and task data obtained from the REST API connection can be stored in local storage or in this case the database room.

1. Room persistence is a library that functions to store data locally. Room helps to perform data transactions on the My Course menu and to display course data that has been added to my course menu, in this case the add Bookmark function. To implement room in android, a database room class needs to be created. In addition, there is also a DAO class which is a class that contains SQL statements to be used in the Entity class.
2. Presenter is one of the components in the MVP architecture pattern that functions to prepare data or process data to be sent to the UI / View component. The Module Presenter class is responsible for retrieving data from the Course Entity class. This data will be used to display courses that have been added to the 'My Course' menu. Detail Presenter manages the data from Module Model to be displayed in the material feature's user interface (UI). This includes retrieving course data and downloading course files from the server. Task Presenter handles data from Task Model to display in the task feature UI. Task Presenter also handles data from Task Model, specifically for the task upload process, and displays the results in the task feature UI.

2.4 Black Box Testing

Blackbox Testing is a software testing technique that evaluates the performance of an application without examining the internal details of the program code. It aims to ensure that the application behaves in accordance with predefined specifications [17]. In designing an Android-based e-learning system, Blackbox Testing is used to ensure that the application functions properly and meets user requirements. Blackbox testing involves functional tests, integration tests, and regression tests. Functional tests test whether all features and functions in the application run correctly. The integration test ensures that the application interacts with the e-learning server via the REST API correctly. Regression tests are used to ensure that any changes in the application do not disrupt existing functionality [18].

3. RESULT AND DISCUSSION

3.1 Assumptions

This application is designed to facilitate the learning process of students. With this application, students can search for courses, add courses, search for materials, download materials and assignments, and submit assignments.

3.2 Hypothesis

Based on the assumptions obtained, the hypothesis of this research and in accordance with the research title is "Application of MVP architecture in android-based E-Learning applications for student learning transformation at SMK Muhammadiyah 1 Prambanan Klaten".

3.3 Run an Experiment

The coding implementation process of this application uses the Kotlin programming language as a programming language that applies MVP architecture to its design. This android application is also connected using the REST API for data exchange from the admin system and teachers designed using the Laravel framework with the PHP programming language.

3.4 Implementations

3.4.1 Login Page

The page that is displayed to the user if the user has not been authenticated in the application. The login page aims to direct the user to enter personal data in the form of username and password to enter the application, and only registered users can access this application. Visualization of the login page can be reviewed in Figure 6 below.

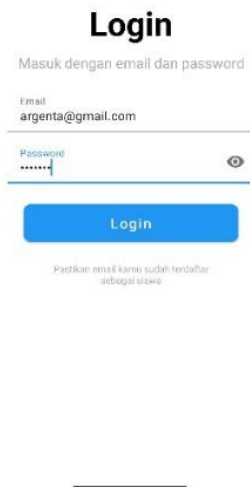


Fig 6: Login Page

3.4.2 Home Page

The page that can be accessed by the user after the user has successfully authenticated at the login stage. The home page displays a welcome message at the top and on the home page there is a search menu to view all available courses. The appearance of the home page can be seen in Figure 7 below.



Fig 7: Home Page

3.4.3 Search Page

The search page displays all available courses and can be minimized by clicking the category feature or can also directly search on the search display, the search page displays more details can be seen through Figure 8 below.

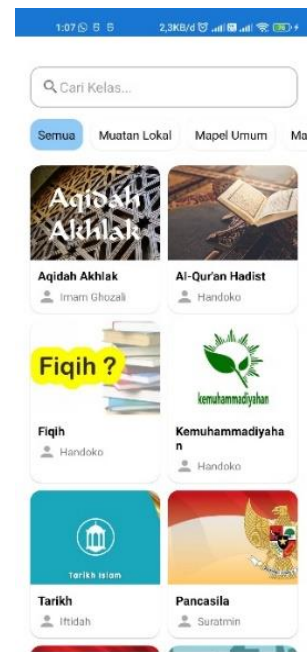


Fig 8: Search Page

3.4.4 Course Detail Page

The course detail page is a prototype page of the home page if the user clicks on one of the courses, the course detail page will appear, which displays a list of course meetings, as well as a button to add the course to my course page. A more detailed view of the course details page can be seen in Figure 9 below.



Fig 9: Course Detail Page

3.4.5 My Course Page

My Course page is a page that displays a list of courses that have been added by the user and the user can open the course to get the material file, but if the user has not added the course, then a Toast will appear "there is no class that you follow". The appearance of my course page can be seen in Figure 10 below.

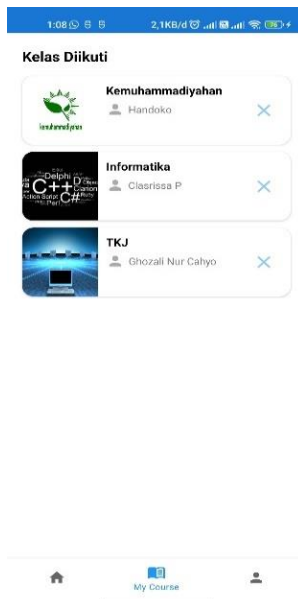


Fig 10: My Course Page

3.4.6 Material Detail Page

The material detail page is a prototype of the course detail page where if the user clicks on one of the meetings, the meeting page will appear, which displays the meeting title, meeting description and download material features that the user can download. The display of the course material page can be seen in Figure 11 below.



