

**EDUCATION MANAGEMENT SYSTEM
POWERED BY OPEN AI**

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UNIVERSITI TUNKU ABDUL RAHMAN

**EDUCATION MANAGEMENT SYSTEM
POWERED BY OPEN AI**

TANG WEI CHERNG


**A project report submitted in partial fulfilment of the
requirements for the award of BACHELOR OF SCIENCE (HONOURS)
SOFTWARE ENGINEERING**

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October 2024

DECLARATION

I hereby declare that this project report is based on my original work except for citations and quotations which have been duly acknowledged. I also declare that it has not been previously and concurrently submitted for any other degree or award at UTAR or other institutions.

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ABSTRACT

In the current evolving landscape of education around the world, the need of an effective management and communication platform are increasing in demand for improving the learning experience for both educators and students mutually. This project aimed to develop a comprehensive MERN stack web application that provides a communication hub, classroom management and most importantly AI powered performance analytics for both students and educators. Some of the key feature includes performance analytics report and personalized journey learning plan generation paired with classroom management tools such as messaging, QnA. Besides that, the development methodology chosen for this project is incremental model, each module is iterated based on the previous cycle of design, development and testing. As mentioned above, this project is built with MERN stack which is MongoDB, Express, React and Nodejs which foster a clean architecture where it treat codes as a modular components that are dynamic. For the deployment of the system, the backend services were deployed using render and the front end is deployed using Netlify. The system was tested using a combination of automated unit testing, usability testing, and user acceptance testing (UAT) to validate the system functionalities and ensure it aligns with the requirements provided in the documentation. After the test, feedback from educators and students shows that there are some limitations and there is a need for more advanced student management tools and this paved the road for future enhancements for this project. In the end, the system successfully met the project objectives, offering a platform for educational management, encouraging a more engaging and organized learning environment with AI featured analytic modules.

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LIST OF SYMBOLS / ABBREVIATIONS

AI	Artificial Intelligence
LMS	Learning Management System
MERN	MongoDB, ExpressJS, React, NodeJS
UAT	User Acceptance Test

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CHAPTER 1

INTRODUCTION

1.1 Introduction

Education is the foundational progress of empowering individuals and driving them into changing the world into a better place. Without education, the current world would not exist as the wonderful place as it is today. It helps individual to equip themselves with knowledge, skill, and critical thinking to tackle complex challenges such as finding solution for cancer and global warming. Educators act as the bridge which they invite their students to cross. They innovate them and help build a base for a more environment to learn. The right to have education is not a privilege but a fundamental right where every person around the world deserves the access to regardless the background.

Education is in the progress of undergoing a significant transformation. In this modernized area where technology is no longer a simple tool in the classroom, technology is being a catalyst for a more dynamic and personalize learning experience for all the students. Education system need to adapt to keep pace with the evolving need for all users in the classroom which are educators and students. Traditional methods often rely on paper-based system and management. In this situation, it limits the communication while struggling to provide collaboration among students.

Therefore, an education management system is the solution which it help to streamline administrative and management tasks. By utilizing the powerful Artificial Intelligence of Open AI, data gathered in the system can be used to help further provide better insight into the students learning progress and ultimately helping educators providing better education to them. This first chapter will contain the project introduction, problem background, problem statement, project objectives, proposed solution, and proposed approach. The final deliverable for this proposed project will be a web-based education management system that aims to create a more efficient, data-driven, and collaborative learning environment powered by Open AI.

1.2 Problem Background

Education can be regarded as one of the most important aspects for a person to excel in their life and every human being has a right to receive the proper education. Unfortunately, the evolving educational landscape demands innovative solutions to help increase effectiveness and personalize student learning. Traditional methods lack data on student's learning progress within the learning environment which causes educators to implement a one-size-fits-all approach, forcing students into a single learning style. This is a major reason why many students find it boring and uninteresting which may hinder the educators the ability to tailor personalized learning for them (21K School, 2023).

With the help of the modern digitalization, most of the education system has been migrated online where students and educators are able to perform the daily usual activities that they would perform during physical class. Even though with the presence of these modern tools, it often lacks tools that encourage synergic learning and collaboration between students and educators.

The large amount of data generated within the learning environment and education institutions remains largely untapped. Traditional method struggles to analyse and interpret the untapped data, making it very difficult to identify the at-risk students. If the at-risk students are identified, educators can take actions and tailor specific instructions and changes to the course which can greatly help those individuals who need this attention. Limited communication between educators and students will create a blind spot in the learning progress which can severely hinder the ability to intervene early when an issue is spotted and provide the necessary support.

These mentioned challenges are interconnected. The lack of collaboration hinders student engagement, complex interfaces create a learning curve to less technical users and making it challenging to implement personalized feedback and lastly limited communication creates a gap between student's needs.

1.3 Problem Statements

1.3.1 Lacks robust functionalities to promote collaborative learning experiences.

The current educational landscape prioritizes individual learning over collaboration activities in the classroom. Traditional classroom tends to structure around teacher instruction, with limited opportunities for students to work together, share their idea and learning from one another (Singh, 2023). With limited collaboration opportunities, student are not able to develop important critical life skills such as teamwork, communication, leadership, and problem solving abilities where all these skills are important and essential to learn in the early stage of education. These skills are crucial to have in the working industry and is the key elements to determine one person success.

1.3.2 Limited Feedback and Individualized Support.

The lack of collaborative experiences is further extended by the limitations in providing personalized feedback and individualized support. Traditional methods of assessment often rely on simple standardized test and assignment which in this case does not accurately capture the student real true understanding or areas of difficulty (Möller, 2015). Without a clear understanding of each individual student needs, it will become a challenging task to provide personalize instruction and give targeted feedback to student and support collaborative learning activities. Besides that, traditional methos is not leveraging educational data effectively which leads to a lack of personalization in learning experiences. The one-size-fits-all approach fails to cater to diverse learners, potentially hindering student engagement and hindering their ability to reach their full potential.

1.3.3 Difficulty in identifying at-risk students.

The amount of data generated within educational institutions are countless and are great for creating opportunities and overcoming challenges in the learning

environment. Traditional systems often struggle to effectively collect, analyze, and interpret this data. Traditional method where educators have limited data of all students across different class has difficulty in identifying at risk students (Shah, 2021). Educators are left searching through a sea of information without the tools to extract meaningful insights. This makes it difficult to identify trends, understand individual student needs, and personalize instruction accordingly. Educators often rely on manual methods to track student progress and identify those who may be falling behind. For example, a student may have a bad score on a standardized test. In this case, this method can be time consuming and may not always provide a comprehensive analysis of the student understand and most importantly it's too late to identify them using the traditional method. Without a better method, it become challenging to help them in the early stage.

1.4 Project Objectives

- 1.4.1 To examine collaborative learning approaches and review similar applications.
- 1.4.2 To develop an education management system which serves as a centralized communication hub and integrated with functionalities.
- 1.4.3 To implement AI-powered analytics for personalized learning.
- 1.4.4 To conduct evaluation on the developed system using unit testing, usability testing and user acceptance test (UAT).

1.5 Proposed Solution

The proposed solution of the problem mentioned previously is the creation of a responsive web-based education management system. The responsive web-based education management system is built for both educators and students. The application will be built with a dedicated front end and back-end service. The application will be built using the MERN stack technology where more details of the MERN can be found below:

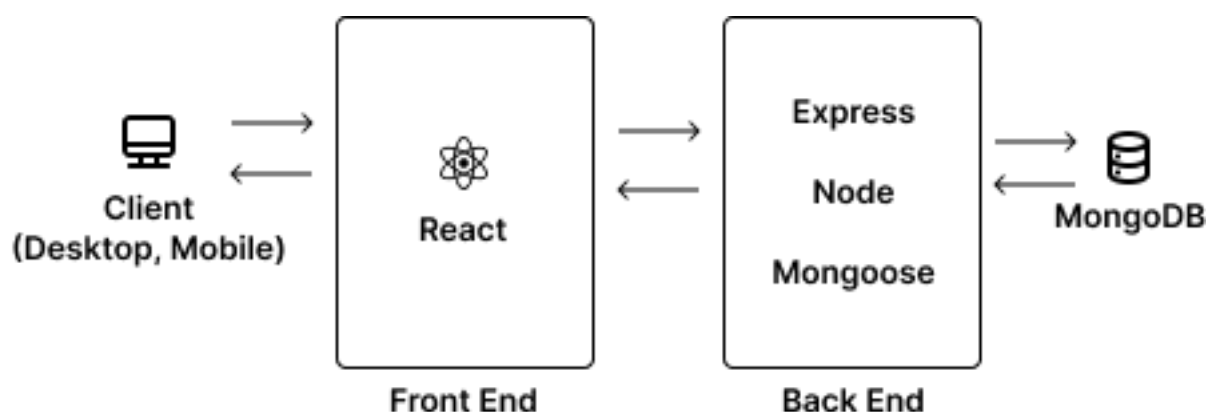


Figure 1.1: MERN stack architectureFigure

The figure above shows the architecture of the MERN stack which consist of MongoDB, Express, React and Node. The MERN stack has been very popular and widely adopted for developing interactive web-based applications. Projects like Coursera uses the MERN stack to create user-friendly platforms and it utilizes the MERN stack to build a user-friendly interface, ensuring a positive user experience for both educators and students. Therefore, the proposed solution will be using this exact architecture and how the client will be interacting with the application. The MERN stack can be divided into separate Front End and Back End. The front end will consist of React which is a popular JavaScript library which can build dynamic and interactive user interface. The back end will be built with Express, Node and MongoDB, this technology will be interacting harmoniously and interacting with the Front End via the Http calls.

1.6 Proposed Approach

1.6.1 Research Approach

Developing an educational platform required a deep understanding of the needs and challenges faced by the educators and student within the learning environment. This project has adopted the Quantitative approaches which to gain a more in-depth insight to better understand the overall process.

The purpose of the quantitative research is to gather and evaluate the numerical data and it is very useful for determining trends and averages, formulating hypotheses, examining causality, and extrapolating findings to larger populations. (Bhandari, 2023). Some of the examples of the quantitative research is survey which has been used in this project.

A well-structured and designed survey will be conducted to gather quantitative data for the project on the target user group needs and their experiences with the current education system that they may have or may have not interact with.

A survey is good for collecting quantitative data because they allow the project to focus on clear and manageable questions that can received the corresponding answers quickly. Survey Method also allows to the data collected for the project to analyse multiple variables at once. (Evaluating Efficacy of Survey Research as a Quantitative Research Method, 2022). The survey will be distributed electronically to a sample target user which are educators and students within the educational setting.

The survey will be structured to have multiple choice and open-ended questions that are related to current experiences with educational technology, perceptions of ideal functionalities and the technical preference. After gathering the data through the survey given by the target user, these data can further be analysed. These analyse data will be great valuable insight for the project as it will help prioritize functionalities and cater to diverse needs of all users.

