

1. Introduction

1.1 Background

Mathematics is often avoided due to its complexity and the need for strong logical reasoning. However, it is crucial for human progress, driving breakthroughs in technology, science, engineering, and economics. Mathematics is foundational to advancements in areas like space exploration, computer science, and AI. By enabling problem-solving and analytical thinking, it continues to push the limits of human knowledge, helping society advance. Creating tools that make math more accessible is essential for fostering future innovations and empowering individuals in their academic and professional endeavors.

The integration of artificial intelligence into educational tools presents a promising opportunity to address these challenges. AI-powered applications can provide interactive, personalized support to help students understand complex concepts and solve problems effectively. [1] This thesis aims to develop a math notes application for Android that incorporates Gemini API to bridge the gap in quality and accessibility between platforms. By combining the capabilities of Android Studio and Gemini AI, the project seeks to create an innovative tool that not only enhances the learning process but also explores the potential of AI in educational technology.

[2] The integration of technology in note-taking has significantly transformed traditional methods, offering greater efficiency and interactivity. This shift has enhanced how students and professionals capture and organize information, with digital tools providing features such as searchability, multimedia integration, and real-time collaboration, which improve both the quality and accessibility of notes. The paper highlights how technology, including mobile apps and AI-powered tools, can support learning and knowledge management, aligning with the growing need for more advanced, effective educational tools.

1.2 Formulation of Problems

Students often face significant challenges in learning mathematics, particularly with fractions. [6] These difficulties include errors in writing fraction values, confusion with relational symbols, misidentifying numerators and denominators, and struggling to understand problems as a whole. Calculation errors, especially in subtraction, and incomplete problem-solving are also common. [5] Many students report difficulties in interpreting problems and recognizing mathematical relationships, leading to a lack of comprehension and a perceived disconnection between lessons. These challenges are further compounded by ineffective instructional strategies, which contribute to reduced interest and engagement in mathematics learning.

Another issue lies in the lack of high-quality math notes applications available for Android devices compared to Apple's ecosystem. While Apple's math notes apps are renowned for their effectiveness, reliability, and advanced features, Android alternatives often fall short in terms of accuracy, usability, and functionality. Many Android math apps struggle with incorrect number recognition, inaccurate answers, and poorly designed interfaces, making them less effective as learning tools. To address this disparity, this study focuses on developing a math notes application for Android that matches the functionality and reliability of its Apple counterparts. The study is limited to foundational mathematical concepts, such as fractions and basic algebra, excluding advanced topics like calculus. It prioritizes problem-solving, equation interpretation, and step-by-step explanations while excluding features such as handwriting recognition and real-time collaboration due to resource constraints. By focusing on the Android platform, the study aims to address specific educational challenges while maintaining feasibility and ensuring accessibility for students and educators.

1.3 Purpose and Significance of the Study

The significance of this project lies in its potential to revolutionize mathematics learning by providing personalized assistance through AI integration. Traditional note-taking applications lack the interactivity and intelligent problem-solving capabilities that this thesis aims to implement. By developing a math notes application that integrates Android Studio and Gemini AI, the project bridges the gap between conventional note-taking and AI-powered tutoring. This innovative tool will enable users to take notes, solve problems, and gain a deeper understanding of mathematical concepts, offering a unique blend of software engineering, artificial intelligence, and educational technology.

The math notes app with AI integration offers several key benefits for students and educators. It improves learning and understanding by providing interactive tools and personalized assistance for complex mathematical concepts, helping students overcome challenges like confusion with fractions and problem interpretation. The app enables instant problem-solving, generating step-by-step solutions and insights, while being user-friendly and accessible to both students and educators. Educators can save time on repetitive problem-solving, allowing them to focus on teaching core concepts. Developed for Android, it ensures broader access to quality math learning tools, especially for students without access to Apple devices. The AI adapts to users' learning progress, offering personalized explanations and tracking performance over time, ultimately improving mathematical literacy and preparing students for higher education and careers requiring math skills.

1.4 Scope and Limitations

This thesis focuses on the design and development of a mobile application intended to support the digital recording and intelligent processing of mathematical notes. The application is developed using Kotlin as the primary programming language, with XML for the user interface layout, and Room as the local database solution. The key scope of this project includes enabling users to create, edit, and delete digital notes that may contain both typed content and hand-drawn mathematical expressions. One of the notable features of the application is its integration with an artificial intelligence (AI) model—specifically the Gemini API—to process and solve handwritten mathematical equations through image recognition and text generation.

Functionally, the application allows users to draw mathematical equations using a custom canvas interface, store these notes locally, and invoke the AI to analyze and solve the equations. This adds significant educational value for users such as students, teachers, and self-learners who benefit from an interactive and intelligent note-taking experience. Furthermore, the system supports basic features like note categorization by date and title, the inclusion of bitmap images representing handwritten content, and a responsive user interface built with Android's architectural components including ViewModel, LiveData, and StateFlow.

Despite its functionality, the application has several limitations that need to be acknowledged. Firstly, the mathematical recognition capability is limited to what the AI model can accurately interpret from the bitmap input. Handwriting quality, image clarity, and the complexity of the equations can impact the model's ability to deliver precise results. Furthermore, the AI integration is dependent on internet access since the Gemini API is cloud-based. This means the solve functionality is not available offline, which may restrict usability in areas with limited connectivity.

