INTI International College Penang School of Computing

3+0 Bachelor of Science (Hons) in Computer Science, in collaboration with Coventry University, UK

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Coursework cover sheet

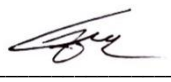
Section A - To be completed by the student

<table>
<tr><td colspan="2">Full Name: Thor Wen Zheng</td></tr>
<tr><td colspan="2">CU Student ID Number: 14641411</td></tr>
<tr><td colspan="2">Semester: April 2025</td></tr>
<tr><td colspan="2">Lecturer: Khor Jia Yun</td></tr>
<tr><td colspan="2">Module Code and Title:

6002CEM– Mobile App Development</td></tr>
<tr><td>Assignment No. / Title: Coursework

CW1 – Individual Report</td><td>% of Module Mark
25%</td></tr>
<tr><td>Hand out date:
24th April 2025</td><td>Due date:
13th May 2025</td></tr>
<tr><td colspan="2">Penalties: No late work will be accepted. If you are unable to submit coursework on time due to extenuating circumstances you may be eligible for an extension. Please consult the lecturer.</td></tr>
<tr><td colspan="2">Declaration:

I/we the undersigned confirm that I/we have read and agree to abide by the University regulations on plagiarism and cheating and Faculty coursework policies and procedures. I/we confirm that this piece of work is my/our own. I/we consent to appropriate storage of our work for plagiarism checking.

Signature(s):  </td></tr>
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Section B - To be completed by the module leader

Intended learning outcomes assessed by this work: LO2: Understand and critically evaluate the different tools and techniques for mobile application development. LO5: Understand, articulate, and provide sustained argument on how Cloud Computing can be used to enhance the use of mobile computing in business.
Lecturer's Feedback:
Internal Moderator's Feedback:

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LIST OF ABBREVIATIONS

APA	American Psychological Association
API	Application Programming Interface
AI	Artificial Intelligence
LLM	Large Language Model
MFA	Multi-Factor Authentication
MMS	Multimedia Message Service
MCQ	Multiple Choice Questions
RCS	Rich Communication Service
SMS	Short Message Service
SEL	Social and Emotional Learning
TTS	Text-To-Speech
U.S.	United States

CHAPTER 1: INTRODUCTION

1.1 Problem Statement

In today's fast-paced educational environment, students face significant academic stress, with many experiencing mental health issues like anxiety and emotional distress (Fatzunnahar, 2023). According to a study conducted by researchers in Malaysia, 53.9%, 66.2%, and 44.6% of university students face moderate to severe depression, anxiety, and stress, respectively (Wong *et al.*, 2023). These alarming statistics highlight a growing crisis in student well-being, which stems from several persistent issues faced by students in the current education system.

One of the major issues is the **overwhelming academic workload** that students must manage. Students face immense pressure to juggle between multiple subjects with continuous assignments, exams, or coursework, often leading to procrastination or burnout. A study conducted on academic stress in higher education found that 80% of participants relate stress to academic workload, with 60% considering exams as a significant source of stress (Perez-Jorge *et al.*, 2025). Additionally, research by the American Psychological Association (APA) indicates that approximately 87% of college students in the United States (U.S.) consider education as a primary stressor, owing to demanding workload, academic competition, financial issues, and family pressure (Verbanas, 2022).

Another critical issue is the difficulty of searching and **accessing accurate and relevant information**. Students frequently use internet search engines such as Google to look for information required for their homework, assignments, or studies. However, it can be highly time-consuming and can lead to confusion due to conflicting information. This is because there are countless sources of information fragmented across the internet. Research from Stanford University indicates that students often struggle to judge the credibility of online information, making it challenging to distinguish reliable sources from incorrect ones (Donald, 2016). Although large language models (LLMs) have made significant advancements in recent years and have become mostly accurate, there is currently no seamless way to integrate LLMs into students' personalized learning environments as they are typically standalone applications (Wang *et al.*, 2024).

Additionally, students often **lack effective review techniques**, resulting in poor knowledge retention. The forgetting curve theory, Ebbinghaus's Forgetting Curve, is a human memory theory which demonstrates the rapid decline of memory retention over time without periodic review. Ebbinghaus emphasized that frequent review ensures less information is forgotten after each review session. In support of this theory, research has found that humans forget 50% of new information within an hour, increasing to an estimated 70% within 24 hours (Gupta, 2024). In today's demanding study lifestyle, students have to take on significant amounts of information from several subjects at a time, further decreasing knowledge retention especially without consistent review.

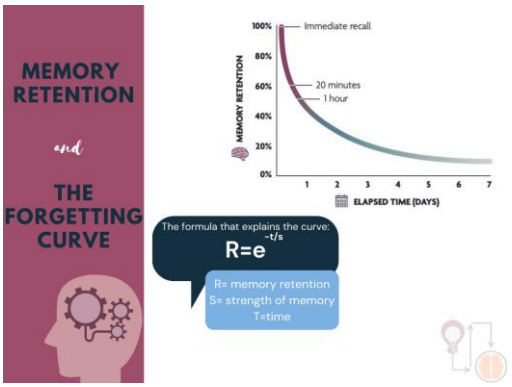

Figure 1.1:The Forgetting Curve (Gupta, 2024)

Effective **time management** is another challenge amongst students. Many students lack the skills to manage and prioritize their tasks, leading to misaligned focus or missed deadlines. This is particularly difficult for students balancing academic work with extracurricular activities, part-time jobs, or personal commitments. For instance, a study by Acuity Training found that 82% of people do not have a proper time management system, while 25% just deal with any task that seems important at a given time without proper consideration (Richardson, 2025). Based on a survey by Kahoot, 47% of respondents consider time management as the biggest challenge in their studies (Kahoot, 2024).

Figure 1.2: Biggest challenges faced by students when studying (Kahoot, 2024)

Finally, **emotional support** is also lacking in the educational environment of most students as they are expected to navigate academic challenges independently. Without appropriate support, academic stress often leads to frustration, anxiety, and depression, further reducing motivation and academic performance (Fatzunnahar, 2023; Wang *et al.*, 2024). However, research has shown that integrating social and emotional learning (SEL) into academic lifestyles can significantly improve mental health and academic performance (CASEL, 2025). Supporting this claim, a study in Canada found that students who participated in SEL programs achieved an average of 13% higher academic performance than those who did not participate (Taylor *et al.*, 2017).

In summary, these interrelated issues clearly highlight the need for a centralized, intelligent, and emotionally aware solution to academic challenges. The proposed mobile application will be designed to address these problems by providing study support, adaptive review, instant access to information, knowledge or notes management, and emotional support, all within a single personalized platform which acts as an intelligent study companion.

1.2 Objectives

The objectives of the proposed solution are:

1. To develop a mobile application with a chatbot using a LLM that provides instant academic support through multimodal input, including answering questions, providing explanations, and summarizing notes.
2. To implement an adaptive review system that generates personalized quizzes based on the user's past mistakes, weak areas, and study history using spaced repetition techniques like flashcards to enhance knowledge retention.
3. To design an intelligent study planner that dynamically adapts to the user's schedule and emotional state, providing personalized study recommendations and notifications.

CHAPTER 2: MOBILE APPLICATION IDEA

2.1 Application Overview

Description

The proposed mobile application is **Athena**, an artificial intelligence (AI) study companion designed to enhance student learning through personalized academic support, adaptive review system, and intelligent study planning. It provides a comprehensive, user-friendly platform where students can receive instant help with their studies, organize or review study materials efficiently, and manage their time effectively.

Target Users

Athena is primarily designed for all **students** including primary, secondary, or university students who face academic challenges such as difficulty understanding complex topics, poor time management, or overwhelming academic workloads. It will be particularly useful for students who struggle with procrastination, low motivation, or stress. However, Athena will not be limited to students alone, it is also an ideal all-in-one solution for anyone with a desire to learn or master any subject.

Core Modules

Athena is built around three core modules that ensure an effective learning experience, including an AI chatbot with multimodal input, adaptive review system, and intelligent study planner, with emphasis on emotional awareness to promote mental well-being.