1.6.2 Development Approach

The development approach for this project will follow the incremental model of the software development lifecycle (SDLC). For the incremental model, the process will be divided into small, manageable modules known as increments. Each increment is built upon the one before it, allowing for further incremental improvements. This development methodology ensures that developers can make changes at an early stage instead of waiting until the very end, when the money has been spent and the time has run out. (Martin, 2023). The incremental approach can allow early deliverable of usable functionality which in this situation allow the early validations and provide feedback. This can help decisions being made throughout the development process. Changes can be made early which can avoid critical issue occur in the late stage. The incremental development ensures incremental value delivery while having the flexibility and adaptation being made to suit the target users' needs and priorities.

1.7 Scope of Project

1.7.1 Target Users

The targeted users for the education management system can be split into 2 groups. The first group of targeted users are educators, and the next group is the students. Both target users are equally important as both users will interact with each other harmonically through the application. Either one group of users will be obsolete if the other is absence. Therefore, the education management system is required to have both group of users to exist to work as intended. The following are the description of the target users.

1.7.1.1 Educators

An educator in the education management system can be regarded as the admin and person who provides instruction or education to the students. Another similar terms that can be applied to the educators are admin, teachers. Educators are provided with the necessary tools for them to become more effective in

providing education for the students. Some of the tools include performance analytics modules that provide real-time insight to students' progress that is powered with Open AI. With these tools, educators can gather more data and act upon it to achieve synergic learning in the learning environment.

1.7.1.2 Students

A student is the normal users in the education management system. Student is provided with a centralized and interactive learning hub where they can use it as an extension of their learning. Students can access to announcement, QnA, learning materials with their peers. Personalized feedback by the educators is provided by the educators through the application so the student can focus on the area they are having difficulty with. This fosters a more self-directed and engaging learning experience. It also promotes collaboration through the forums and achieve synergic learning in the classroom.

1.7.2 System Scope

The education management system is a web based responsive application. The responsive design allows the web application to be displayed in various devices with different type of resolution. In this case, it allows users to access the application in their mobile, iPad or even desktop devices. The application will be in English only. By focusing on the target user, this application aims to create a learning ecosystem that allows all users to engage with each other to achieve synergic learning. The module of the system scope can be listed as the following:

1.7.2.1 Scope of Performance Analytics Module

The performance analytics module provides educators with a dashboard that has the data necessary to track all student progress throughout the learning activities. They can generate reports with summary and visualizations to identify key trends and areas in students that require additional focus and action. The integration of AI with Open AI helps this module to unlock the potential of creating personalized recommendations which can help educators to tailor

students custom need and giving them the much-needed feedback and comments.

1.7.2.2 Scope of Content Sharing Module

The content sharing module will create a secure and centralized hub for all users to share diverse learning materials and information. This could include announcement board, QnA where the users can share their intended content on. Content such as pdf, images and other resources can be shared and accessed to all users in their own respected classroom.

1.7.2.3 Scope of Collaboration Module

The collaboration nodule acts as a central hub for seamless communication within the learning environment. Educators and students have tools to interact with each other where they can message within the classroom. This can help foster the relationship and collaboration with student, this two-way communication help both users to stay informed and address any challenges as soon as possible and achieve a more supportive learning environment.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

In the recent years, the use of advanced technologies specifically artificial intelligence (AI) has transformed our world in different way. One of the sectors that the AI has made its presence is in the education field. To deeply understand how the education field has transformed to its current state, an in-depth analysis of existing literature will be conducted. This review will delve into the current state of education management system used in both internationally/worldwide and in Malaysia. By finding the diverse arrays of studies, research paper, online articles and many more, the review aim to inform the practically of implementing AI in the education management system. Ultimately this exploration hopes to understand how transformative potential of AI in shaping the future education method to fosters a lifelong learning in the digital age.

This section of the report will be diving into the literature review of the project and how these technologies will be revolutionizing the educational process, improving the learning and educational experiences compared to similar applications in the current market.

2.2 Importance of Education

In the complex world of the 21st century, education empowers every person in this planet with the skills, knowledge, and necessary critical thinking to navigate between modern challenges. Across different learnings, May (2023) mentioned that the importance of combining different learning approaches which can foster a deeper understanding and innovation skills in the student. Similarly, studies by Liñán and Pérez (2015) showcase that the value of education is considered very greatly in driving an institution growth and creating a better culture of continuous learning within the education environment.

Effective education management systems play a crucial part in the educational delivery which is highlighted by Montoya (2018). These education management systems streamline administrative tasks, provide a centralized hub that can be accessed for learning materials, and facilitate communication between all users within the system. However, the true impact of an education management system extends beyond just efficient management and tools.

Bradley (2023) emphasizes the critical role of education in providing individual growth and development. Zaky (2023) underlines the importance of the feedback from an educator/teacher, where they provide targeted and constructive feedback to support a learner's individual needs. Besides that, another Melo (2023) suggests that by incorporating artificial intelligence (AI) into an educational environment can greatly help the learning process much more enjoyable and valuable. By leveraging all the potential data with AI, educators can structure a custom instruction for a fellow student by his learning styles and knowledge gaps. In this situation, it will be a more effective and engaging learning journey for all students.

In summary, education is not about acquiring knowledge, skill, and information, but is about empowering individuals and driving them to have societal progress. Effective education management systems supported by advanced technologies such as artificial intelligence may lay the foundation for individual growth and a brighter future for all.

2.3 Education powered by Artificial Intelligence

The education field is undergoing a significant transformation, it has been driven by the emergence of the Artificial Intelligence (AI). While traditional education such as a teacher-centred approaches have served their purpose, the need for a more optimize and better handling of a larger group of students with specific needs become a must adaptation in the 21st century. For this reason, the education landscape must adapt and necessitates a shift. Artificial intelligences offers' a powerful set of tools to revolutionize the education field mentioned by Bailey, 2023. With the help of AI, it can help educators to prepare a dynamic and optimize learning experiences for the students, ultimately preparing them become a better learner in the future.

The potential of Artificial Intelligence could help personalize learning experience, it can help analyse large amount of untap student data to identify the strength and weakness of each student, this can enable educators to draw up a special learning plan and act based on the data to the target student. This personalized approach can address the diverse needs and learning styles of different kinds of student within in the classroom. This situation will ensure that no one in the classroom feel neglected and left behind. AI powered platform can recommend learning resources and suggest personalized feedback mechanisms. Therefore, giving the students a more dynamic learning pace and a more engaging and effective learning journey.

Although artificial intelligence looks to be wonders in an education management system, the integration is not without its own problem and challenges. Ethical considerations towards the user privacy and potential wrongful information given within an Artificial Intelligence algorithm need to be addressed (Parsons, 2024). Some guardians and parent may not want AI to consume their children's data. Thus, making the system more transparent is crucial for not only educators but every other user within the system. Some may argue that AI should complement rather than replace the human in the education. The role of educators will be more likely to shift towards in providing guidance, promoting creativity and teaching thinking skill.

In short of the education powered by AI, AI hold its immense potential to transform the education field. The personalizing learning experiences can

help educators providing a deeper learning experience for students. On that note, a nuanced approach is necessary, ensuring all ethical considerations are addressed and the human element remains central to the learning process and not fully replacing the core fundamental with artificial intelligence. The systems must be transparent to all users and educators must be in charge at every corner. As the world move forward, AI has the power to create a better education experience for all and hope that it will help rather hinder the educations system.

2.4 Review of Existing Similar Applications

The current educational technology system is blooming with innovative platforms each day. All the system currently in the market is offering unique functionalities and catering to diverse learning needs. By analysing these existing applications is a valuable first step in developing the proposed project. Understanding all the strength and limitations of these establish platforms which is currently being used by millions of students all together, successful features and potential area for improvement can be isolated and identified. Ultimately designing a more comprehensive and user-centric educational platform for the future. When comparing similar applications, it is essential to evaluate their features, strengths, limitations comprehensively to get a better idea how each of the system has earn success in their own.

The similar applications that are going to be compared are Moodle, Google Classroom, My Campus and Duolingo. Some applications are being used internationally by students around the globe and some applications are being used locally in Malaysia. Comparing both internationally and locally can help identified some trends and pattern in the current education management system ecosystem.

2.4.1 Moodle

For the first similar application is an open-source learning management system which is called Moodle. This system is very popular among tertiary education and is currently being used both internationally and locally. Moodle offers a wide range of features such as including course management, collaborative tools,

and assessment capabilities. One of its many strengths is it's an open source and very cost-effective platform. This is because it removes all the licensing fees which make Moodle more accessible to educational institutions with limited budget. Moodle is also very flexible, and it scales very well with the users using the application. Its modular design allows institutions to choose the features they need and can easily scale them to their requirements. Not to mention that Moodle is also supported by a large and active community. For Moodle, it means that they have a very rich resource that is available for all users that can be accessed through support forums and a constant stream of extensions and plugins built by 3rd party developers.

Moodle is a very powerful and popular tool which really helps them with its success around the world. However, its robust features may pose a challenge to less technical users who are unfamiliar with this kind of education management system. Another platform compared to Moodle are providing a better user interface. Therefore, causing some limitations on the platform itself.

2.4.2 Google Classroom

The next similar application is Google Classroom. Google Classroom is a web-based platform that streamlined the process of managing classroom activities, assignments, and communication. One of its biggest strengths is that it is known for its very user-friendly interface. Integration with the existing Google accounts eliminates the need for the creation of a brand-new account that some users may find troublesome. This operation makes users reuse the same credentials to login which makes this a readily accessible platform for students and educators within the Google ecosystem. The ease of use lowers the requirement to entry for educators for those who are not very comfortable with complex platforms. Besides that, it offers seamless communication and collaboration. Google Classroom facilitates communication between all users seamlessly through the virtual classroom. The virtual classroom can be easily created and joined by all students where they can communicate and collaborate in real time without any hassle. This classroom allows them to perform any actions that usually being done physically in a classroom, giving more accessibility to all users that seek education.

Having a user-friendly interface is one of the biggest reasons why people choose Google Classroom and the simplicity and familiarity just make it very easy for all users to adopt. However, the platform does lack some features that some institutions desire which makes this platform not being used as much as intended.

2.4.3 My Campus

My Campus is next similar application, it is a learning management system that is currently being used locally in Malaysia. My campus offers a robust cloud-based learning management system which they provide in supporting synchronous online learning through virtual classrooms with interactive whiteboards. The virtual whiteboard in the classrooms is one of the strengths of the My Campus. The virtual classrooms which are equipped with the whiteboards are very beneficial in delivering lectures, facilitating group discussions and promote collaboration between students. Interactive whiteboards allow educators to share content with students in a dynamic way, and students can interact with the content in real time. In this situation can lead to a more engaging and interactive learning journey for the students. Another strength of the My Campus is that it's also provide the tools for analyzing and tracking. It provides educators the feature of monitoring their students with personalized plans built from competency framework and learning objectives. This aim to identify students that are failing and taking the appropriate action.

Overall, My Campus is a powerful modern eLearning system designed to streamline the education management process. However, same as the Moodle application, it has a learning curve for less technical users where the user interface considered as complex. Thus, causing some limitation to beginner users that are unable to use the platform to its fullest potential. Besides that, the system does require payment and does charge an amount of fee compared to both Moodle, Google Classroom that has offer a free plan.

