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Cloud-Based Learning Analytics Platform for English Learning: Developing the Grammarlyze Mobile Application Using Firebase Realtime Database

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ABSTRACT

Purpose – This study was conducted to address the growing need for a flexible and interactive English language learning platform by leveraging cloud computing technology. Specifically, it aims to develop an Android-based English learning application, Grammarlyze, and examine how Firebase can be effectively utilized to manage and store learning materials in real time, thereby improving accessibility and user experience compared to conventional learning media.

Methods – The study employed the Waterfall development method, consisting of requirement analysis, system design, implementation, testing, and maintenance. The application was developed using Android Studio with Java, while Firebase Realtime Database and Firebase Storage served as the cloud backend for managing text and video learning materials. System testing was conducted using black-box testing to evaluate feature functionality.

Findings – The results show that all core features of the Grammarlyze application functioned as expected. Black-box testing confirmed that 100% of the tested features, including material access, navigation, and data synchronization, were valid. Firebase enabled real-time data management, efficient storage, and seamless retrieval of learning content, contributing to a stable and responsive learning application.

Research limitations – This study is limited to basic English learning materials and does not yet include automated evaluation features such as quizzes or adaptive feedback. The findings also limited to functional testing and do not measure learning outcomes quantitatively.

Originality – This research provides practical evidence of Firebase implementation as a cloud platform for English learning applications, offering a scalable and efficient model that can extended in future studies to include advanced learning analytics and assessment features.

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INTRODUCTION

In this era of globalisation, English has become a very important international language for communication between countries, especially in the professional, educational and technological fields. Good English language skills provide access to global opportunities, both in the world of work and in personal development. This is because English has become the lingua franca that dominates international communication, facilitating interaction in various fields including business and education (Ahmad et al. 2023). However, not everyone has the opportunity to learn English optimally, especially in developing countries. This has led to a need for learning methods that are more accessible and can be tailored to individual needs. This challenge can also be exacerbated by a lack of adequate guidance from teachers, leaving students feeling stuck without clear guidance in their learning process (Aradillos et al., 2023).

The use of technology in education has a significant positive impact, especially in the context of language learning. This is because the integration of technology provides wider access to educational resources that were previously difficult to access. Gómez et al. show that more than 60% of students feel strengthened in the process of learning English through the use of technology, reflecting students' positive assessment of the technological tools used in learning (Gómez et al., 2018). English language learning applications provide an interactive experience that allows users to learn simultaneously with the flexibility of access anytime and anywhere. Nurkholis et al. reveal that learning applications designed with interactive elements can increase student engagement and encourage better language skill development (Nurkholis et al. 2022). However, one of the main challenges in developing such applications is how to manage and present learning materials efficiently.

Cloud computing, particularly platforms such as Firebase, is an ideal solution to overcome these challenges. One of the main advantages of Firebase is its real-time database feature, which allows applications to synchronise data in real time across all connected clients. This feature is essential for applications that require instant feedback and updates, such as voting platforms. For example, Tjandra and Setiyawati designed a mobile e-voting application that utilises Firebase's real-time database to facilitate smooth interactions between users, thereby enhancing the voting experience (Tjandra & Setiyawati, 2019). Similarly, Gunadi et al. demonstrated the effectiveness of Firebase Cloud Storage in managing fast storage of agricultural images, confirming its efficiency in handling real-time data uploads and retrievals (Gunadi et al., 2020). By using services such as Firestore and Firebase Storage, developers can easily manage learning material data and store user videos.

Grammarlyze is an English language learning application designed to present material in text and video form. This application focuses on helping users understand grammar and the correct use of English through a simple and accessible approach. Firebase was chosen as the cloud platform for this application because of its ability to provide scalable and secure solutions, allowing the application to grow in line with user needs.

In developing the Grammarlyze application, Firebase offers various advantages, such as real-time data management, the ability to quickly save and retrieve video files via Firebase Storage, and user authentication features that make it easy for users to log in and save their progress. By using Firebase, this application not only offers convenience for developers, but also a smoother and more responsive user experience.