Table 2.1: Core modules of Athena

Concept	Description
AI Chatbot with Multimodal Input	Allows students to ask questions via text, voice, or photos, providing instant explanations, homework help, note summarization, and more. This ensures quick access to accurate information and adapts its tone using sentiment analysis to accommodate the user's mood.
Adaptive Review System	Generates personalized quizzes or exercises based on specific topics and the user's past mistakes, weak areas, and study history, using spaced repetition to enhance knowledge retention.
Intelligent Study Planner	Helps students plan their study sessions effectively by dynamically adapting to their schedule. It also provides reminders and adjusts study recommendations based on user mood and achievement of study targets, ensuring a balanced and personalized study schedule.

2.2 Key Features

The following table provides a detailed breakdown of Athena's key features, categorized by its three core modules, as well as additional features that add value to the application.

Table 2.2: Key features of Athena

Feature	Description	Benefit
AI Chatbot		
Academic Question Assistance	Provides instant answers via text, voice, or photo input.	Quick and reliable help without distractions.
Note Summarization	Allows users to upload notes and generates concise summaries with key points. The note can be saved and organized by the user.	Saves time by simplifying complex information for fast review.
Multi-Subject Support	Covers various subjects and is not limited to specific fields.	Comprehensive academic support for all study domains.
Emotionally Aware Responses	Detects user emotion through text input and responds with the appropriate tone or encouragement.	Provides real-time emotional support.
Adaptive Review		
Quiz Generation	Automatically creates quizzes such as flashcard quizzes based on user-provided input.	Saves time by removing the need for users to manually find or create their own quizzes.
Spaced Repetition	Schedules reviews using spaced repetition, providing frequent exercise for long-term knowledge retention.	Enhances knowledge retention over long periods of time.
Progress Tracking	Monitor user performance and suggest focus areas for improvement based on past mistakes.	Enables the user to identify their weak areas.
Study Planner		
Customizable Study Goals	Allows user to set specific study goals.	Keeps the user motivated and focused on their target.

Dynamic Schedule Management	Adapts study plans based on user's availability in their schedule. Furthermore, it makes adjustments based on achievement of study goals. If the user exceeds study goals, upcoming study sessions can be shortened to allow for free time.	Efficient time management without manual intervention.
Emotionally Aware Adjustment	Adjust study recommendations based on user mood.	Supports mental well-being.
Reminders and Notifications	Sends reminders for study sessions or study goals.	Helps user maintain consistent study habit.
Additional Features		
Study Material Management	Allows users to organize or manage their study materials like notes.	Eliminates the need for external note-taking apps.
Study Timer with Focus Modes	Offers a built-in study timer with customizable focus modes like Pomodoro to ensure timeboxed study periods with sufficient rest in between.	Helps maintain concentration and prevent burnout.
Study Buddy Matching	Connects users with peers studying similar topics for collaborative learning.	Encourages social learning and peer support.
Progress Badges and Achievements	Rewards users for consistent study habits and performance milestones.	Boosts motivation and engagement.
User Dashboard	Provides a visual summary displaying study time, subjects covered, quiz performance, study goals, and more.	Enables the user to understand their overall performance at a glance.

2.3 Similar Application Review

Athena is compared with two educational applications with similar functionality currently available on the Google Play Store, which are **Gauth** and **Quizlet**. They have been selected because they are the most well-developed applications in their respective categories for academic assistance and knowledge review.

2.3.1 Gauth

Gauth is an AI-powered educational application designed to assist students with homework across various subjects. It was initially focused on mathematics, but it has expanded its capabilities to include general topics as well as other specific subjects like physics, chemistry, literature, geometry, language, economics, math, and history. Gauth has over 50 million downloads and a rating of 4.8 stars on the Google Play Store, solidifying its position as a top contender among educational mobile applications. Gauth's core functionality is its photo-based homework assistant, supported by minor features like expert tutor and question bank. It also has premium features like writing assistant and literature studies (GauthTech, 2025).

Homework Assistant

Gauth's AI homework assistant requires users to provide a photo of the question or problem as input. It then provides step-by-step solutions and detailed explanations of the solution to the question.

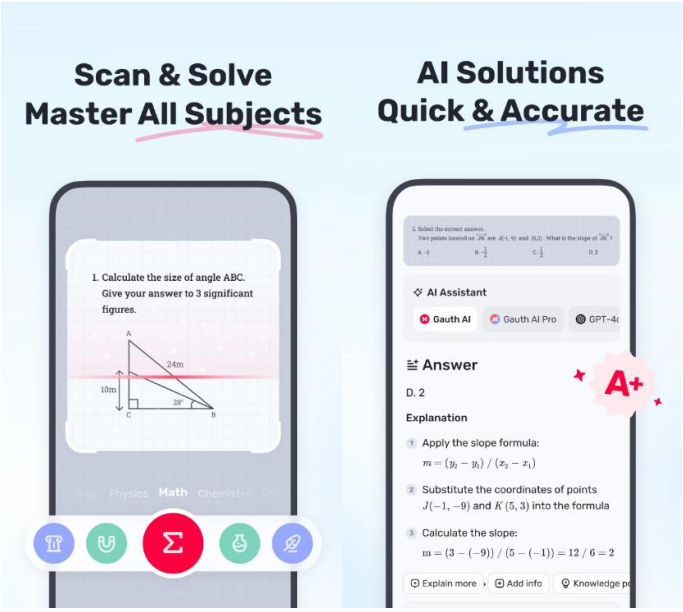

Figure 2.1: Homework assistant feature in Gauth (GauthTech, 2025)

Expert Tutor

If users require additional help or homework assistant is unable to provide a satisfactory answer, they can send the question to live expert tutors. Users can connect with subject experts who provide personalized guidance and clearer explanations on complex topics. Verified experts can earn money for helping users with their questions or problems.

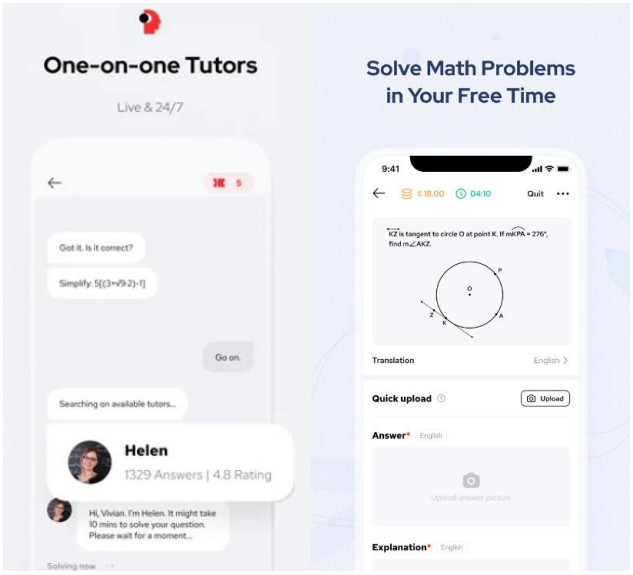

Figure 2.2: Expert tutor feature in Gauth (Dubey, 2025; GauthTech, 2025)

Question Bank

Gauth allows users to manually save questions they have submitted for future reference. This feature enables the user to build a personal collection of important or challenging questions, which they can revisit at any time.

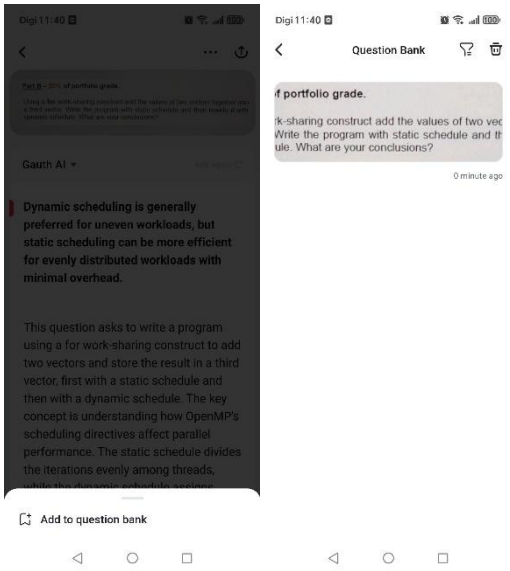

Figure 2.3: Question bank feature in Gauth

Writing Assistant

Gauth offers a writing assistant that helps users with sentence correction, grammar checking, and basic writing improvement. This feature is useful for students working on essays, reports, or other written assignments to improve grammar, vocabulary, and sentence structure.