2.4.4 Duolingo

Finally, the last similar application is Duolingo which is a language learning web-based application. Duolingo really stands out for its innovative approach to teaching language to people around the world through a simple yet effective way which is gamification and adaptive learning algorithm. With this gamification approach, every person can easily understand the application and does not have a barrier that less technical users may face. These engaging and interactive user interfaces are familiar to all users, and this will motivate learners to practice regular.

On the other hand, Duolingo is only built for individual language learning experience, and it does not really is target for education management system or foster collaboration between learners. Therefore, making Duolingo a good platform for individual language learning which they excel at.

2.4.5 Summary Table of Similar Applications

Each of these applications offers its unique strength and limitations but has a similar target audience. A comparison is summarized in the table below:

Table 2.1: Summary Table of Similar Applications.

Feature	Moodle	Google Classroom	My Campus	Duolingo
Target Audience	Higher Education, K-12	K-12	Higher Education, K-12	Language Learning Individuals
Strengths	Highly customizable, Open-source, Extensive plugins	User-friendly, Integrates with Google Workspace, Easy to set up	Virtual Classrooms with whiteboard that promote collaboration	Adaptive learning, Gamification, Effective for language acquisition
Limitations	Steep learning curve, Requires technical expertise, Potentially overwhelming for some users	Limited customization options, Primarily focused on content delivery, Lacks advanced analytics	Less User Friendly Interface Require recurring payment	Primarily focused on individual learning, Limited collaboration features

From the table, each of these application offers valuable tools and functionalities especially My Campus for educational purpose. Their suitability depends on factors such as the learning goals, user preferences and institutional requirement. After carefully evaluating these applications, decisions can be made for which applications is a better platform to be used by educators.

2.4.6 Key Takeaways from Similar Applications

By analyzing this similar existing education management system, this project can prioritize user-friendliness like Google Classroom and Duolingo while offering more customization option like Moodle and providing collaboration tools like My Campus which can promote engagements during learning environment. Most importantly, this project can address the need for a comprehensive platform that caters to diverse educational background needs.

2.5 Development Framework

In this section, the development framework for this project has been researched and discussed. There are tons of framework and technologies that can be used to develop a responsive web based application in the current market and there's is a lot of possible combination to create the application. Instead, the chosen framework is based on the application requirement and needs. So, the following will be discussing what framework and database are chosen and why it suitable for this current project. There are 2 parts of the project which can be categorized as Front End and Back End.

2.5.1 Front End

The front-end framework chosen for this project is ReactJS. React is a popular JavaScript library to build a dynamic and interactive user interface web application. The main strength of React is that it focuses on building reusable components which it facilitates efficient development and maintenance. Reusable component allows developer to save time and focus on the more important part which are the functionalities and user experience. The focus of user-friendly interface directly will help educators and students to easily navigate and utilize and engage more within the learning environment.

2.5.2 Back End

The backend for this project consists of many technologies where these technologies is essential in building an efficient server and database.

The first framework is Nodejs. It is a JavaScript environment where JavaScript code will be served, enabling a full-stack development approach. It allows efficient server-side scripting and streamlines the development process.

The second framework is Express.js. This web framework will provide the foundation for building the server-side logic of the project. It will allow for efficient handling for incoming HTTP request and provide the appropriate response to the client which ensures a seamless communication between the front-end interface and back-end data storage. This efficient communication infrastructure is crucial for feedback and personalized feedback. It ensures real-time data exchange between educators and students facilitating effective collaboration.

The last technology is the database which is to store the data of the application. A NoSQL database is chosen which is MongoDB. MongoDB will be used to store and handle the diverse information generated within the system platform. MongoDB's scalability and flexibility make the database very well suited for handling the dynamic of educational data. This efficient data storage directly relates help the retrieval data. By readily accessing and analyzing student data, it can generate insight and identify at-risk students more effectively.

2.5.3 Integrating AI-Powered Analytics with Open AI

This project will be integrated with one of the most popular artificial intelligence technologies in the world which is Open AI. It will use the Open AI application programming interface (API) to unlock the power of AI for educational purposes. Open AI offers various tools and functionalities that can be leverage for data analysis and generation of insights. This integration will provide the solution of personalized feedback and generate comprehensive analytics based on the students. By utilizing Open AI, recommendations, and support to support individual learning needs can be generated easily.

CHAPTER 3

METHODOLOGY AND WORK PLAN

3.1 Introduction

In this chapter, the selected development methodology will be outlining the workplan that is adopted for this project. This chapter will also emphasize the use of the incremental methodology within the Software Development Life Cycle (SDLC). The methodology that is selected for this project is the incremental methodology. This methodology is characterized by its iterative and incremental approach towards the software lifecycle, where it's aligns well with the project goals of delivering incremental value and adapting to evolving requirements. Besides the incremental methodology, the planning, design, development tools that is used in this project will also be discussed. At the end of this chapter, the work breakdown structure (WBS) and Gantt chart will be showcased.

3.2 Software Development Methodology: Incremental Development Methodology

The incremental development methodology is an iterative approach in the software development that breaks down the project into small and very management increments. Each increment will deliver a subset of the overall functionality and it is built upon on the previous one. In this situation it allows early feedback from stakeholder, continuous improvement, and early delivery of usable features. This methodology emphasizes the flexibility, adaptability, and responsiveness to the overall project, making this methodology to be well suited for this project that may have requirements that are likely to evolve and need for frequent feedback and validation.

As mentioned above, the incremental methodology breaks down the SDLC into small and manageable modules. Each module will be focusing on a specific subset of functionalities that is built on top of each other in a step-by-

step manner. This methodology offers some advantages that make this method particularly suitable for this project.

For the first advantage for this methodology is that it reduces risk. By focusing on smaller deliverable modules, the project will be able to mitigate the risks that are associated with large-scale development efforts. One of the frequently conducted processes throughout the software development cycle is the testing process. Testing frequently will allow the identification and correction of bugs and errors early and before they escalate into major issues. Usually bugs that are not found in the early stage will be costly to fix in the later stage and require much more effort to solve this issue. This incremental approach ensures the project stays on track and avoids any costly fixes later in the future.

The next advantage of this methodology is the early user feedback. A cornerstone of incremental development is the incorporation of user feedback throughout the iterative cycles. After each module is developed and tested, user feedback mechanisms such as surveys are deployed to gather more insights on the current platform usability, effectiveness, and make sure it aligns towards the targeted user needs. This early feedback loop allows the development process to refine the functionalities and prioritize features to ensure the project remains user-centric and addresses the needs of the target's users in their learning environment.

There are 4 primary phases in the incremental methodology which include, planning, analysis, and design, increments of design, development and testing, lastly followed by the closing phase of the overall project. After the last phase is completed, the next phase will begin, and each increment consists of the design, development, and testing. The core functionality of the project will be conducted first in the first iteration as it lays the foundation of the overall project. The next highest priority of the modules will be implemented throughout the next few incremental processes. After the last increment, the closing phase will be carried out and all the necessary documentation will be generated for future references.

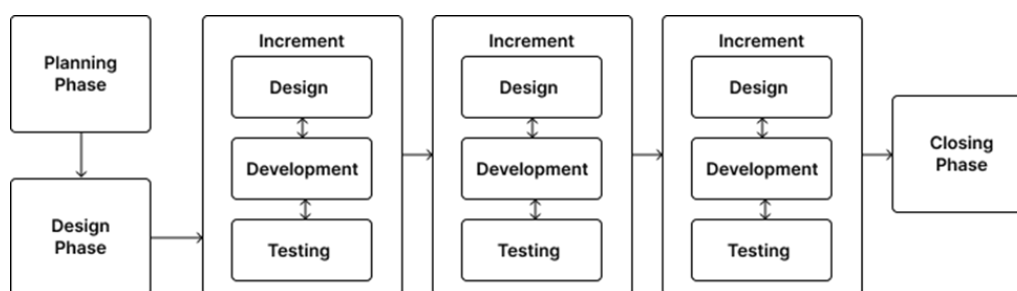


Figure 3.1: Incremental Methodology Structure

3.2.1 Planning

The initial phase of the SDLC development process begins with the planning phase. This planning phase clearly defined the project goals, target users, system modules. During the planning phase, the overall project scope, project objectives and deliverables were defined too. The key milestones and core features, project constraints based on the requirement were identified during this phase. Furthermore, the requirement elicitation was conducted to generate a list of functional and nonfunctional requirements. In the end of this phase, the project schedule was created to estimate the overall project duration.

3.2.1.1 Project Proposal

In this project proposal phase, the project scope, project objectives and project approach are formalized in a comprehensive proposal document. Before all of that, the project title was compiled by understanding the current landscape of the education field within the technology-rich world. Problem statement and problem background were carried out after all previous steps are completed and enough information and resources are present. Based on the problem background and statement, this project proposes a solution with the suitable software methodology. The research and development methodology were identified and are to the core guide on how the project is conducted throughout the SDLC. The incremental methodology was reflected in the proposal by outlining the planned increments along with its corresponding timelines, deliverables, and milestones. Furthermore, the proposal emphasizes the incremented nature of the development, highlighting the importance of frequent feedback and

continuous improvement throughout the project lifecycle. In the end, the project scope is narrowed down and the target audience and timeline are produced within the budget.

3.2.1.2 Requirement Gathering and Elicitation

After the project proposal phase, the requirement gathering phase is carried out. The requirement gathering and elicitation is a critical phase in the software development process. The needs, requirement and expectations of the targeted users are collected, analyzed, and prioritized. In the context of the current project, it aims at developing an educational platform focused on synergic learning while providing a comprehensive analytics and collaboration tools for the target users through a combination of surveys and reviews of similar applications that are currently being used around the world or locally in Malaysia.

One of the requirements' gathering technique is by using surveys. Google form is selected as the survey as it provides tools to analyze the data gather without having to pay any usage fee. Survey provides a structured and efficient way to collect quantitative and qualitative data with open or closed ended questions prepared. The questions are designed carefully and distributed to the targeted users which are students and educators in the education environment. The survey can help solicit feedback on various aspect of the proposed platform such as desired features, usability requirements, content preferences, and desired learning outcomes. The distribution of the survey took couple of weeks to maximize the number of responses from the end users.

Simultaneously, another way of gathering requirement is to conduct a comprehensive review of similar applications that are currently exists in the market. Couple of applications are found such as Moodle, Google Classroom, MyCampus and Duolingo. These applications can be categorized as Learning Management System (LMS) and are very popular and widely used in the same target users for this project. By reviewing these applications side by side with the proposed project, insights into the industry best practices, emerging trends and potential areas of innovation can be identified. By finding out opportunities and differentiation from other application, it ensures that the proposed project

offers a unique value that address the users' needs and stand out among these existing applications.

With the help surveys and review of similar application, it can capture a wide range of students' and educators' perspective, thus providing valuable benchmarking data. These insights can be developed into a better understanding of the user needs and expectations. In this situation, the project can focus and prioritize features accordingly while defining a clear project goals and objectives. Additionally, the incremental methodology allows the requirement and validation to be an ongoing process ensuring the final product align closely with user needs and delivers maximum value of the project.

