Designing E-Learning Applications As An Android-Based Student Learning Media With The Waterfall Method

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Abstract *The advancement of information technology has brought significant changes to the field of education, particularly in learning methods. This study aims to design and develop an Android-based e-learning application as an alternative learning medium for students. The application is designed to provide easy access to learning materials anytime and anywhere via mobile devices. The software development method used in this study is the Waterfall model, which consists of the stages of requirements analysis, system design, implementation, testing, and maintenance. The result of this research is an e-learning application equipped with features such as learning materials, practice questions, and evaluations. System testing shows that the application runs well and is well-received by users as an effective and efficient learning medium. This application is expected to increase students' learning interest and support a more flexible and interactive learning process.*

Keywords: *e-learning, Android, learning media, mobile application, Waterfall method*

Introduction

The rapid development of information and communication technology has brought significant impacts in various aspects of life, including in the field of education. Digital transformation in education encourages the birth of various learning innovations that utilize technology as a supporting medium, one of which is e- learning applications. E-learning is a form of learning that utilizes electronic devices and internet networks in the teaching and learning process, which allows students to learn independently, flexibly, and interactively.

In the current learning context, especially among school students, the use of mobile devices such as Android-based smartphones is very common. This opens up a great opportunity to develop learning media that can be accessed easily through these devices. However, there are still many schools that have not optimally utilized this potential, so a solution is needed that is able to answer these needs.

This research aims to design an Android-based e-learning application that can be used as a learning media for students. In developing this application, the *Waterfall* method is used as a systematic approach consisting of several structured stages, from needs analysis to system maintenance. It is expected that the resulting application will not only facilitate students' access to subject matter, but also improve the effectiveness and quality of learning as a whole.

Research Methods

This research uses a software engineering approach by applying the *Waterfall* system development method. The *Waterfall* method was chosen because it has systematic and structured stages, making it suitable for use in projects that have clear needs from the start. The stages in this method include:

1. Requirement Analysis
   At this stage, data collection and analysis of system requirements are carried out by means of observations and interviews with teachers and students. The purpose of this stage is to understand what features are needed in the application, as well as the obstacles faced in the conventional learning process.
2. System Design

Based on the needs that have been analyzed, the design of the user interface, database structure, and system architecture is carried out. This design aims to describe how the application will work as a whole.

3. Implementation
   At this stage, the design that has been made is converted into program code using a programming language and the Android platform. The application is developed using Android Studio with the Kotlin or Java programming language, and uses Firebase as a backend database.
4. Testing
   After the implementation is complete, testing is carried out to ensure that the application runs according to specifications and is free from errors (bugs). Testing is done using the black-box method, which is by testing the main functions without seeing the code structure directly.

Maintenance

After the application is tested and used by users, a maintenance phase is performed to fix any bugs found, add new features as needed, and perform periodic updates.

This method is expected to produce a stable application, according to user needs, and can be implemented effectively in the student learning process.

Results and Discussion

The result of this research is an Android-based e-learning application designed to assist students' learning process. This application has been successfully developed through five main stages in the Waterfall method, namely requirements analysis, design, implementation, testing, and maintenance.

1. Application Development Results
   The developed application has several key features, including:
   - Home page, which displays the main navigation menu such as material, practice questions, user profile, and help information.
   - The Material feature, which contains a collection of learning modules that can be accessed and read by students offline.
   - Practice Questions, which allows students to work on multiple-choice questions to test their understanding.
   - Evaluation of Results, which displays the score and discussion of the results of the exercise questions.
   - Account Management, which makes it easy for users to manage their profile and learning history.

2. Application Testing
   Testing was carried out using the *black-box testing* method on all the main functions of the application. The test results show that all features run as designed. No major errors were found in the testing process, and the application can be used smoothly on various Android devices with a minimum version of 8.0 (Oreo).
   In addition, a limited trial was also conducted with 20 students as end users. Based on the results of the evaluation questionnaire distributed, 85% of respondents stated that the application was easy to use, 80% found the material easy to understand, and 90% stated that the application was useful as an additional learning media outside the classroom.

3. Discussion
   The use of the *Waterfall* method provides a structured workflow in the application development process, so that each stage can be completed properly before moving on to the next stage. The development results show that this e-learning application can be an effective alternative to support student learning activities, especially in distance learning conditions or independent learning needs.

Although however, there are some notes for development of for further development, such as the addition of interactive features (learning videos, discussion forums), integration with the e-learning system, etc.school, and improved interface design to make it more attractive and adaptive to various screen sizes.

Conclusion

Based on the results of research and development that has been done, it can be concluded that the Android-based e-learning application designed using the *Waterfall* method is able to function as an alternative learning media that is effective and easy to use by students. The structured development process from needs analysis to testing allows the application to run well and in accordance with learning objectives.

The app provides key features such as presentation of subject matter, practice questions, evaluation of learning outcomes, and user account management. The test results show that the application can be well received by users, and supports a flexible and interactive self-learning process. Thus, this application has the potential to become a learning support solution in the digital era, especially in supporting learning activities outside the classroom independently and practically.

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