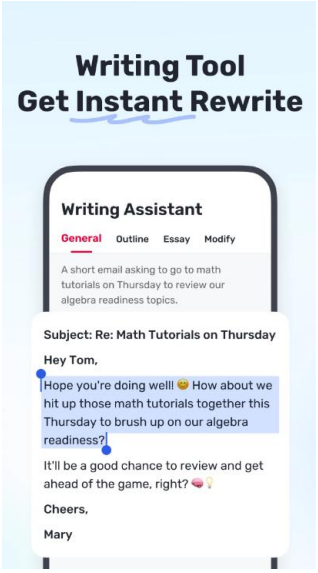

Figure 2.4: Writiing assistant feaeture in Gauth (GauthTech, 2025)

Literature Studies

Gauth provides dedicated support for literature studies, including collections of works from various famous authors. This feature helps users understand complex texts by providing summaries, analysis of themes, quotes, characters, and symbols.

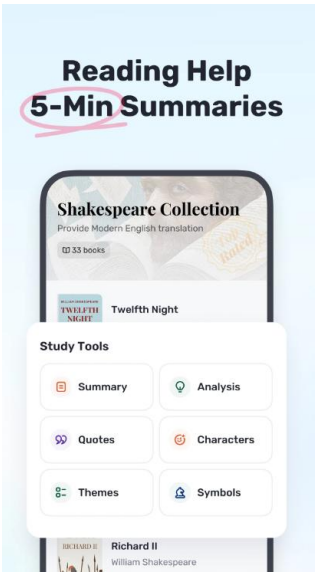

Figure 2.5: Literature studies feature in Gauth (GauthTech, 2025)

2.3.2 Quizlet

Quizlet is an educational application designed to enhance learning and knowledge retention through interactive study tools and gamification. It also stands out as one of the most popular applications on the Google Play Store, with 10 million downloads and 4.7 stars rating. Quizlet has a comprehensive set of interactive learning features like customizable flashcards, study guides, as well as alternative learning modes such as learn, match, test, blast, and blocks (Quizlet Inc., 2025).

Flashcards

Quizlet's primary feature allows users to create and study digital flashcards. Flashcard sets can be created manually by the user or automatically by AI via document scanning, image upload, text, or files. Study guides are automatically created at the same time when users create new flashcard sets. Alternatively, users can access pre-made flashcard sets made by other users on the platform.

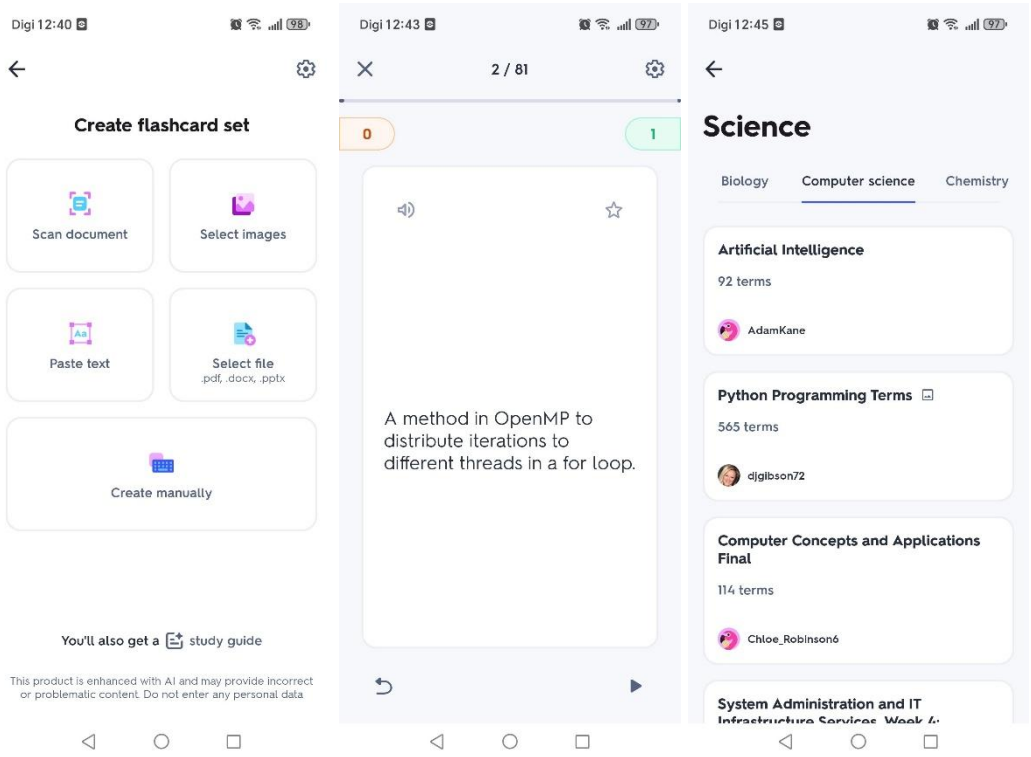

Figure 2.6: Flashcards feature in Quizlet

Study Guides

Quizlet allows users to transform their notes into structured study materials generated by AI, including outlines and quick references. Study guides can be generated from scanned documents, image uploads, text, or files. Flashcards are automatically generated at the same time as study guides are created.

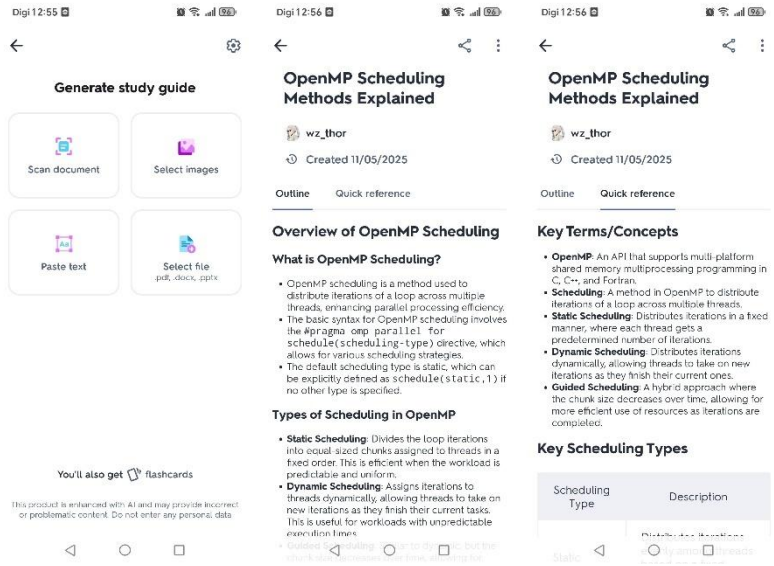

Figure 2.7: Study guides feature in Quizlet

Alternative Learning Modes

Besides flashcards, Quizlet offers a variety of interactive study modes that cater to users' different study styles including:

- **Learn Mode**: Adaptive study mode with different question types like multiple choice questions (MCQ) and written questions that adjusts difficulty based on user performance.
- **Test Mode**: Customizable test generator with various question types like true/false, MCQ, and written questions with scoring and evaluation.
- **Match Mode**: Learning minigame where users match blocks of terms with definitions.
- **Blast Mode**: Learning minigame where users "blast" asteroids containing definitions based on the provided term.
- **Blocks Mode**: Learning minigame similar to Tetris where users have to provide correct answers to questions in order to gain more blocks to complete the game.