3.2.1.3 Project Scheduling

The final phase of the project planning is the project scheduling phase. 2 keys tools for scheduling were utilized for this project which is Work Breakdown Structure and Gantt Chart. Both WBS and Gantt chart serve as a hierarchical breakdown of the entire project into smaller, more manageable deliverables. For this project where the incremental methodology approach is selected, the WBS was structured around development iterations. Each iteration focus on a specific module with well-defined functionalities.

After the Work Breakdown Structure is completed, a Gantt Chart is created based on the WBS to create a visualization of the schedule of the tasks and their dependencies over time. The Gantt chart consist of a horizontal timeline representing the project timeline, with individual tasks which is the bars along the timeline. For each bar, it represent the start and end date of a task. Therefore, it can be easily visualized the sequence of activities and potential scheduling conflicts can be identified in the Gantt Chart. The chart is also reflected upon the project scope, priorities, and resource availability. New increments may be added, task may be modified, and dependencies may be adjusted, this incremental methodology allow the project to adapt to the requirements. Thus, making the Gantt chart and WBS an important tool to allocate resources effectively ensuring that each increment is completed on time and within budget.

3.2.2 Analysis and Design

After the planning phase is completed, the next phase that is carried out which is the analysis and design phase. In the analysis and design phase for the project, it will focus on analyzing and translating on the objectives scopes and gathered requirements into actionable design specifications and prototypes. This phase involves several key activities, including the creation of use case diagrams, use case descriptions, interface flow diagrams, and user interface prototype designs. The use case diagram is one of the key activities where it is used to visually represent the interactions between users – actors and the system. This can help depict various scenarios or use case on how the target user will interact with the system to achieve their goals and tasks. Each use case describe a sequence of interactions between the user and system, highlighting the user's goals. By creating the use case diagrams, the project can identify the core functionalities and features of the education application and ensure all the target user requirement are addressed.

The next key elements in the analysis and design phase are the use case descriptions. It provides detailed narratives of each use case which include the preconditions and postconditions steps that are involved in executing the use case. These descriptions serve as a documentation of the system's behavior which can help the project to have a better structure on how the user will interact with the system. Outcome and input can be predicted in different scenarios through the use case description.

Interface flow diagrams is also an important element in this phase. It illustrates the flow of the user interactions within the system. By mapping out the sequence of screens, dialogs, and actions that the user may touch and see as they navigate through the application, it can help identify the potential usability issues and inefficiencies in the user experience. A visual representation of the user interface will be translated into the interface flow diagram. By analyzing this interface, the project can optimize the UI design to enhance usability, accessibility, and user satisfaction. The diagram will be built using Figma to showcase the layout of the proposed system.

3.2.3 Design, Development and Testing

In the next phase after completing the analysis and design, the incremental methodology was applied. The project was broken down into iterations of design, development, and testing. Following the incremental model, the core functionality of the project was focused on the initial increment of design, development, and testing. Following iterations was decided based on the additional requirement where the software system was carried out incrementally. Each iteration includes of designing, developing, and testing new features that meet the expectations of the user's needs. The software system was continuously improved and refined in an iterative approach, which incorporates user and stakeholder feedback into each iteration for future development efforts.

3.2.3.1 First Iteration

The first and initial iterations of the project focused on establishing the core functionalities. Before any of the steps are conducted in the initial iterations, some preliminary setting up for the project are required such as creating the repository and database for the project, setting up the development environment and the linkage of all tools used. A well configured environment allows the iterations process to be carried out smoothly without critical challenges.

The design of the user interface of the first few features were refined and analyzed before continuing into the development. The first iteration lays the foundational groundwork for the platform which prioritizing the essential features such as the user registration, login for both students and educators.

Additionally, the user profile management functionalities were designed and implemented. This enables the target user the ability to manage basic information and privacy settings. After these core functionalities are implemented for the overall project, the features that benefit the students and educators will be developed. Features such as the ability to upload learning materials, documents that will empower them to structure learning modules effectively.

When the development process is done, rigorous testing was conducted. This will ensure seamless integration of these core features into the project. By

implementing user acceptance test, it can play a vital role in gathering initial feedback on usability and platform navigability. Providing a clear insight of the status of the current project. The deliverables for the first iterations was a functional prototype encompassing essential functionalities for all the targeted users.

3.2.3.2 Second Iteration

In the second iteration, the focus shift into developing and enhancing performance tracking and communication capabilities within the platform. Before proceeding to the development phase, the interface of the modules were further refine based on the user's needs. Building upon the foundation laid in the first iteration, the project aims to introduce a performance analytics module that is powered by Open AI for the educators and students. This enable them to monitor student or their own progress in the learning environment. Besides that, basic communication tools such as QnA and announcements were integrated. After these modules are implemented, thorough testing is used to ensure the accuracy of the data within the performance analytics modules and the smooth operation of the communication modules. User acceptance testing was conducted, thus the students and educators provided valuable feedback which was analyzed and dictate the effectiveness and usability of these features. The deliverables for this iteration is a much-refined platform with performance analytics functionalities and communication tools for student and educator in the learning environment.

3.2.3.3 Third Iteration

For the third iteration of the project, it focus on expanding to incorporating personalized learning and collaboration functionalities. Leveraging advanced technology, this phase aims to enhance the educational experience by intergrading AI-powered features for both student and educators. A deep understanding on the AI and Open AI is carried out to integrate the API seamlessly into the project. A well structure design on implementing Open AI into the project greatly reduce any critical challenges during the development

phase. Once the design phase is completed, the features was developed and it enable personalized learning recommendations based on student performance data, allowing educators to modify the learning journey plan to individual student needs. Additionally, collaborative learning functionalities were introduced after a refined design interface. It includes QnA and tools that foster interaction between each other user in the platform. Testing was be conducted after the development is completed to ensure the accuracy and effectiveness of AI-powered modules and collaborative learning features. Usability testing assess the experiences for both students and educates which ensure that the platform engagement and collaboration are effective and up to their needs. The deliverable of this iteration is a platform enriched with integrated AI functionalities for personalized learning recommendations, along with robust features for collaborative learning activities.

3.2.3.4 Fourth and Final Iteration

The fourth and last iteration, the project shift its focus to its refinement and expansion where the project was incorporating user feedback and expanding functionalities to meet the evolving needs. Building upon the features that has been developed and tested in the previous iterations, this final phase prioritized the refinement based on the user feedback and introduction of new features to future enhance the platform capabilities. Through comprehensive testing, the project ensure the platform function cohesively and address the diverse need of all target users within the educational ecosystem. User acceptance test with all users plays a crucial role in gathering final feedback and validating the platform if it has met the user requirement. The deliverable for this final iteration is a polished platform where it has incorporating user feedback, addressing emerging needs, and providing a seamless educational experience for all stakeholders.

3.2.4 Closing

Once the incremental development phases are completed and the system has been fully developed and each module has been tested, a user acceptability test is critical to evaluate and validate if the project has met all requirements that has been mentioned from the target user. The UAT process is involve finding the target testers and specific modules to be tested which is followed by the actual test of the modules by the target testers. After the test has been conducted, feedback were be collected, analyzed, and most importantly documented. This provide meaningful and valuable insight into the usability of the platform. Thus, the system documentation will offer a comprehensive description of the system including screenshots grouped with its explanation and test scenarios. The documentation serve a reference for stakeholders and future development efforts. Through these final steps, this project is effectively documented and presented, ready for deployment and utilization in the educational domain.

3.3 Development Tools

3.3.1 Visual Studio Code (VSCode)

Visual Studio Code that can also be called as VSCode is a lightweight but very powerful integrated development environment (IDE) code editor that provides many features and extensions. Features and extension such as syntax highlighting, debugging support, and Git integration will make the development process much enjoyable. This IDE will serve as the primary development environment for the MERN stack where all the HTML, CSS and JavaScript code will be written on. Debugging and managing project files are another benefit of using VSCode.

3.3.2 Git

Git is used in this system as a version control system that enable the development team to track, store and make changes to their source code in an organized manner. It allows developers to work on separate branches where each branches serve different purpose. A branch purpose may be a new feature, bug fixes or formatting of the documentation. These separate branches then can be merge or reverted based on the needs of the developer. Multiple versions can exist with git therefore giving the developers the ability of version control for their source code. This will help the development process as it works well with incremental methodology which is also implemented for this project.

3.3.3 GitHub

GitHub is a web-based hosting service to store the project code using Git repositories. It provides features for code hosting, collaboration, and project management. Beside that, it provides a place to store and managed your source code on the cloud while providing tools for code review, issue tracking, integration, actions and many more. GitHub will be used to store this project repository which provides a central location for managing project files and code.

3.3.4 MERN Stack

The MERN which stands for MongoDB, Expressjs, Reactjs and Nodejs is a popular technology stack for developing full-stack web applications. For the front end and client side, ReactJS will be responsible in building dynamic interface where it is a component based framework for building the desire interface. Meanwhile for the backend side which include the server and database, MongoDB is a NoSQL database that will be used for storing all the information and data. Lastly, Expressjs is a server framework for building server-side applications. The server will run on Nodejs which is a runtime environment for JavaScript for our backend server code. The MERN stack will be used to develop all components of the project.

3.3.5 Figma

The primary design tool used for this system is Figma. It is a design tool that promotes collaboration among designers and developers. It allows them to create high-fidelity prototypes, graphics, and many more in real time. It also offers features for designing responsive layouts by providing frames and dimensions for multiple devices in the market. Figma also allows sharing and reviewing prototypes very easily to the developers. This designing tool is selected to create all prototypes, flows, and graphics for this project which can be easily shared with the intended users for feedback.

3.4 Work Breakdown Structure (WBS)

0.0 Education Management System powered by OpenAI

1.0 Planning

- 1.1 Analyze the project title
- 1.2 Study background of the problem
- 1.3 Define problem statements
- 1.4 Define project objectives
- 1.5 Define project solution
 - 1.5.1 Study the similar system architecture
 - 1.5.2 Design project's system architecture
- 1.6 Define project approach
 - 1.6.1 Define research approach
 - 1.6.2 Define development approach
- 1.7 Define project scope
 - 1.7.1 Identify target users
 - 1.7.2 Identify the covered modules
 - 1.7.3 Identify the scope exception
- 1.8 Requirement gathering
 - 1.8.1 Conduct survey
 - 1.8.1.1 Generate questions for survey
 - 1.8.1.2 Distribute the survey
 - 1.8.1.3 Analyze and summarize the responses
 - 1.8.2 Review similar existing systems