This study aims to address the development of an effective English language learning application by leveraging a cloud-based platform that enables flexible, interactive, and scalable learning experiences. Specifically, it examines how Firebase can be utilized to store, manage, and synchronize learning material data efficiently within the Grammarlyze application, ensuring accessibility, reliability, and real-time data management. Through the integration of cloud technology, the study seeks to provide a modern English learning

platform that supports dynamic content delivery while optimizing data storage and management processes.

METHOD

Development Method

The development method used in creating the Grammarlyze application is the Waterfall Method. The Waterfall Method is one of the approaches used in structured software development. In this method, each development phase must be completed sequentially without jumping to the next phase until the previous phase is complete (Oktaviani & Setiawan, 2023). This approach encompasses several distinct stages, namely requirements analysis, system design, implementation, testing, and maintenance. (Santoso et al., 2023). Each stage in the Waterfall method has specific objectives and deliverables, thereby facilitating the software project management process. (Sembiring et al., 2024). This method was chosen because of its structured and sequential nature, where each phase is carried out in order and no phases are skipped. The following are the stages involved in developing an application using the Waterfall model:

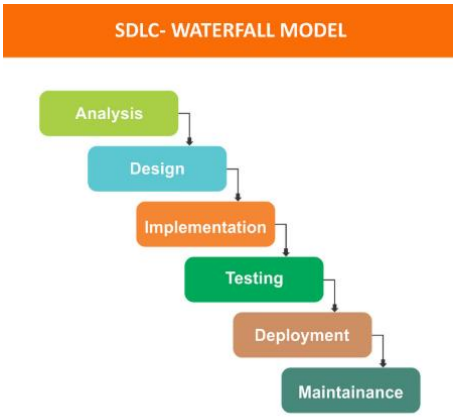


Figure 1. Stages of the Waterfall Method

Analysis

In the first stage, the requirements for the software to be developed are identified and analysed. The main objective of this stage is to understand and define what users or stakeholders need from the application. The requirements analysed include the main functions that must be present in the application, such as features, user interface, and how the application will interact with users and other systems. The result of this stage is a clear and detailed requirements document, which will serve as a reference in the next stage.

a. System Design

During the design phase, the application architecture is designed, including the selection of the platform and tools to be used, as well as the design of the user interface using Figma. This design will include navigation settings, layout, and other visual elements that make the application easy to use for users.

b. Development

During the development stage, the application was built using Android Studio with the Java programming language. The application was implemented based on the design that had been created previously, and integration with Firebase was carried out to store learning material data.

c. Testing

After development is complete, the application is tested to ensure that it functions as expected. Testing is carried out to verify key features such as video and text management via Firebase.

d. Maintenance

After the application is launched, maintenance is carried out to ensure that the application continues to run smoothly, update materials, and fix any bugs that may be found by users.

Platform and tools

In developing the Grammarlyze application, the following platforms and tools were used:

a. Android Studio

Android Studio is an Integrated Development Environment (IDE) used to develop Android applications. This IDE is equipped with various tools that assist developers in writing, editing, and testing application code. Using Android Studio, developers can create user interfaces, manage files, and write code in Java.

b. Java

The Java programming language is used to develop this Android application. Java is a programming language commonly used for Android application development due to its stability and extensive capabilities in handling various mobile application development tasks.

c. Firebase

Firebase is a cloud platform used to handle the backend of applications. In the Grammarlyze application, the Firebase Realtime Database service is used to store and manage learning material data (text and video) in real time.

d. Figma

Figma is used to design application user interfaces. With Figma, development teams can visually design application displays, create prototypes, and ensure that application designs can be easily implemented in Android Studio.