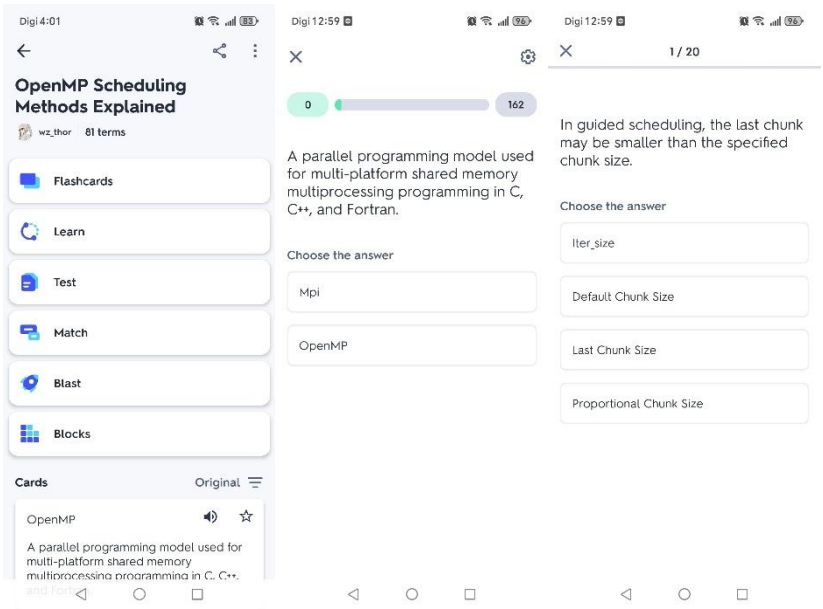

Figure 2.8: Quizlet alternative study mode selection (left); Learn Mode (centre); Test Mode (right)

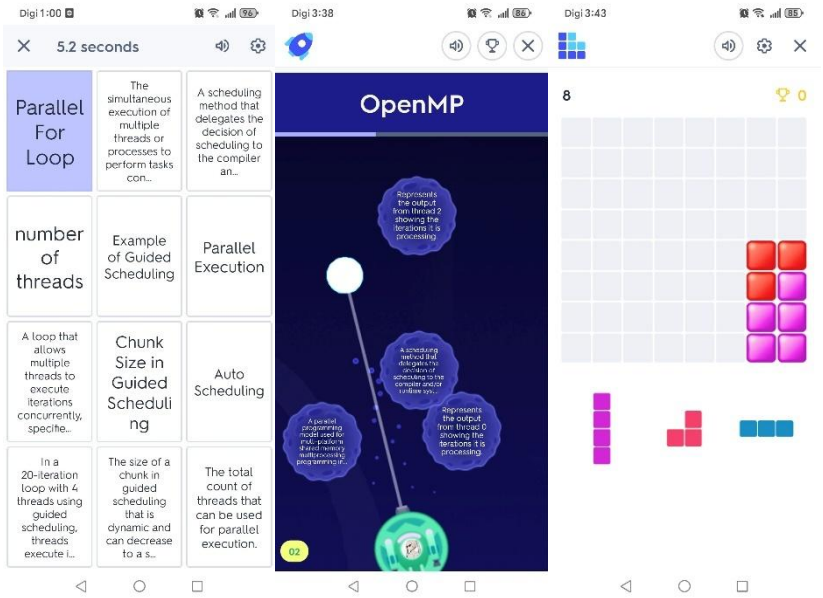

Figure 2.9: Quizlet Match Mode (left); Blast Mode (centre); Block Mode (right)

2.3.3 Feature Comparison

The following table compares the key features between Gauth, Quizlet, and the proposed mobile application, Athena.

Table 2.3: Comparison of key features between Gauth, Quizlet, and Athena

Feature	Gauth	Quizlet	Athena
AI Chatbot			
Academic Question Assistance	User unable to send messages Photo input only	N/A	Two-way communication Text, voice, and photo input
Note Summarization	N/A	N/A but is available as study guides	Available
Multi-Subject Support	Available	N/A but is supported in adaptive review	Available
Emotionally Aware Responses	N/A	N/A	Available
Adaptive Review			
Quiz Generation	N/A	Flashcards and alternative study modes	Flashcards and tests
Spaced Repetition	N/A	Available	Available
Progress Tracking	N/A	Available	Available
Study Guides	N/A	Available	N/A but is available as note summarization in AI chatbot
Study Planner			
Customizable Study Goals	N/A	N/A	Available
Dynamic Schedule Management	N/A	N/A	Available

Emotionally Aware Adjustment	N/A	N/A	Available
Reminders and Notifications	N/A	Available	Available
Additional Features			
Study Material Management	N/A	Able to manage study guides but cannot modify contents	Able to manage notes and modify contents
Study Timer with Focus Modes	N/A	N/A	Available
Study Buddy Matching	N/A	N/A	Available
Progress Badges and Achievements	N/A	Available	Available
User Dashboard	N/A	Limited to streak tracking and navigation only	Visual summary displaying study time, subjects covered, quiz performance, study goals, and more.
Live Tutor	Human experts	N/A	AI chatbot
Writing Assistant	Dedicated writing assistant tool	N/A	AI chatbot as writing assistant
Pre-made Flashcard Sets	N/A	Available	N/A

2.3.4 Analysis

2.3.4(a) Strengths and Weaknesses

Gauth is excellent for instant question assistance and is particularly useful for short, specific questions like math problems. It shines in its simplicity and clarity as the interface focuses entirely on the homework assistant feature, thus reducing clutter and confusion. However, its major disadvantage is that the AI homework assistant is restricted to photo input only. This leads to a lack of convenience and customizability over the question being provided to the AI assistant. Furthermore, the user is not allowed to send follow-up questions to the AI assistant in a conversational interaction, which means the user would need to physically modify the original question and resubmit.

Quizlet has a highly comprehensive adaptive review system suitable for practice and knowledge retention. Its greatest strength is its interactive and gamified study modes including flashcards and alternative modes which accommodate various learning styles. However, its downside is the lack of direct question or homework assistance to support the review system. If a user encounters confusion while reviewing a flashcard set or study guide, they are forced to seek external help, which disrupts the learning process and reduces convenience.

2.3.4(b) Key Differences

Athena aims to be a major upgrade to existing applications like Gauth and Quizlet by offering a complete study companion that combines academic assistance, adaptive review, and study planning, with emphasis on emotional support. Unlike Gauth, Athena supports multimodal input for its academic assistant AI chatbot which supports two-way communication, note summarization, and emotional awareness. Compared to Quizlet, Athena's review system has lesser study modes as it focuses more on practicality instead of gamification. Athena's chatbot can also assist with review while Quizlet does not have such functionality. Additionally, Athena adds unique value by including an intelligent study planner along with additional features like study material management, study buddy matching, and study timer with focus modes. These key differences and added value come together to make Athena an original all-in-one study companion application.

2.4 Impacts

Athena transforms the learning experience of students by replacing traditional study methods with technology-assisted solutions. The following table details the transition from traditional study methods to the positive changes brought by Athena.

Table 2.4: Impacts of Athena in transforming students' learning experience

Aspect	Traditional Method	Transformation
Academic Assistance	Students rely on search engines which often provide conflicting or incomplete information.	Athena provides instant accurate answers via an AI chatbot.
Review and Knowledge Retention	Students create their own review notes and rely on user-created practice questions which may not be useful.	Athena generates quizzes based on user-provided study materials with emphasis on important points.
Study Planning	Students manually perform time management, which may be inflexible and ineffective.	Athena offers an intelligent study planner that dynamically adjusts study plans based on the user's schedule and emotional state.
Note Management	Students manually organize notes or scattered files which are difficult to review.	Athena allows users to upload, organize, and summarize notes, providing convenient access to important information.
Emotional Support	Students cope with academic stress alone with no mental health support. Alternatively, students seek assistance from counsellors which may not always be convenient.	Athena provides emotionally aware AI chatbot that can detect mood in the user's text input and offers support accordingly.
Collaboration	Students manually search for study partners or friends who may not be interested or available for collaboration.	Athena offers study buddy matching which allows users to connect with available peers studying similar topics.
Progress Tracking	Students track their progress manually, often in a mental note. This causes students to potentially miss out on crucial steps in their study progress.	Provides a clear progress dashboard with streaks, achievements, and performance insights.