1.8.2.1 Review Moodle

1.8.2.2 Review Google Classroom

1.8.2.3 Review MyCampus

1.8.2.4 Review Duolingo

1.8.2.5 Identify the common features

1.8.2.6 Identify the differences

1.8.2.7 Generate an application review table

1.9 Literature review

1.9.1 Research on the importance of education

1.9.2 Research on the education powered by Artificial Intelligence

1.9.3 Research on development methodologies

1.9.4 Research on collaborative learning tools

1.10 Requirement elicitation

1.10.1 Choose the recommended features

1.10.2 Define the functional and non-functional requirements

1.10.3 Refine the requirements

1.10.4 Finalize the requirements

1.11 Project scheduling

1.11.1 Create Work Breakdown Structure

1.11.2 Create Gantt chart

2.0 Analysis and Design

2.1 Design use case diagram

2.2 Create use case description

2.3 Design interface flow diagram

2.4 Design prototype

3.0 Development

3.1 Set up development environment

3.1.1 Create repository

3.1.2 Set up database

3.1.2.1 Create a database

3.1.2.2 Implement database schema

3.1.3 Configure development tools

3.2 Preliminary Setup

3.2.1.1 Establish project environment

3.2.1.2 Configure development tools

3.3 Incremental Development

3.3.1 First Iteration

3.3.1.1 Design

3.3.1.1.1 Refine the UI of the user registration and login functionalities

3.3.1.1.2 Design and refine user profile management system

3.3.1.2 Development

3.3.1.2.1 Develop user registration and login functionalities

3.3.1.2.2 Implement user profile management system

3.3.1.2.3 Set up basic content upload functionalities

3.3.1.3 Testing

3.3.1.3.1 Develop test cases

3.3.1.3.2 Execute unit tests

3.3.1.3.3 Perform system testing

3.3.1.3.4 Conduct user acceptance testing

3.3.2 Second Iteration

3.3.2.1 Design

3.3.1.1.1 Refine the UI of performance analytics module

3.3.1.1.2 Refine the UI of communication tools

3.3.2.2 Development

3.2.3.2.1 Introduce performance analytics module

3.2.3.2.2 Implement communication tools

3.3.2.3 Testing

3.3.2.3.1 Develop test cases

3.3.2.3.2 Execute unit tests

3.3.2.3.3 Conduct user acceptance testing

3.3.2.3.4 Perform integration testing to ensure cohesive functionality

3.3.3 Third Iteration

3.3.3.1 Design

3.3.3.1.1 Refine the UI of personalized learning recommendations module

3.3.3.1.2 Refine the UI of collaborative learning modules

3.3.3.2 Development

3.3.3.2.1 Integrate AI-powered features for personalized learning recommendations

3.3.3.2.2 Develop collaborative learning functionalities

3.3.3.3 Testing

3.3.3.3.1 Develop test cases

3.3.3.3.2 Execute unit tests

3.3.3.3.3 Conduct user acceptance testing

3.3.3.3.4 Perform integration testing to ensure cohesive functionality

3.3.4 Fourth and Final Iteration

3.3.4.1 Design

3.3.4.1.1 Refine features based on user feedback

3.3.4.1.2 Refine UI/UX design

3.3.4.2 Development

3.2.3.4.1 Expand functionalities

3.2.3.4.2 Iterate on feature development based on user feedback

3.2.3.4.3 Enhance functionalities based on emerging needs

3.3.4.3 Testing

3.3.4.3.1 Develop test cases

- 3.3.4.3.2 Execute unit tests
- 3.3.4.3.3 Perform system testing
- 3.3.4.3.4 Conduct user acceptance testing
- 3.3.4.3.5 Perform integration testing to ensure cohesive functionality

4.0 Closure

- 4.1 Code Review
- 4.2 Review project milestones and deliverables
- 4.3 Ensure documentation is accessible to relevant stakeholders

5.0 Deployment

- 5.1 Prepare for deployment
- 5.2 Deploy the application to production environment
- 5.3 Perform post-deployment testing

6.0 Documentation

- 6.1 Create system documentation
- 6.2 Finalize project documentation

7.0 Maintenance and Support

- 7.1 Address user feedback and bug fixes
- 7.2 Provide ongoing technical support
- 7.3 Monitor and optimize application performance

8.0 Project Closure

- 8.1 Conduct project review and lessons learned
- 8.2 Archive project documentation
- 8.3 Celebrate project completion and success