System Testing

The testing method applied to test this application is black-box testing. Black box testing is a method that focuses on software function specifications without regard to its internal structure (Pirdaus & Hidayana 2024). In this test, the tester only looks at the output generated from the given input, which helps in evaluating software performance (Rahadi & Vikasari, 2020). This method is generally used to identify errors in software functionality, interface display errors, and errors in database access, as well as to ensure that the output produced is as expected (Setiawan et al., 2020).

RESULTS AND DISCUSSION

After going through a series of stages using the Waterfall method, the following are the results achieved in application development of Needs Analysis

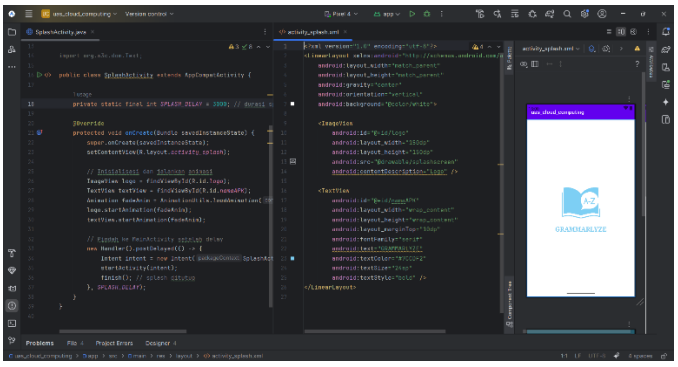
At this stage, an application requirements analysis is carried out, which includes determining key features such as text and video material presentation, user authentication, and material data storage in Firebase.