CHAPTER 3: CLOUD COMPUTING

3.1 Introduction to Cloud Computing in Mobile Applications

Cloud computing is a technology that allows any system or device to utilize computing resources in remote servers over the internet. Unlike traditional applications that rely solely on local resources of a mobile device, mobile applications with cloud integration can access virtually unlimited computing resources for data storage, processing, and service delivery, enhancing both performance and user experience (Terekhov, 2023).

3.2 Benefits of Cloud Computing in Enhancing User Experience

Data Storage and Access

Cloud computing enables mobile applications to store data online in cloud servers, reducing reliance on local device storage and eliminating storage limitations. This is because cloud computing infrastructure typically have virtually unlimited storage capacity across countless servers shared by all users. This minimizes the need for users to manage their device storage to clear up space for data used by mobile applications. Cloud storage also ensures users can access their data anytime and anywhere provided that they have internet connectivity. For example, Google Drive is a cloud storage application that allows users to store large volumes of data on Google's cloud infrastructure (Terekhov, 2023).

Real-Time Data Synchronization

With cloud computing, users' data can be synchronized in real-time through the internet. This ensures that changes made on one device are almost instantly reflected on other devices, offering up-to-date information to users at all times. For instance, WhatsApp uses cloud infrastructure to ensure that chat messages are synchronized across devices, providing a consistent user experience (Singh, 2025).

Scalability

Mobile applications with cloud integration can easily scale their resources to accommodate varying volumes of users without the need for infrastructure or system architecture changes. This is due to the fact that cloud infrastructure typically consists of server farms with countless virtual servers that automatically allocate resources for the hosted application based on demand. This ensures that all users have uninterrupted access to these services with smooth user experience. In contrast, traditional on-premise server infrastructure is prone to lag and performance drops in the event of overwhelming traffic (MoldStud, 2024).

Computational Power

Cloud computing allows mobile applications to perform complex tasks without consuming the computing resources of the user's device. This is because processing tasks can be offloaded to cloud servers behind the scenes, while the mobile application simply serves as a frontend interface for interactivity and displaying results. This is particularly useful for resource-intensive tasks like image recognition, machine learning, complex calculations, and other computationally heavy tasks which could strain mobile device resources. For example, Google Photos uses cloud-based resources to enhance images, organize photo libraries, and perform object recognition (Vadita, 2023).

Security and Backup

Cloud computing services are often built with advanced security features such as data encryption, authentication, and automatic backups. Data encryption transforms user information into an unreadable format, securing it from unauthorized personnel during storage and transmission. Secure authentication mechanisms such as multi-factor authentication (MFA) adds additional layers of security to verify user identity and prevent unauthorized access. In the event of a disaster or security breach, automatic backups enable quick data recovery, ensuring both data availability and reliability (Terekhov, 2023; Oleg, 2025).

3.3 Practical Use of Cloud Computing in Athena

3.3.1 Integration of Cloud Computing in Athena

AI Model Hosting

The AI models used to facilitate features such as Athena's chatbot assistant and adaptive review system will be hosted in a cloud server. This enables Athena to perform computationally complex tasks such as natural language processing and response generation on cloud servers without consuming the user's device resources. All users can benefit from fast and accurate responses from these features even on devices with lower specifications. Therefore, this helps students save cost by eliminating the need to purchase new devices with improved hardware just to use Athena.

Data Storage and Access

Athena will securely store all user data such as chatbot conversations, notes, review sets, study plans, and study progress in cloud servers. A cloud database will be used to store structured or unstructured data with querying capabilities, while cloud storage will be utilized to store raw files like images and documents. This approach ensures that user data is safely stored without occupying the user's local device storage. Furthermore, data stored on the cloud can be accessed remotely, which allows students to conduct study sessions anytime and anywhere based on their schedule and preferred study environment.

Real-Time Data Synchronization

Athena will utilize cloud computing to ensure all user data is automatically synchronized across the user's devices. Users can begin a study session on one device and continue on another device without disruption as any change in data is instantly updated on the cloud. This eliminates the need for manual transfer of data and ensures an efficient study experience.

Security and Backup

Athena will secure the confidentiality, integrity, and availability of user data through cloud-based security mechanisms. All user data such as profiles, chatbot conversations, or notes will be encrypted in transit and at rest. Regular backups will also be scheduled and performed to guarantee data recovery in the event of infrastructure damage or system failure. Additionally, users can enable MFA to add an extra layer of security and prevent unauthorized access to their accounts.

3.3.2 Cloud-Integrated System Architecture

The cloud-integrated system architecture of Athena would consist of the client-side Frontend layer as well as the Backend and Data Storage layers hosted in the cloud. The **Frontend** consists of the mobile application which acts as the interface that users interact with to use the system features. The **Backend** consists of an Application Programming Interface (API) that contains code and AI models used to run key features. It completes processes requested by the client and returns the output to the user. The **Data Storage** comprises a storage platform and database server. The storage platform stores raw files such as images and documents uploaded by users for academic assistance, note management, and more. The database server stores structured and/or unstructured user data supported with querying capabilities for data retrieval and manipulation.

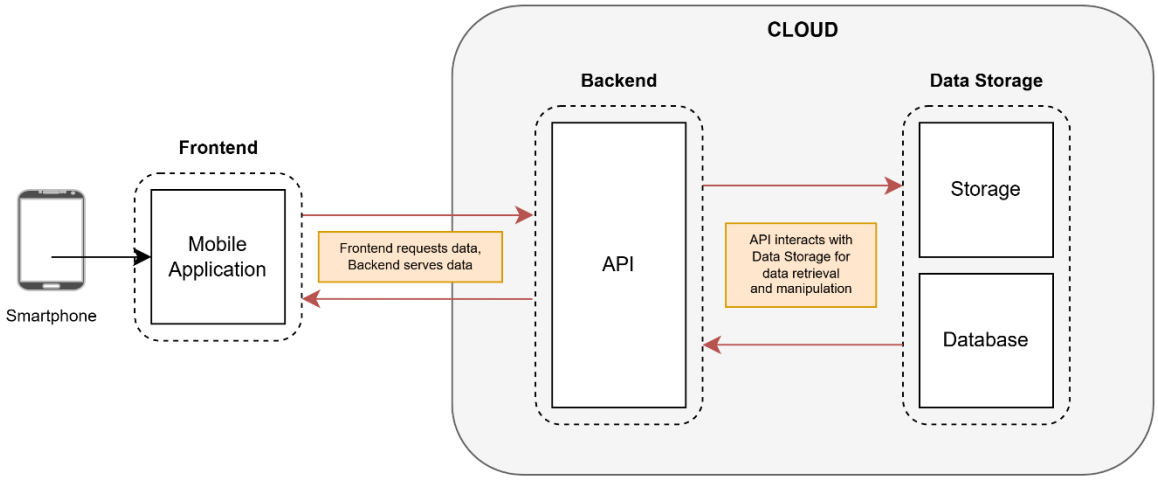

Figure 3.1: Cloud-integrated system architecture of Athena

CHAPTER 4: EMERGING TECHNOLOGIES

4.1 Introduction to AI in Mobile Applications

AI in mobile applications utilize advanced algorithms and techniques that enable applications to autonomously perform tasks without direct human intervention. There is a plethora of uses cases of AI in mobile applications, such as understanding natural language, image recognition, predictions, recommendation systems, and more (Wangoo, 2025). Generally, AI technology enhances user experience by allowing applications to provide intelligent assistance, automate routine tasks, interact with users based on pre-established context, and adapt to individual user preferences for personalized experiences (Jha, 2024). As AI technology continues to rapidly evolve and become more accessible, AI features will become increasingly sought after in mobile applications to enhance system functionality and user satisfaction.

4.2 Benefits of AI in Enhancing User Experience

Personalization & Recommendation

AI enhances user experience in mobile applications by facilitating personalized content delivery and interactivity. AI has the ability to analyse user behaviour and past interactions to deliver content or recommendations tailored to the user's preferences. This personalized experience increases user engagement and satisfaction as users are more likely to interact with content that matches their interests. For example, Netflix's recommendation system uses AI algorithms to suggest movies or shows based on a user's viewing history and search behaviour to ensure that users receive content that aligns with their preferences (Apostoliadis, 2025).