3.5 Gantt Chart

3.5.1 Overview of Project Timeline

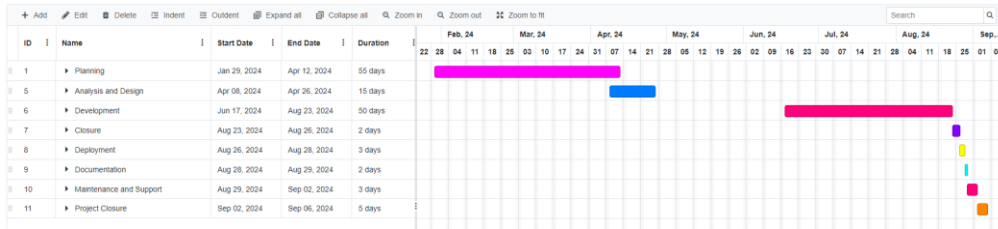


Figure 3.2: Overview of Project Timeline

3.5.2 Planning Phase Timeline I

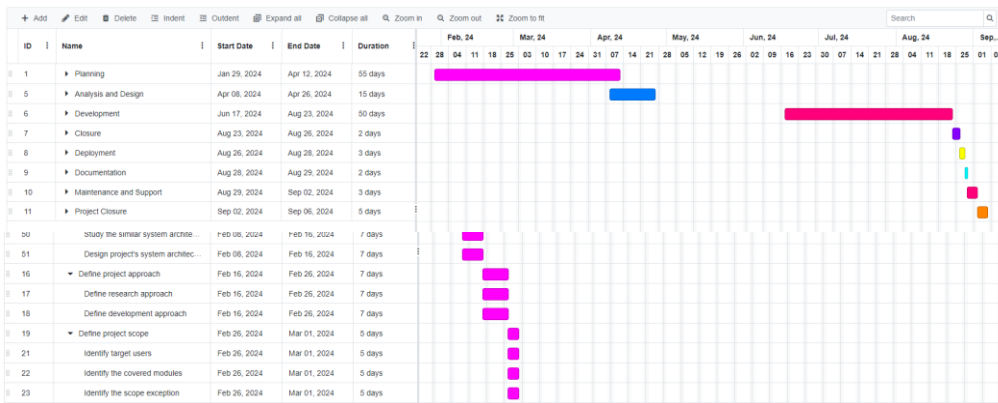


Figure 3.3: Planning Phase Timeline I

3.5.3 Planning Phase Timeline II

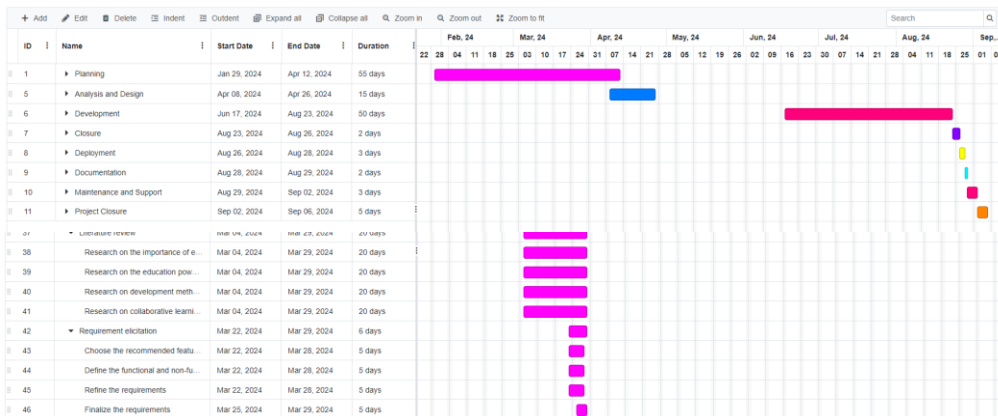


Figure 3.4: Planning Phase Timeline II

3.5.4 Planning Phase Timeline III

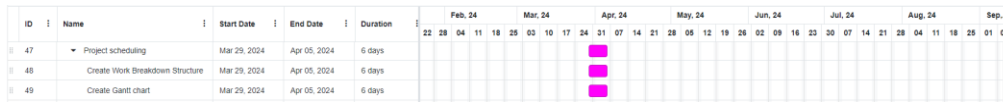


Figure 3.5: Planning Phase Timeline III

3.5.5 Analysis and Design Phase Timeline

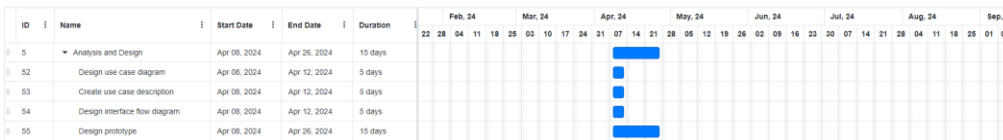


Figure 3.6: Analysis and Design Phase Timeline

3.5.6 Development and Preliminary Setup Timeline

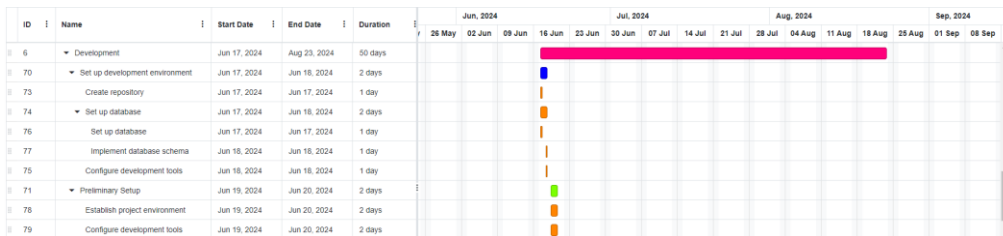


Figure 3.7: Development and Preliminary Setup Timeline

3.5.7 Design, Development and Testing Iteration I Timeline

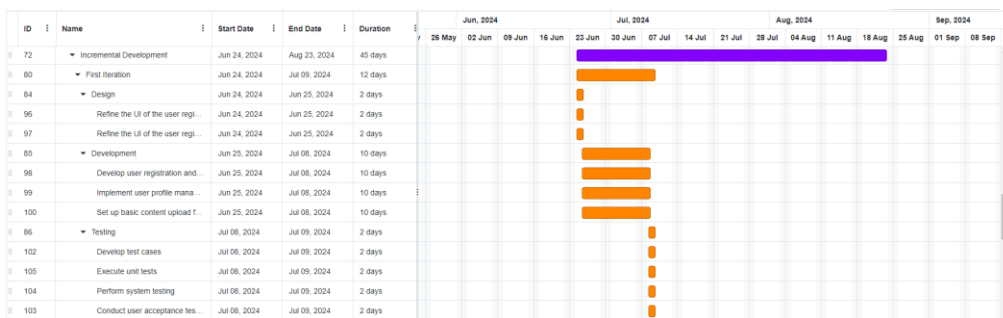


Figure 3.8: Design, Development and Testing Iteration I Timeline

3.5.8 Design, Development and Testing Iteration II Timeline

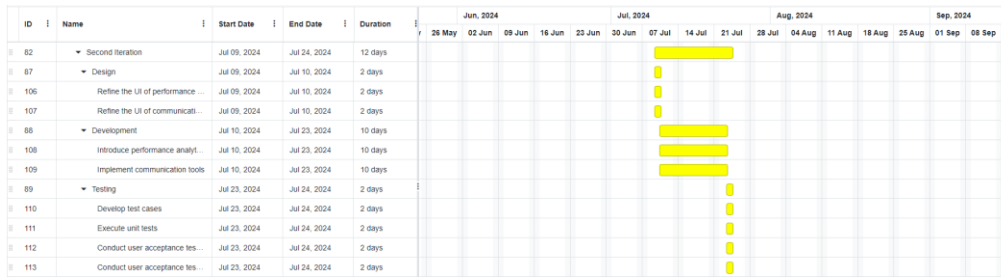


Figure 3.9: Design, Development and Testing Iteration II Timeline

3.5.9 Design, Development and Testing Iteration III Timeline

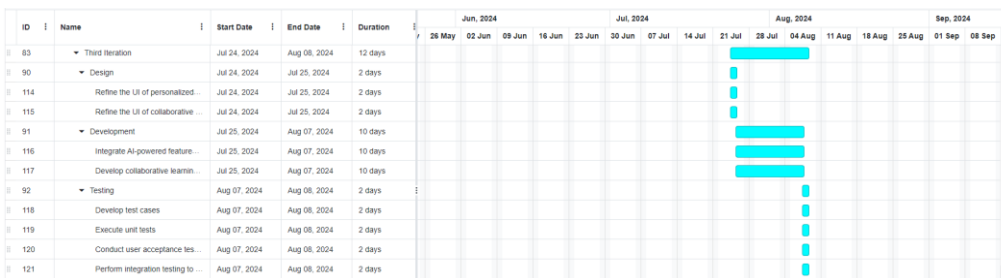


Figure 3.10: Design, Development and Testing Iteration III Timeline

3.5.10 Design, Development and Testing Iteration IV Timeline



Figure 3.11: Design, Development and Testing Iteration IV Timeline

3.5.11 Project Deployment, Documentation & Maintenance Timeline

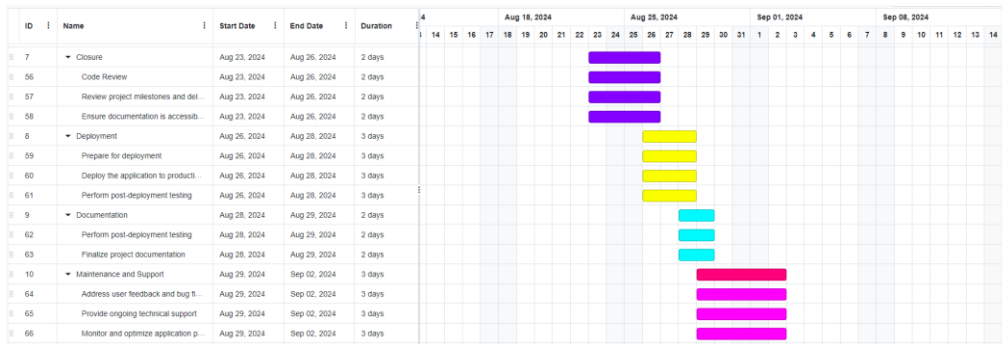


Figure 3.12: Project Deployment, Documentation & Maintenance Timeline

3.5.12 Project Closure Timeline

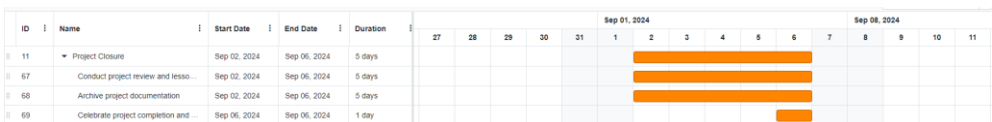


Figure 3.13: Project Closure Timeline

3.6 Summary

The incremental methodology is selected for this project. By having no dedicated design and development team, it is crucial to handle and implement the proposed project based on this methodology which is in increments by increments that is build upon the previous one. In this situation, it will greatly reduce any risk that could be occur on other development methodology which could cause project failure. There are certain deliverables in each increments throughout the life cycle.

The deliverable for the planning phase would be the project proposal that consists of the problem objectives, statements, research and development methodology, project scope and solution. Project specifications and schedule will also be a part of the deliverables in the planning phase.

After that, analysis and design phase produced a comprehensive use case diagram with descriptions, interface flow diagram and the user interface prototype design. With all the documents produced, the incremental development will began where there will be 4 iterations which each iteration providing their own deliverables. The iterations will start from the most important module to least important module. When all iterations are completed and tested, a refined product is produced. A complete project documentation is created for future references and support.

CHAPTER 4

PROJECT SPECIFICATION

4.1 Introduction

For the project specification chapter, the initial specifications of this project will be outlined based on the data collected through the survey that has been distributed to the target users using Google Form. The survey gathers responses from a representative sample of potential users which allow for a clearer understanding of the current needs in the educational field. The analysis of the survey will produce the comprehensive list of functional and non-functional requirements for the project. Furthermore, the use case diagram, use case description and interface flow diagram is created to visualize how the user will interact with system in various scenario. With these components and the user interface prototype, it provides an overview of the system architecture and functionalities.

4.2 Facts finding

In this section of the fact-finding, a survey is created and distributed online to gather the necessary data and information from the intended user. A set of questions are prepared for both users and educators. The set of questions consist of 28 questions with 3 sections that divides them. The first section have questions about the demographic information, section B is a multiple choice questions and lastly section C will be gathering open ended questions. The survey will be distributed using Google Form where it is free to use and a very efficient method for collecting responses. A total of 30 responses including students and educators were collected from the users that consist of educators and students. The following is the description of the responses collected along with the analysis.

4.2.1 Section A: Demographics of respondents

Figure 4.1, 4.2, and 4.3 summarized the overall demographic of the respondents that ranged from their age, gender and general questions about their preferences on learning. There are 30 respondents total and around 93.3% of them are 24 and below while the highest age group is 55 age and above (3.3%). Most of the respondents are male (70%) students (96.7%) in the tertiary education field (93.3%).

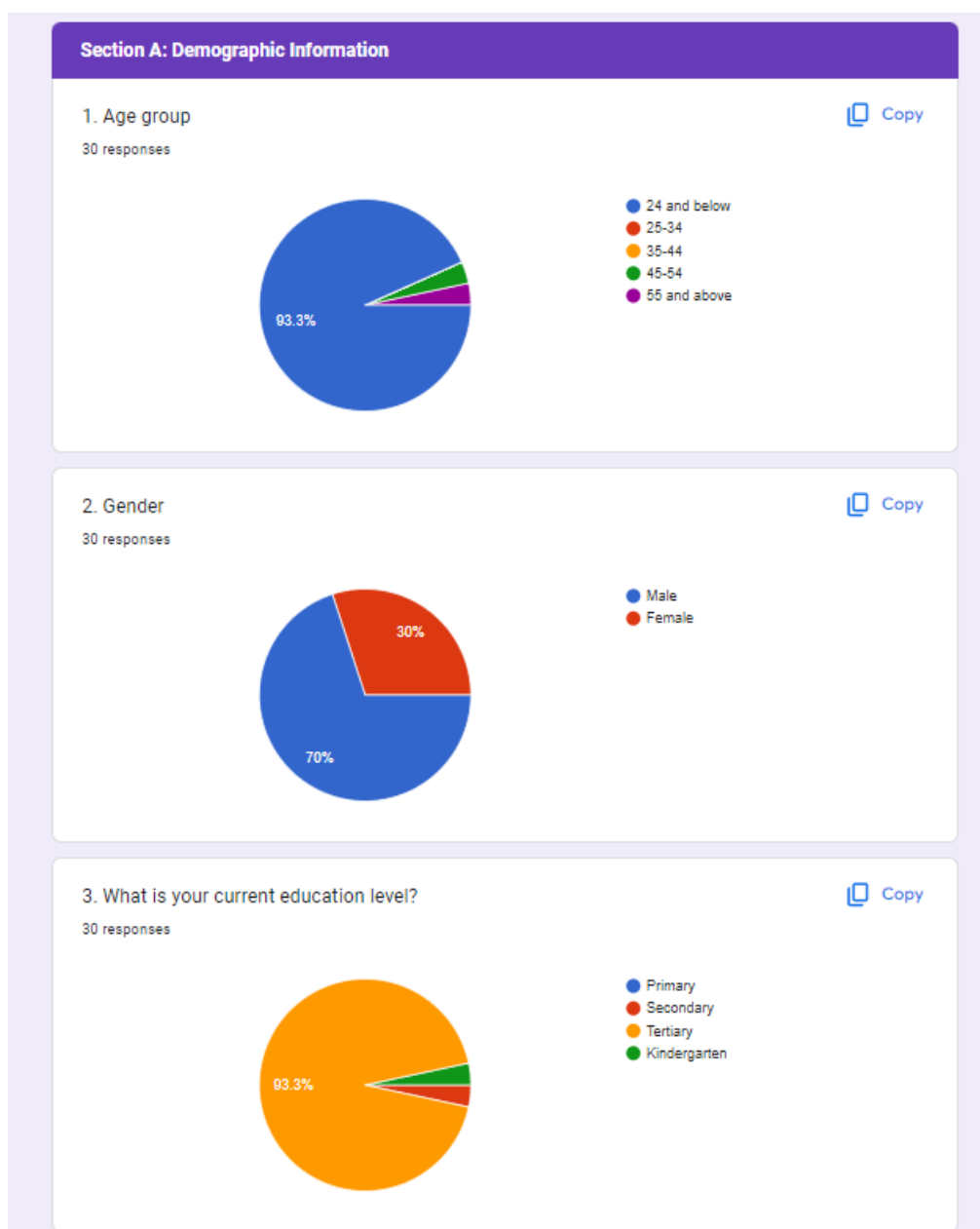


Figure 4.1: Age Group, Gender and Level of Education

Figure 4.2 and figure 4.3 showcase that the 63.3% of the respondent has actually engage with web-based learning platforms before while 36.7% has not. Some of the web-based learning platforms that the respondents has used are British Council, MsTeams, WBLE, Coursera and Physiopedia & KenHub. These platformas are widely used in the tertiary education which make sense as most of the respondent are in the tertiary education.