Fig 11: Material Detail Page

3.4.7 Task Page

The task page is a card view display on the home page where if the user clicks on the task, the task page will appear not yet done and the task has been done. The display of the task page has not been done and the task has been done can be seen in Figures 12 below.

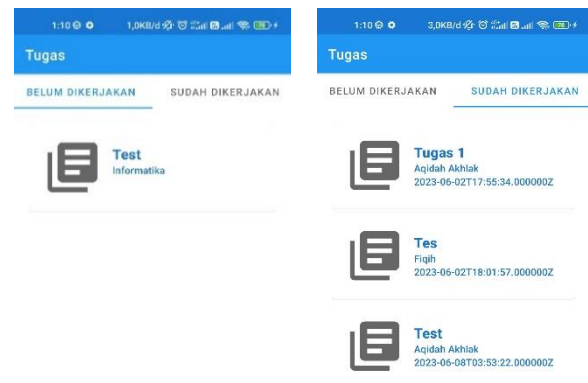


Fig 12: Task Page

3.4.8 Task Detail Page

The task detail page is a prototype view of the unworked task page where if the user clicks on one of the tasks, the task detail page will appear which can be downloaded, and the task collection upload form can be seen in Figure 13. On the task detail page there is a task file download button and a task collection file upload which if the user clicks, a notification will appear which can be seen in the following figures 14.



Fig 13: Task Detail Page

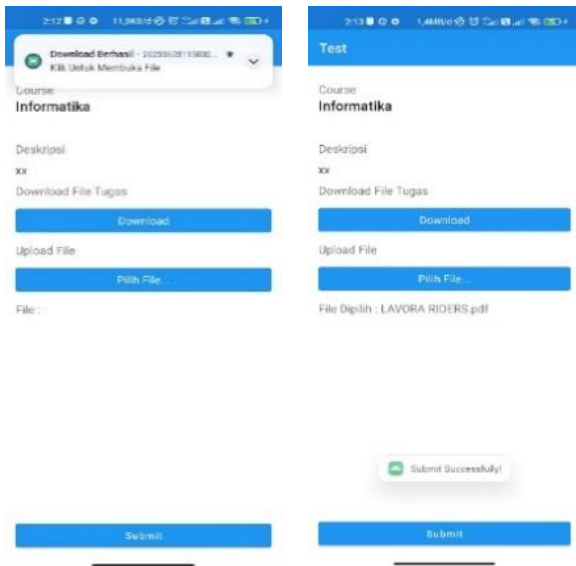


Fig 14: Download and Upload Notification

3.4.9 Profile Page

The profile page is a page that displays student identity data, on the profile page this application only displays profile photo data, name, nis, and the number of courses the student has attended, as well as 1 button that can be used to log out to exit the authenticated account. The profile page can be seen in Figure 15 below.



Fig 15: Profile Page

3.5 System Testing

The last step in the results and discussion of the android-based e-learning system of SMK Muhammadiyah 1 Prambanan Klaten is system testing. The test results using the black box are shown in Table 1 below.

Table 1. System testing using black box testing.

Numb	Test Scene	Desired Result	Test Result
1	Click the login button	The system redirects students to the home view	Success
2	Click the subjects search button	The system displays a list of subjects with the inputted title	Success
3	Click on a subject	System displays subject details	Success
4	Click the subject list button	The system redirects students to my course menu page if they are registered for the course.	Success
5	Click on material	System displays material details	Success
6	Click the download button	The system directs students to select the internal storage	Success

		of material downloads	
7	Click the task button	The system displays 2 slides of assignments that have not been collected and assignments that have been collected.	Success
8	Click on tasks not yet done	System displays task details and task upload form	Success
9	Click the download task button	The system directs students to select the internal storage of the assignment download	Success
10	Click on task upload	The system directs students to select the assignment file that will be collected through internal storage.	Success
11	Click the submit button	The system displays a toast for successfully submitting the assignment and redirects to the collected assignment view.	Success
12	Click on the profile menu	The system displays the student profile and the number of subjects followed	Success

4. CONCLUSION

The research conducted on the E-Learning application of SMK Muhammadiyah 1 Prambanan Klaten reveals several key findings. Firstly, the application successfully utilizes the MVP architecture pattern and is developed using the Kotlin programming language for android. Secondly, the application incorporates important features such as subject searching, listing, accessing learning materials, downloading files, and submitting assignments. These features improve accessibility to learning resources, save time, and provide flexibility in learning for both students and teachers. Thirdly, the E-Learning application resolves the limitations of face-to-face learning by offering online learning options. This enables students and teachers to access learning materials anytime and anywhere, thereby improving learning efficiency and convenience at SMK Muhammadiyah 1 Prambanan Klaten. Overall, the E-Learning application has proven to be a practical and effective solution for enhancing the learning experience at the school.

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