Intelligent User Assistance

AI chatbots can enhance user experience by providing instant support without human intervention. These intelligent chatbots can independently assist users by answering queries, resolving common issue, and escalating unfamiliar or complex problems to human agents when necessary. This improves response times while also allowing human agents to focus on more important tasks (Apostoliadis, 2025; Wangoo, 2025). A notable real-world example of this is H&M's AI chatbot for customer support which supports product inquiries, order tracking, and styling advice. The use of this chatbot significantly increased customer satisfaction by 35% and reduced operational costs by 20% (Shetty, 2024).

Enhanced Accessibility

Accessibility in mobile applications can be enhanced by AI through features like voice recognition, image recognition, and text-to-speech (TTS) capabilities, making applications more inclusive for a wide range of users, including those with disabilities (Apostoliadis, 2025). For instance, Google Assistant uses AI voice recognition to detect voice commands from the user to assist with tasks like phone calls, texting, queries, scheduling, and more. Additionally, there are applications specifically designed to assist disabled people, such as Be My Eyes which uses AI image recognition to describe objects and surroundings for visually impaired users (Be My Eyes, 2023). These AI-enabled accessibility features allow mobile applications to be more user-friendly and adaptable to varying needs of users.

Enhanced Security

AI is widely applied in mobile cybersecurity to enhance the security of applications through threat detection, management, and response (Goodman, 2025). A good example of AI-driven security is real-time fraud detection and prevention in mobile banking applications. By continuously monitoring user behaviour and transaction patterns, AI algorithms can identify anomalies that indicate fraudulent activities, thus enhancing security for customers (Sapra, 2024). In addition, Google's Messages application utilizes AI to detect scam texts by monitoring Short Message Service (SMS), Multimedia Message Service (MMS), and Rich Communication Service (RCS) messages for suspicious patterns, while also providing real-time warnings to users (Weatherbed, 2025). These AI-powered security measures help protect users from various threats, thus building trust in the application's reliability and enhancing overall user experience.

4.3 Practical Use of AI in Existing Applications

4.3.1 Introduction to Duolingo

One of the most well-developed educational mobile applications that effectively apply AI is **Duolingo**. With over 500 million downloads an a rating of 4.7 stars, Duolingo is the most popular language-learning application available on the Google Play Store worldwide (Duolingo, 2025). Duolingo utilizes AI to provide personalized, adaptive learning experiences for users, making it a leading example of how AI can be used to enhance mobile application functionality and user experience.

4.3.2 Integration of AI in Duolingo

Adaptive Learning System

Duolingo uses their own proprietary AI system called Birdbrain, which is used to create personalized learning experiences for each user (Wallingford, 2024). Through analysis of user performance data such as accuracy and time spent on exercises, Birdbrain is able to identify the user's strengths and weaknesses. Furthermore, the difficulty may increase if the user is consistently getting the answers correct in an exercise. This approach allows Birdbrain to adjust difficulty of lessons and modify lesson content dynamically to ensure that users can focus on specific areas of improvement (Wodzak, 2023).

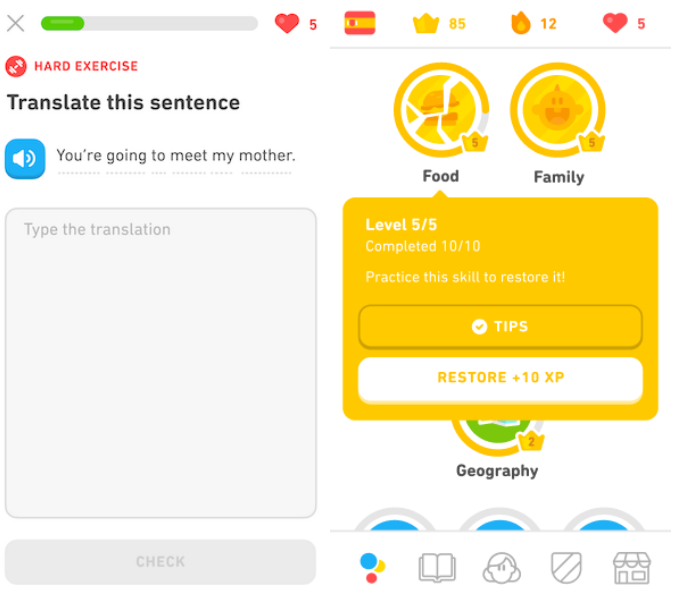

Figure 4.1: Adaptive learning system in Duolingo (Walsh, Lownes and Blanco, 2020)

Speech Recognition

To assist users in improving pronunciation, Duolingo incorporates AI speech recognition technology in learning features. During speaking exercises, the speech recognition system analyses the user's speech in real-time and the application provides immediate feedback based on pronunciation accuracy (Wallingford, 2025). This feature not only aids users in pronunciation but also indirectly enhances the accessibility of the application for users with varying learning preferences or disabilities.

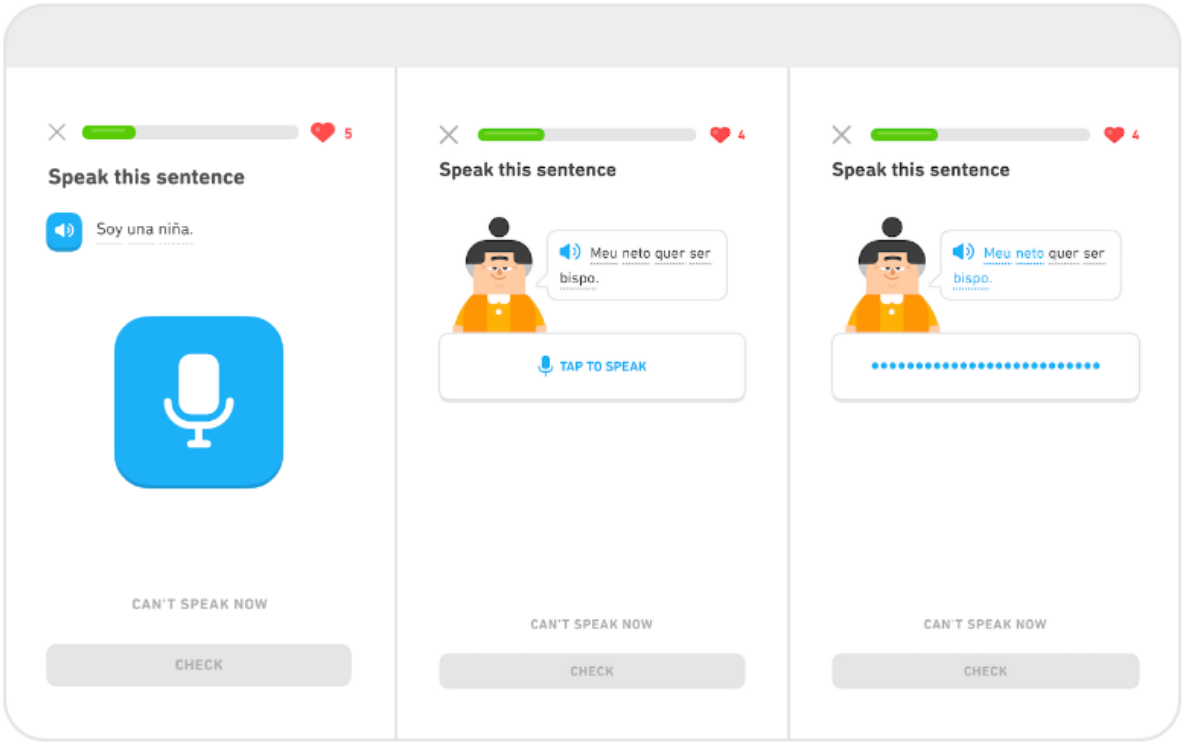

Figure 4.2: Speaking exercise with speech recognition in Duolingo (Moline and Blanco, 2020)

Verbal Conversation Chatbot

Duolingo comes with an interactive verbal chatbot character named Lily, designed to facilitate language learning through natural conversational practice in the form of video calls. Lily is powered by LLMs that generate context-aware dialogue, allowing users to practice real-world conversations while receiving immediate feedback including corrections, explanations, and encouragement. The LLMs behind Lily are guided by structured prompts that are used generate Lily's responses while maintaining their personality. This helps users learn from their mistakes and improve their language skills in more engaging and immersive practice sessions (Duolingo Team, 2024; Henry, 2025).