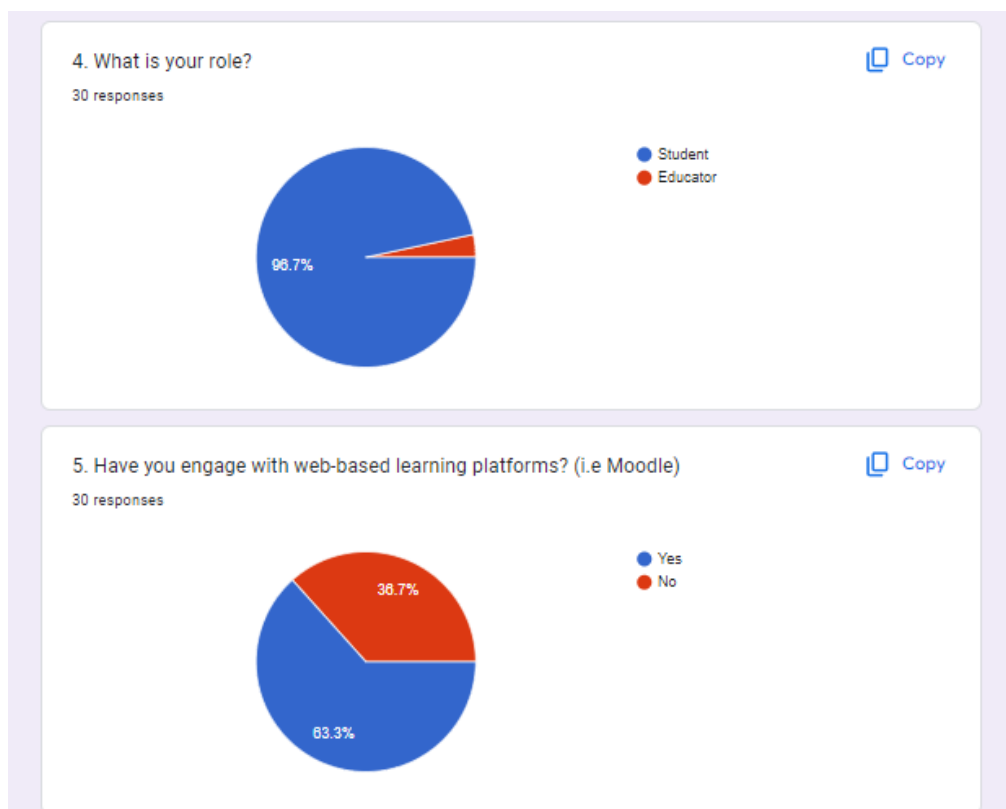


Figure 4.2: Role and Engagement with Learning Platforms

Figure 4.3 shows that the satisfaction level of the respondent using the mentioned web-based learning platform where 20.3% are not satisfied. This could be due to a range of various issues such as lack of features to bad user friendly interface. Question 7 in figure 4.3 shows that more than half of the respondents (53.3%) actually prefer to learn in both independently and collaboratively which makes tools for personal and collaboration tools very important.

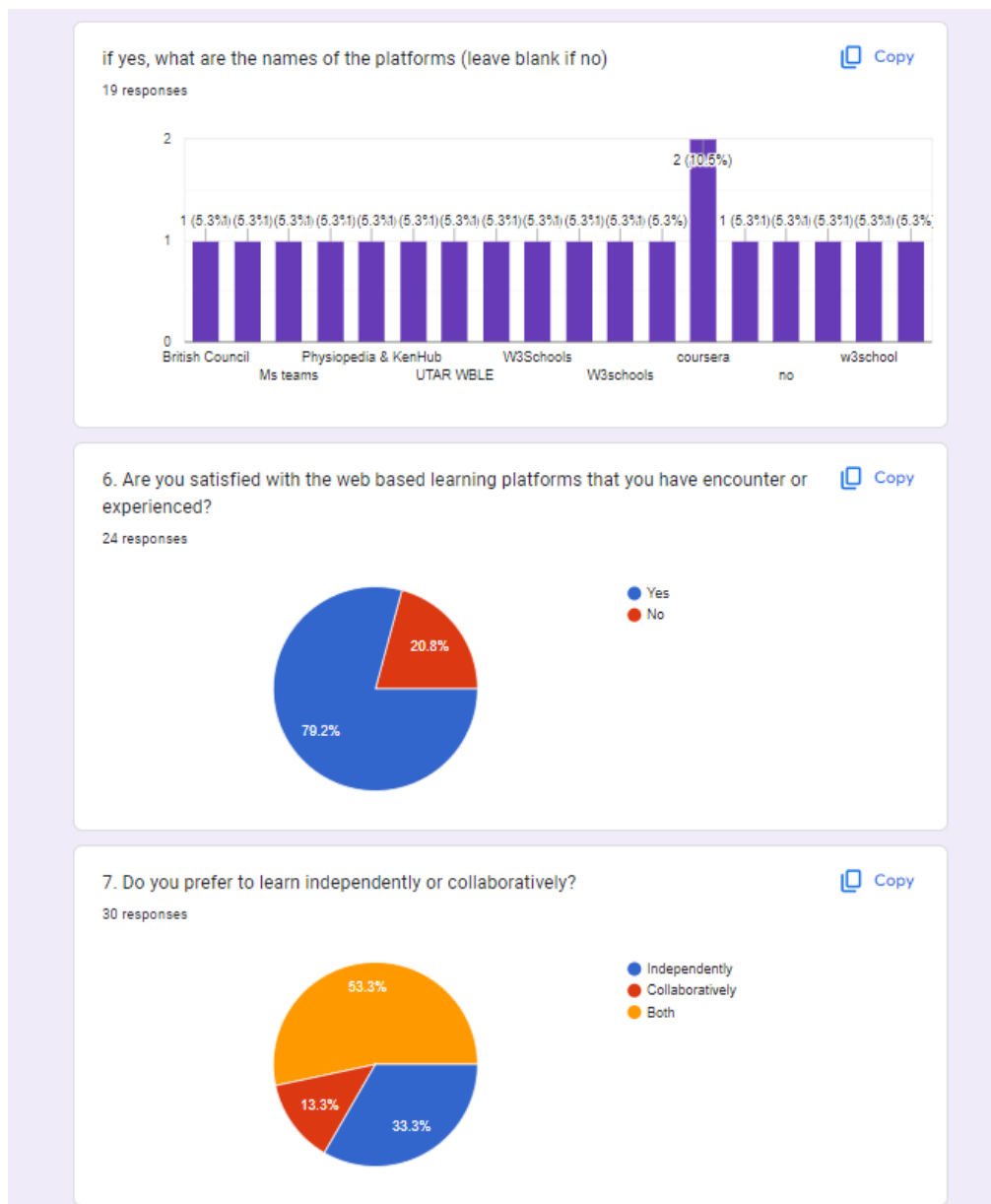


Figure 4.3: Satisfactory & Preferences on Learning

4.2.2 Section B: Experience With LMS

This section of fact finding focus on the questions that will ask respondent on their experience with existing learning management system. All question are multiple choice questions that has answer that range from very, somewhat and not. With these questions, the project can understand what are the respondent needs.

Based on the figure 4.4, 16 respondents very agree that it is valuable to have personalized learning recommendations and the rest responded with somewhat agree. On the same page, the figure indicates that majority of the respondents 76.7% vert agree that a system that identifies student's learning path and recommendation would be helpful and 0% respond with not helpful. From this, it is obvious that having personalized recommendations is crucial feature for the project.

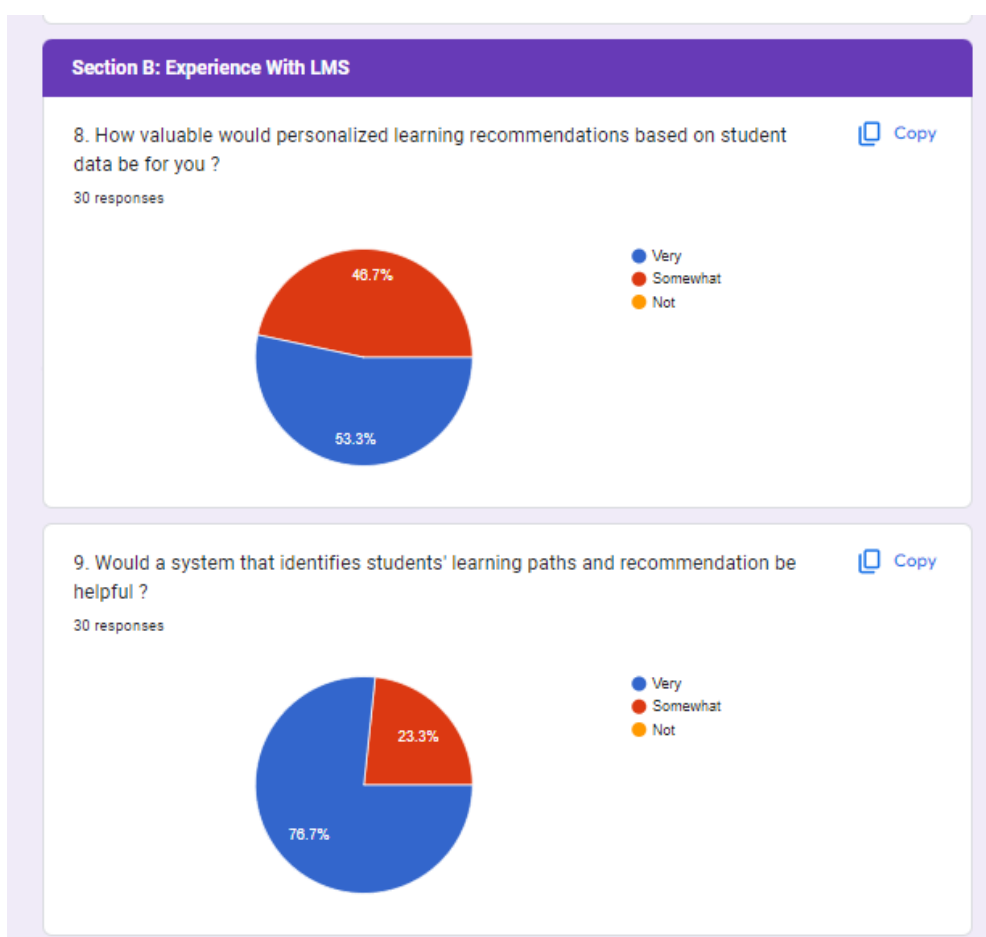


Figure 4.4: Opinion on personalized learning & recommendation path

From question 10 to 12 in figure 4.5, it showcase the opinion of the tools that would useful for a education management system. 50% very agree and 50% somewhat agree that tools in facilitating collaboration, feedback and peer to peer learning would be effective in the project. Furthermore, 66.7% from the 30 responses very agree that comprehensive performance analytics would be valuable to them. Lastly, question 12 shows that 76.7% respondents very agree that personalized feedback is important to them.