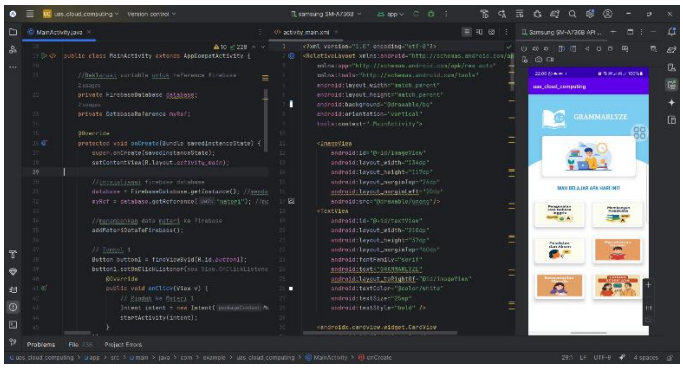
1) Design System

Features	Design
Splashscreen	
Dashboard	

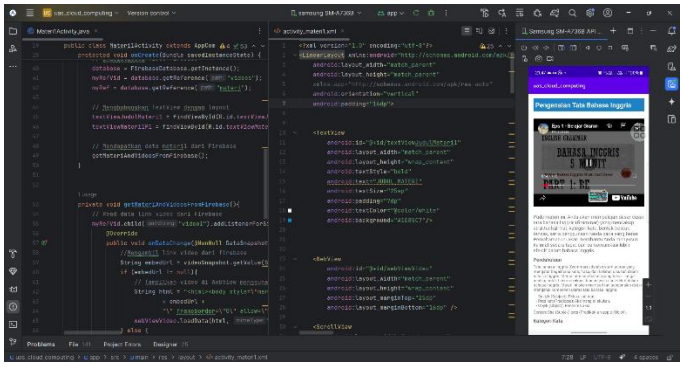
Access to Materials

2) Application Development

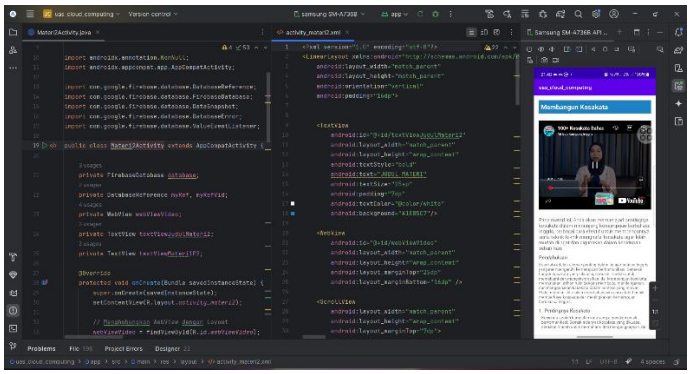
Fitur	Result
Splashscreen	
Dashboard	



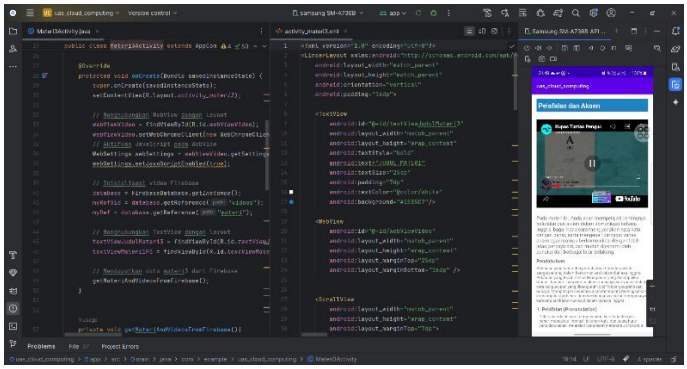
Access to Grammar Introduction Materials



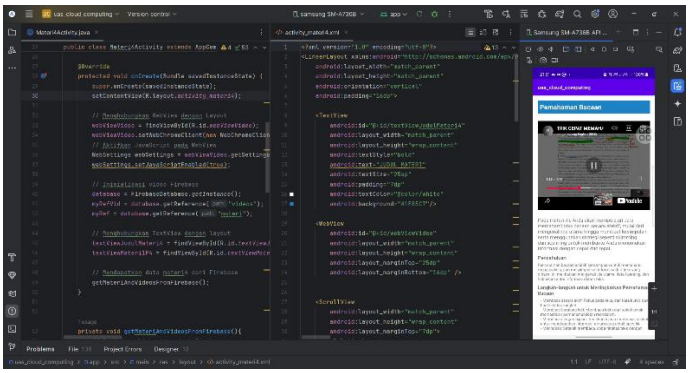
Access Materials Building Vocabulary



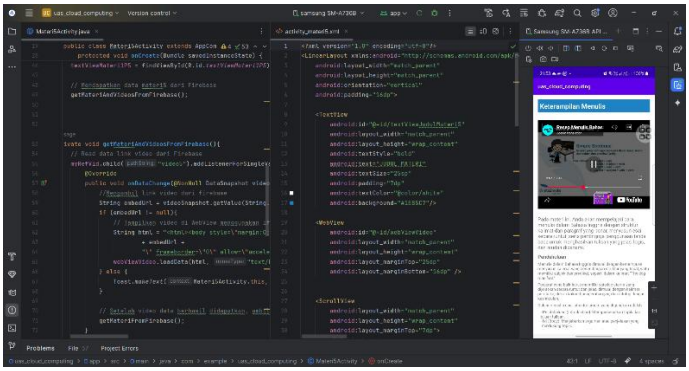
Access to Reading Comprehension Materials



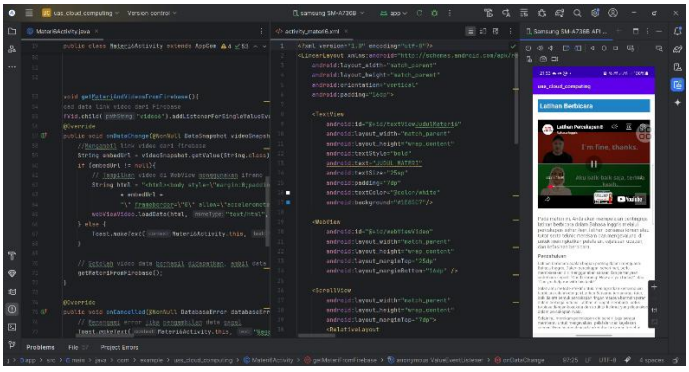
Access to Reading Comprehension Materials