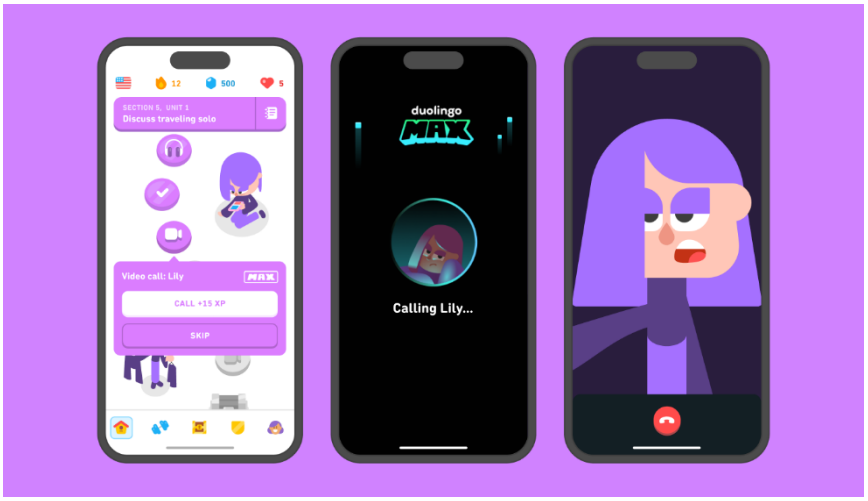

Figure 4.3: Video call feature in Duolingo Max (Duolingo Team, 2024)

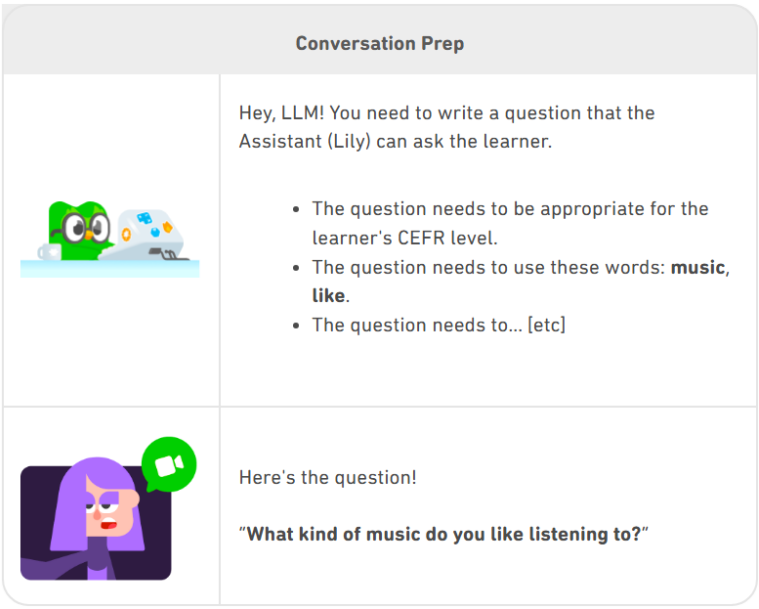

Figure 4.4: Example of prompt used to generate conversation starter (Henry, 2025)

Roleplay Chatbot

Similar to Lily, Duolingo also provides a Roleplay feature which allows users to engage in simulated conversations with AI chatbots. However, the key difference is the Roleplay feature only supports text-based conversations. Roleplay interactions are designed to simulate real-life scenarios to provide users with practical language practice. This feature is powered by the GPT-4 LLM which dynamically generates responses based on the user's input for personalized experiences. In each interaction, the LLM provides feedback to help users improve their conversational skills (Duolingo Team, 2023).

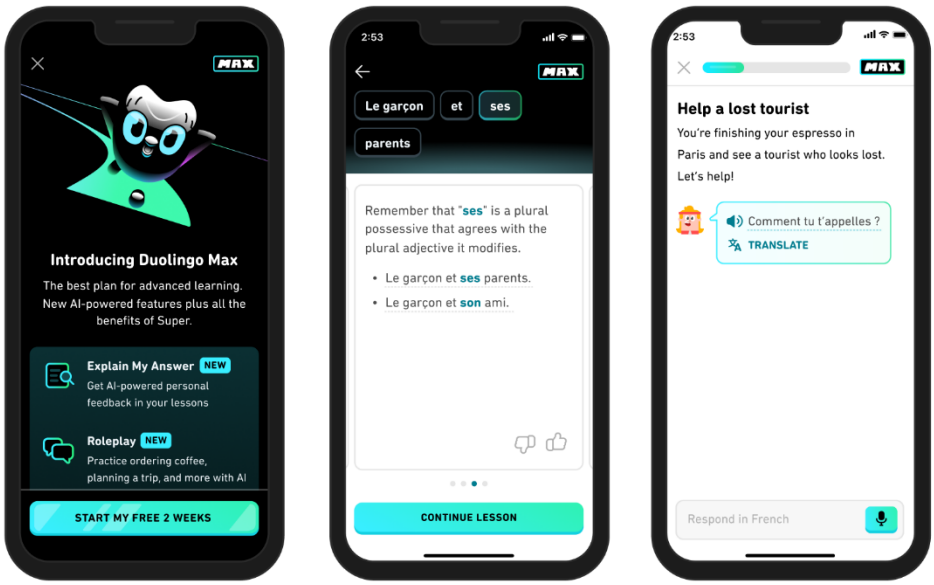

Figure 4.5: Roleplay feature in Duolingo Max (Duolingo Team, 2023)

Lesson Content Generation

Duolingo also uses LLMs to automatically generate lesson content, saving time and resources. These LLMs are capable of producing a variety of language exercises such as vocabulary practice, grammar explanations, and sentence construction tasks. They are guided by prompts carefully designed by Duolingo's curriculum experts to ensure generated content aligns with specific learning objectives and high educational standards (Henry, 2024). This method allows Duolingo to easily expand its course offerings by introducing new languages and course contents with minimal manual effort. Users can benefit from an ever-growing collection of courses and lessons with fresh and diverse contents.

```
Write an exercise that uses the word VISITAR in SPANISH.

Rules:
1. The exercise must have two answer options.
2. The exercise must be fewer than 75 characters.
3. The exercise must be written in A2 CEFR level SPANISH.
4. The exercise must contain THE PRETERITE TENSE and THE IMPERFECT TENSE.

Go!
```

Figure 4.6: Example of prompt used to generate lesson contents in Duolingo (Henry, 2024)

CHAPTER 5: CONCLUSION

In conclusion, this proposal details the features and functionality of Athena, an innovative AI study companion mobile application. Athena offers a comprehensive all-in-one solution combining an academic assistant chatbot, adaptive review system, intelligent study planner and additional features that make it outperform existing educational applications like Gauth and Quizlet. Through cloud computing, Athena can benefit from remote data access, smooth data synchronization, secure storage, and scalable performance, thus enhancing user experience. Furthermore, the integration of AI powers empowers Athena's key features to provide a personalized and engaging learning experience for all users. The case study on Duolingo has also demonstrated how AI can transform educational mobile applications to improve the study experience for users, providing valuable insights that can be used to support Athena's development. Overall, this proposal highlights the potential of Athena in revolutionizing the way students plan, study, and achieve their academic goals.

REFERENCES

Apostoliadis, A. (2025) *How AI Reshapes UX: A Design Expert Sheds Light on Benefits and Success Strategies*, *Toptal*. Available at: https://www.toptal.com/designers/ux/ai-user-experience (Accessed: 11 May 2025).

Be My Eyes (2023) *Introducing: Be My AI*, *Be My Eyes*. Available at: https://www.bemyeyes.com/blog/introducing-be-my-ai/ (Accessed: 11 May 2025).

CASEL (2025) *What Does the Research Say?*, *CASEL*. Available at: https://casel.org/fundamentals-of-sel/what-does-the-research-say/ (Accessed: 7 May 2025).