Secondly, the scope of supported mathematical operations is constrained to the types outlined in the prompt sent to the AI model. These include basic arithmetic, algebraic equations, and trigonometric expressions, with solutions provided in step-by-step format when possible. More advanced topics such as calculus, graphing, or symbolic integration may yield inconsistent results or may not be handled at all. Additionally, while the application offers drawing and erasing tools, it does not currently support multiple pages per note, handwriting-to-text conversion, or cloud synchronization across devices.

From a technical perspective, the application employs only a local Room database, which means all notes are stored on the device. Consequently, data loss may occur if the application

is uninstalled or the device is reset, since there is no backup or cloud storage mechanism in place. Moreover, while the system architecture is modular, with a clear separation of concerns through the use of use cases and a repository pattern, the application does not yet support multi-user functionality, user authentication, or role-based access.

In summary, while the developed math note-taking application provides significant utility in combining manual note input with automated equation solving, its usage is best suited for individual learners operating in a connected environment. Future enhancements may address the identified limitations, such as improving offline support, expanding mathematical recognition capabilities, and integrating synchronization or user account features to broaden its applicability and robustness.

1.5 Methodology

The methodology used in developing the Math Notes Application follows a structured, step-by-step approach inspired by the Waterfall model. The process began with requirement gathering, where the application's core features—such as drawing mathematical expressions, saving notes, and calculating results using the Gemini API—were identified. This was followed by a system analysis phase to define user needs and system behavior. Next, the design phase involved creating the system architecture, user interface mockups, and data flow diagrams. During the implementation phase, the application was developed using Android Studio with Kotlin, XML for layouts, and SQLite for local storage. Gemini API integration was handled through network requests. After coding, the application underwent testing to ensure functionality and usability. Finally, the system was evaluated and documented to reflect its performance and potential improvements. This methodology ensured a systematic, traceable development process that met both functional and user experience goals.

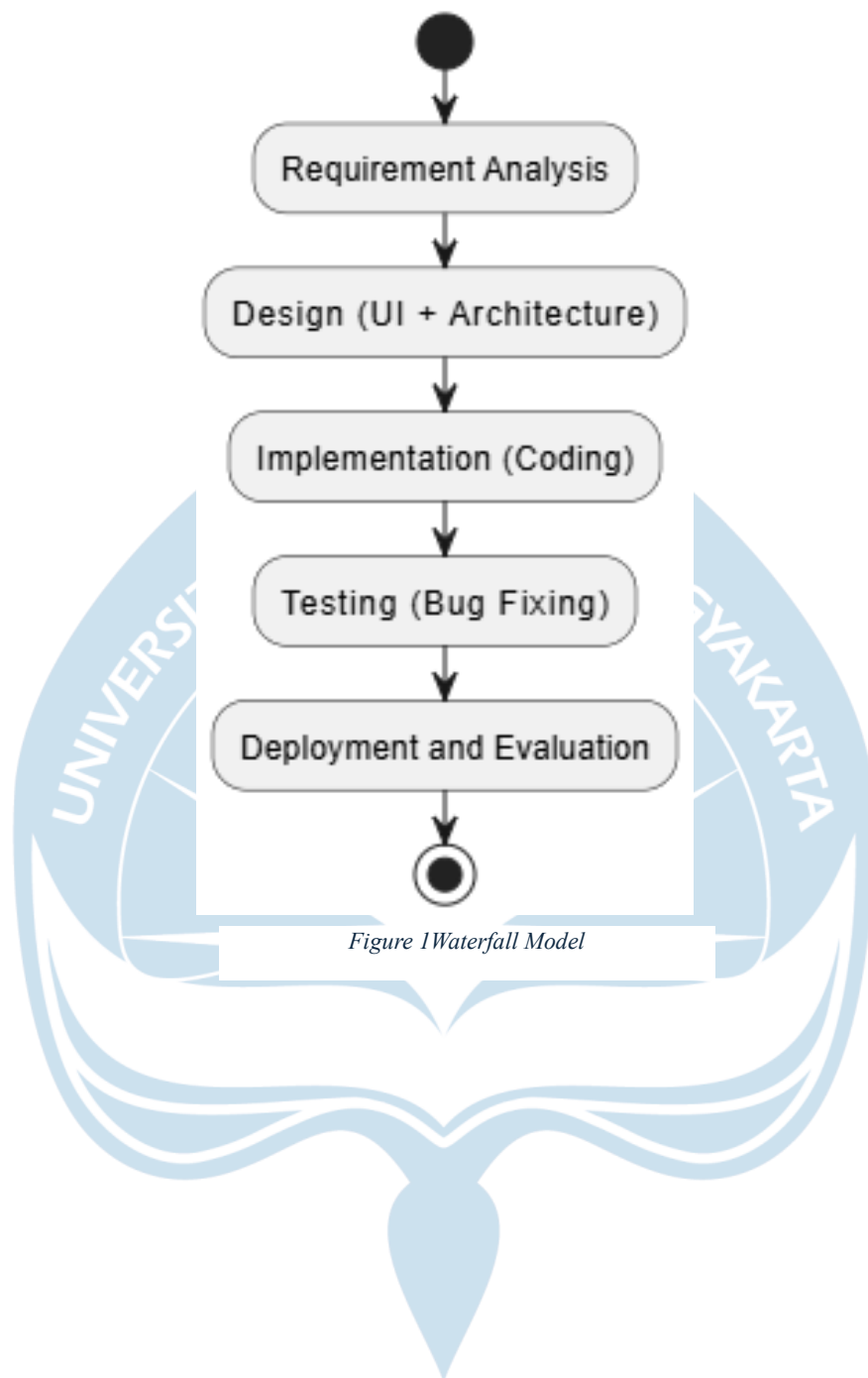


Figure 1 Waterfall Model