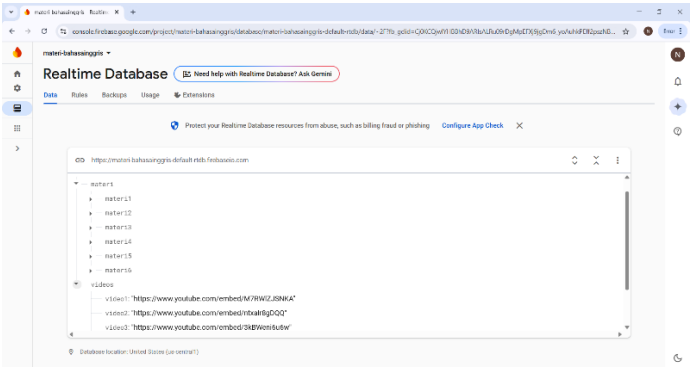


Access to Writing Skills Materials



Access to Exercise Materials



Database Design in Firebase	

3) Testing

The system being tested	Expected output	Test results
Application Launch	The application opens without errors or crashes and displays the Dashboard.	Valid
Dashboard Display	The dashboard is displayed correctly, showing six material options that are clearly accessible and legible.	Valid
Navigate to Material 1: Introduction to Grammar	After clicking on Material 1, the application displays material on Introduction to English Grammar.	Valid
Navigate to Material 2: Building Vocabulary	After clicking on Material 2, the application displays the material Building Vocabulary.	Valid
Navigate to Material 3: Pronunciation and Accent	After clicking on Material 3, the application displays the Pronunciation and Accent material.	Valid
Navigate to Material 4: Reading Comprehension	After clicking on Material 4, the application displays the Reading Comprehension material.	Valid
Navigate to Material 5: Writing Skills	After clicking on Material 5, the application displays the Writing Skills material.	Valid
Navigate to Material 6: Speaking Practice	After clicking on Material 6, the application displays the Speaking Practice material.	Valid

4) Maintenance

After the application is launched, maintenance will be carried out to fix bugs that arise, optimise features, and improve performance. Some of the results of the maintenance carried out include:

a) Improved application performance on devices with low specific actions.
b) Addition of a material search feature that allows users to easily find specific learning topics.
c) Updates to fix several minor issues found after the application launch.
d) The result of this maintenance is a more stable, faster, and more user-friendly application.

CONCLUSION

Based on the results of the development and testing of the Grammarlyze application, it can be concluded that the use of Firebase as a cloud platform contributes significantly to the efficiency of managing English learning materials in real time. This application was successfully developed using the Waterfall method and tested using black-box testing with valid results for each main feature, from the splash screen to access to materials. Firebase Realtime Database facilitates the storage and access of video and text materials. Overall, the application of cloud technology through Firebase has proven to support the creation of interactive, flexible, and easily accessible learning applications, thus having the potential to be an effective means of improving users' English language skills.

For further research, it is recommended to develop automatic evaluation features, such as interactive quizzes and instant feedback on user answers, to increase engagement and understanding of the material directly. In addition, the application is currently limited to several basic topics. Further research can expand the scope of material to intermediate and advanced English topics, including material for test preparation such as TOEFL or IELTS.

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AUTHOR CONTRIBUTION STATEMENT

NA was responsible for the conceptualization of the study, application design, implementation using Firebase, and drafting the manuscript. FR, DF and SA contributed to the research supervision, methodological guidance, critical revision of the manuscript, and validation of the study's technical and academic quality. All authors reviewed and approved the final version of the manuscript before submission.

AI DISCLOSURE STATEMENT

The authors used ChatGPT during the preparation of this manuscript for language refinement and structural editing. All generated content was carefully reviewed, revised, and validated by the authors to ensure accuracy, originality, and academic integrity. The authors take full responsibility for the content of this publication and declare that the research design, implementation, analysis, and conclusions were conducted without reliance on artificial intelligence for substantive research activities.

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