Donald, B. (2016) *Stanford researchers find students have trouble judging the credibility of information online*, *Stanford*. Available at: https://ed.stanford.edu/news/stanford-researchers-find-students-have-trouble-judging-credibility-information-online (Accessed: 7 May 2025).

Dubey, A. (2025) *Gauth AI Homework Helper Review (Formerly Gauthmath)*, *Mobile App Daily*. Available at: https://www.mobileappdaily.com/product-review/gauthmath-math-problem-solver (Accessed: 8 May 2025).

Duolingo (2025) *Duolingo: Language Lessons*, *Google Play*. Available at: https://play.google.com/store/apps/details?id=com.duolingo&hl=en (Accessed: 12 May 2025).

Duolingo Team (2023) *Introducing Duolingo Max, a learning experience powered by GPT-4*, *Duolingo*. Available at: https://blog.duolingo.com/duolingo-max/ (Accessed: 12 May 2025).

Duolingo Team (2024) *Video Call lets you have real life conversations with Lily*, *Duolingo*. Available at: https://blog.duolingo.com/video-call/ (Accessed: 12 May 2025).

Fatzunnahar, A.S.B. (2023) *A Youth Issue in Malaysia: Academic Stress and Career-Building Pressure, A Strain on Mental Health*, *Malaysiakini*. Available at: https://www.malaysiakini.com/announcement/670111 (Accessed: 7 May 2025).

GauthTech (2025) *Gauth: AI Study Companion*, *Google Play*. Available at: https://play.google.com/store/apps/details?id=com.education.android.h.intelligence&hl=en (Accessed: 8 May 2025).

Goodman, C. (2025) *AI in Cybersecurity: Transforming Threat Detection and Prevention*, *Balbix*. Available at: https://www.balbix.com/insights/artificial-intelligence-in-cybersecurity/ (Accessed: 11 May 2025).

Gupta, D. (2024) *Ebbinghaus's Forgetting Curve: How to Overcome It*, *Whatfix*. Available at: https://whatfix.com/blog/ebbinghaus-forgetting-curve/ (Accessed: 7 May 2025).

Henry, P. (2024) *How Duolingo uses AI to create lessons faster*, *Duolingo*. Available at: https://blog.duolingo.com/large-language-model-duolingo-lessons/ (Accessed: 12 May 2025).

Henry, P. (2025) *Get to know the AI behind every Video Call with Lily*, *Duolingo*. Available at: https://blog.duolingo.com/ai-and-video-call/ (Accessed: 12 May 2025).

Jha, A. (2024) *Using AI to Design Better Mobile-App User Experiences*, *UXmatters*. Available at: https://www.uxmatters.com/mt/archives/2024/07/using-ai-to-design-better-mobile-app-user-experiences.php (Accessed: 11 May 2025).

Kahoot (2024) *Kahoot Students Survey Results*, *Kahoot*. Available at: https://kahoot.com/kahoot-study-survey/ (Accessed: 7 May 2025).

Moline, A. and Blanco, C. (2020) *Covering all the bases: Duolingo's approach to speaking skills*, *Duolingo*. Available at: https://blog.duolingo.com/covering-all-the-bases-duolingos-approach-to-speaking-skills/ (Accessed: 12 May 2025).

Oleg (2025) *Mobile cloud computing: the future of app development?*, *Touchlane*. Available at: https://touchlane.com/mobile-cloud-computing-the-future-of-app-development/ (Accessed: 10 May 2025).

Perez-Jorge, D. *et al.* (2025) 'Examining the effects of academic stress on student well-being in higher education', *Nature*, 12, 449. Available at: https://doi.org/10.1057/s41599-025-04698-y.

Quizlet Inc. (2025) *Quizlet: Study with Flashcards*, *Google Play*. Available at: https://play.google.com/store/apps/details?id=com.quizlet.quizletandroid&hl=en (Accessed: 8 May 2025).

Richardson, B. (2025) *Time Management Statistics: Original Independent Research*, *Acuity Training*. Available at: https://www.acuitytraining.co.uk/news-tips/time-management-statistics-research/ (Accessed: 7 May 2025).

Sapra, Y. (2024) *AI in Mobile Banking: From Chatbots to Fraud Protection - The Power of Smart Banking*, *HashStudioz*. Available at: https://www.hashstudioz.com/blog/ai-in-mobile-banking-from-chatbots-to-fraud-protection-the-power-of-smart-banking/ (Accessed: 11 May 2025).

Shetty, S. (2024) *The Digital CX Revolution: Leveraging AI and Emerging Technologies to Enhance Customer Engagement*, *CXPA*. Available at: https://www.cxpa.org/blogs/sahil-shetty/2024/11/09/the-digital-cx-revolution-leveraging-ai (Accessed: 11 May 2025).

Singh, V. (2025) *The Role of Cloud Integration in Mobile Apps*, *Brilworks*. Available at: https://www.brilworks.com/blog/cloud-integration-in-mobile-apps/ (Accessed: 10 May 2025).

Taylor, R.D. *et al.* (2017) 'Promoting Positive Youth Development Through School-Based Social and Emotional Learning Interventions: A Meta-Analysis of Follow-Up Effects', *Child Development*, 88(4), pp. 1156–1171. Available at: https://doi.org/10.1111/cdev.12864.

Terekhov, V. (2023) *Cloud Computing: The Backbone of Modern Mobile App Development*, *Attract Group*. Available at: https://attractgroup.com/blog/cloud-computing-in-mobile-app-development/ (Accessed: 10 May 2025).

Vadita (2023) *Power of Cloud Computing in Mobile Apps*, *Talent500*. Available at: https://talent500.com/blog/power-of-cloud-computing-in-mobile-apps/ (Accessed: 10 May 2025).

Verbanas, P. (2022) *How College Students Perceive Academic Stress Affects Their Mental Well-Being*, *Rutgers*. Available at: https://www.rutgers.edu/news/how-college-students-perceive-academic-stress-affects-their-mental-well-being (Accessed: 7 May 2025).

Wallingford, P. (2024) *How Duolingo Use Ai: Making Language Learning Smarter*, *DuolingoGuides*. Available at: https://duolingoguides.com/how-duolingo-use-ai/ (Accessed: 12 May 2025).

Wallingford, P. (2025) *Why Is Duolingo Not Recognizing My Answers? Fix It Now*, *DuolingoGuides*. Available at: https://duolingoguides.com/why-is-duolingo-not-recognizing-my-answers/ (Accessed: 12 May 2025).

Walsh, C., Lownes, C. and Blanco, C. (2020) *Keeping You at The Frontier of Learning with Adaptive Lessons*, *Duolingo*. Available at: https://blog.duolingo.com/keeping-you-at-the-frontier-of-learning-with-adaptive-lessons/ (Accessed: 12 May 2025).

Wang, S. *et al.* (2024) 'Large Language Models for Education: A Survey and Outlook', *Computation and Language* [Preprint]. Available at: https://doi.org/10.48550/arXiv.2403.18105.

Wangoo, R. (2025) *Artificial Intelligence in Mobile Apps: Benefits, Use Cases, and Scope for 2025 and Beyond*, *Apptunix*. Available at: https://www.apptunix.com/blog/artificial-intelligence-in-mobile-apps-benefits-use-cases-and-scope-for-2024-and-beyond/ (Accessed: 11 May 2025).

Weatherbed, J. (2025) *Google Messages is using AI to detect scam texts*, *The Verge*. Available at: https://www.theverge.com/news/623632/google-messages-pixel-android-updates-scam-detection (Accessed: 11 May 2025).

Wodzak, S. (2023) *3 ways Duolingo improves education using AI*, *Duolingo*. Available at: https://blog.duolingo.com/ai-improves-education/ (Accessed: 12 May 2025).

Wong, S.S. *et al.* (2023) 'Depression, anxiety, and stress among university students in Selangor, Malaysia during COVID-19 pandemics and their associated factors', *Public Library of Science*, 18(1). Available at: https://doi.org/10.1371/journal.pone.0280680.

APPENDICES

Appendix A: Turnitin Similarity Report