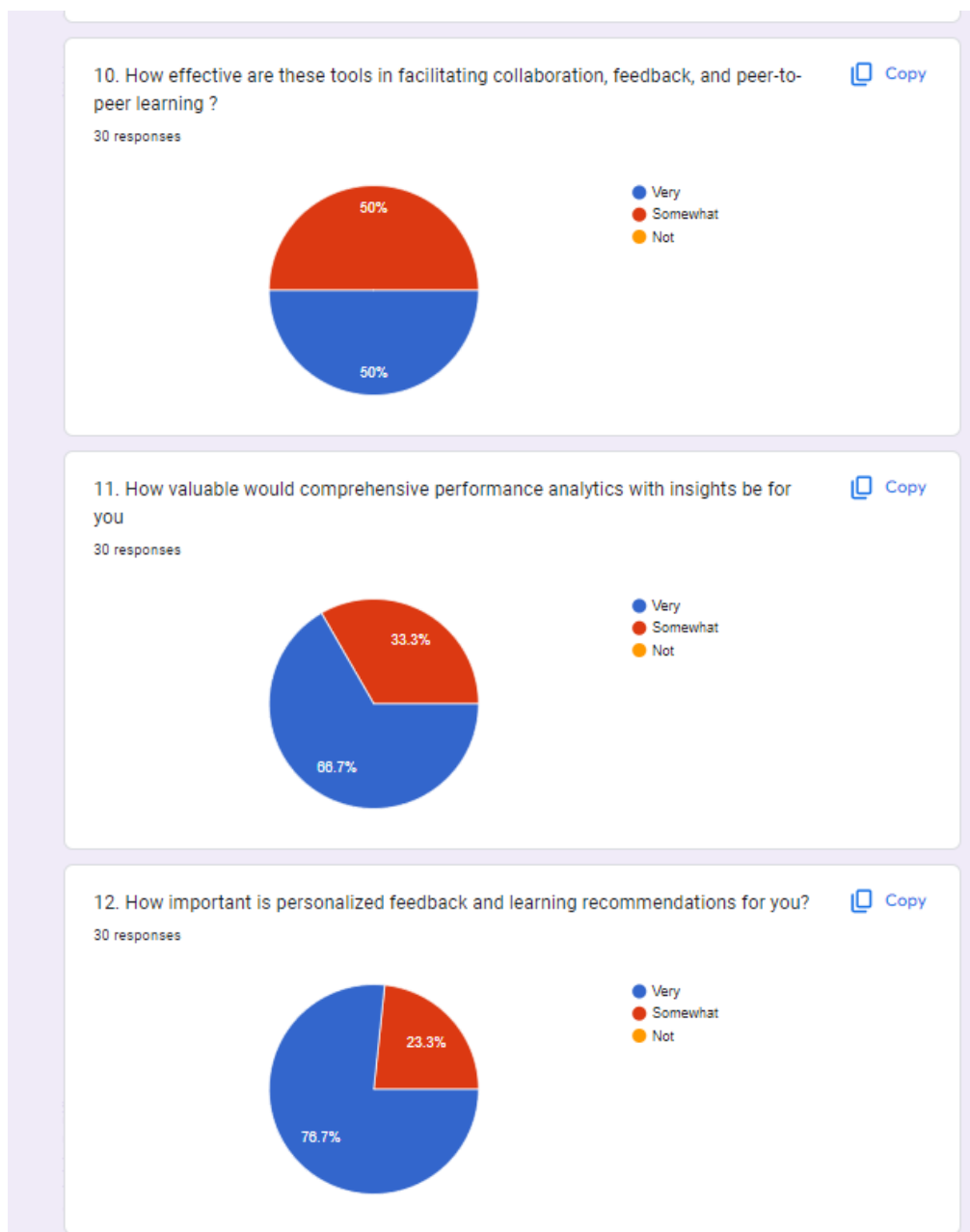


Figure 4.5: Opinion on analytics, collaboration and recommendations tools

4.2.3 Section C: Questions on the Education Management System

This section of questions in the survey will focus on the education management system which is this proposed project. These questions aim to gather information to have a deep understanding of the requirement and needs of target users and identify the respondent general experience interact with the education management system.

Figure 4.6 shows that 40% of the users rarely interact with other users in an education management system. This is a problem and it will not achieved synergetic learning between all users. Following that, 90% of them agree that tools to encourage collaboration would be beneficial. Lastly, over half of them agree that measuring the impact of collaboration is important. Theremore, making user collaboration an important aspect in the education management system.

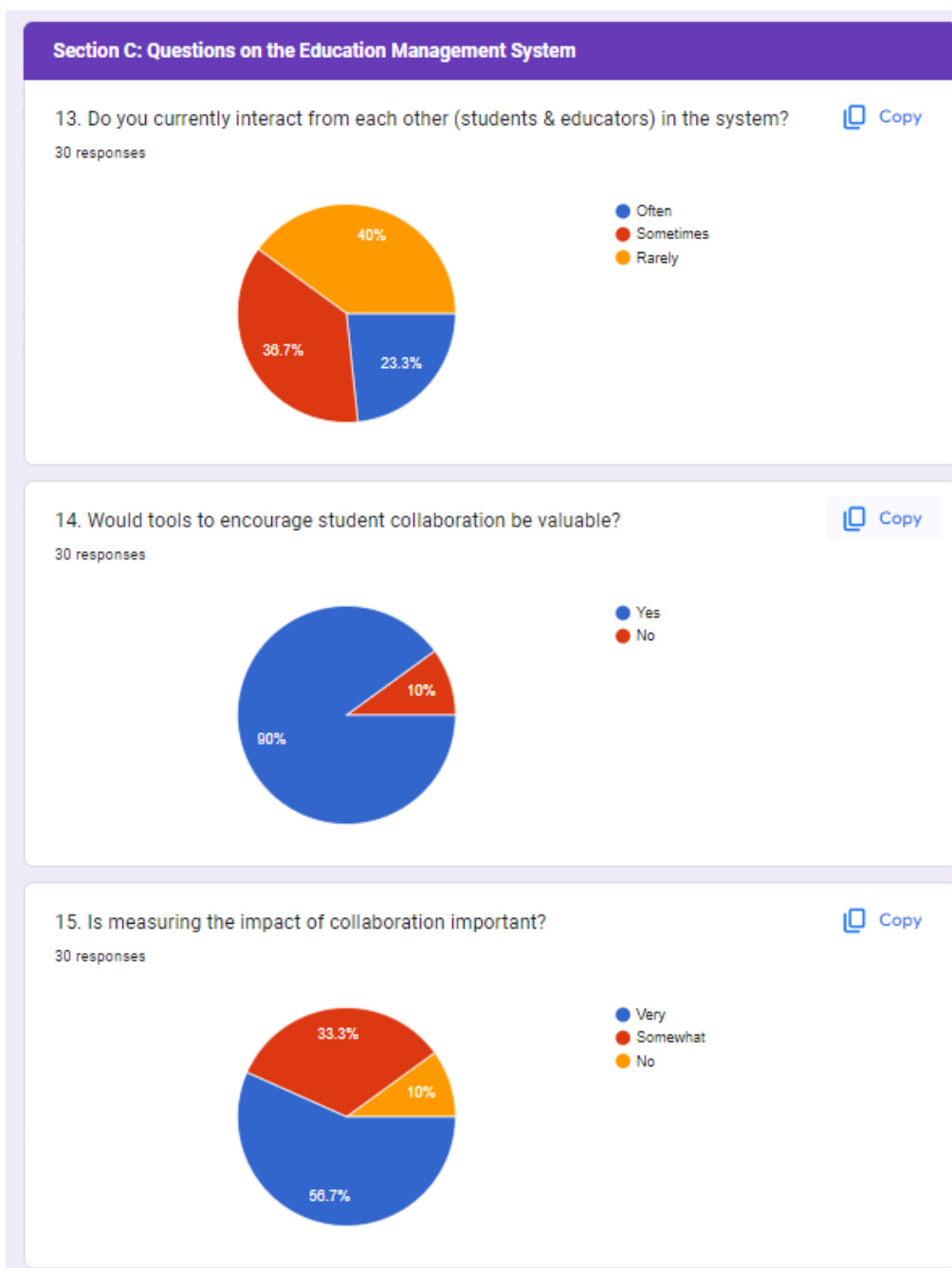


Figure 4.6: Importance of collaboration

Questions 16 to 18 in figure 4.7, 46.7% respondent mentioned that they could not easily track their progress and around 33.3% of them are not clear that their current communication tools is effective for them. This highlights the importance of having a good communication tools while having a good personalized learning insights be useful.

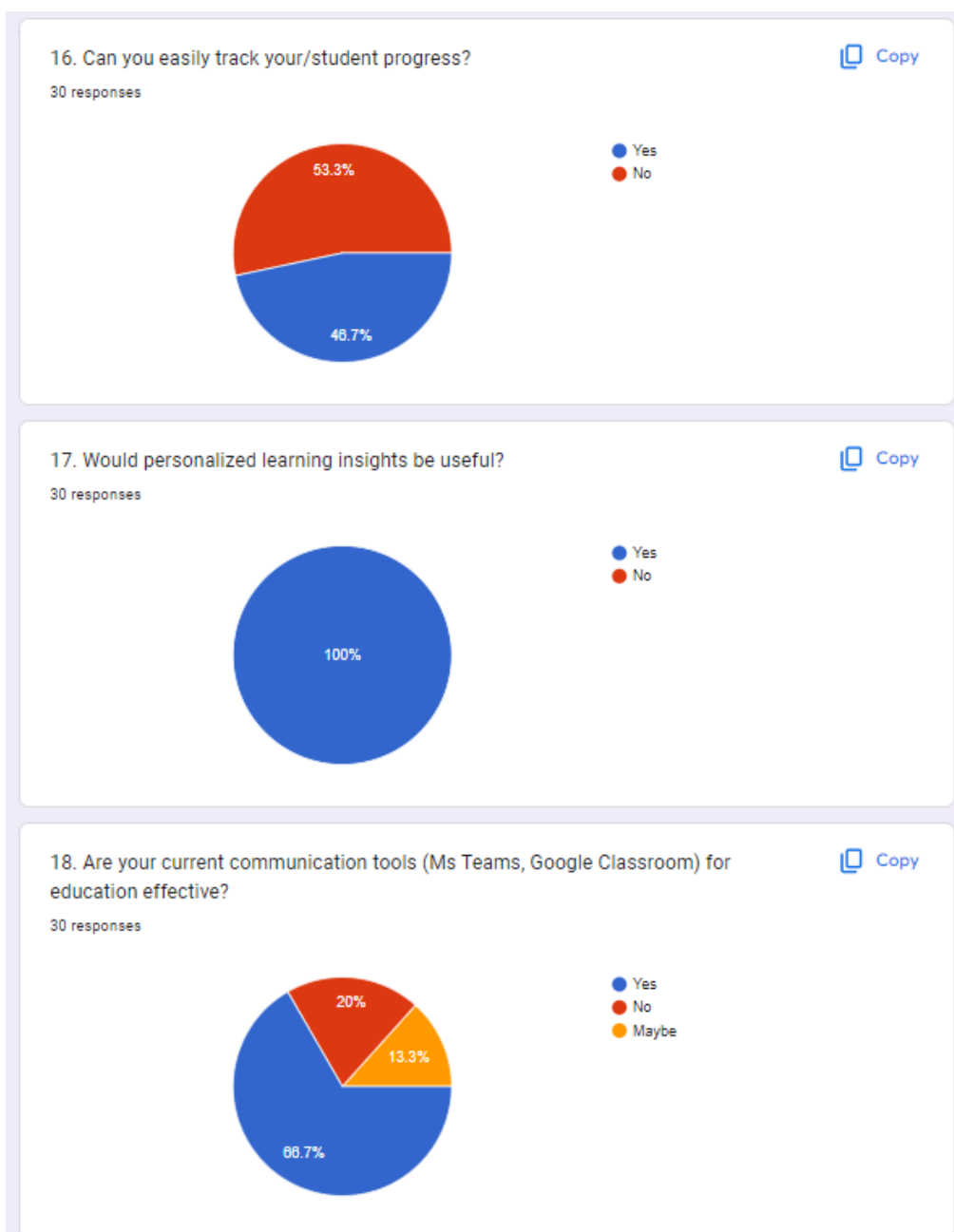


Figure 4.7: Importance of tracking and insights on performance

Figure 4.8 helps to showcase the importance of data privacy and all in one communication tools. 29 out of 30 respondents think that a system with all-in-one communication tools for education will help in their learning. Besides that, similarly 96.7% of them agree that data privacy is very important to them. Thus, having a secure and feature rich platform is very important to the target users.

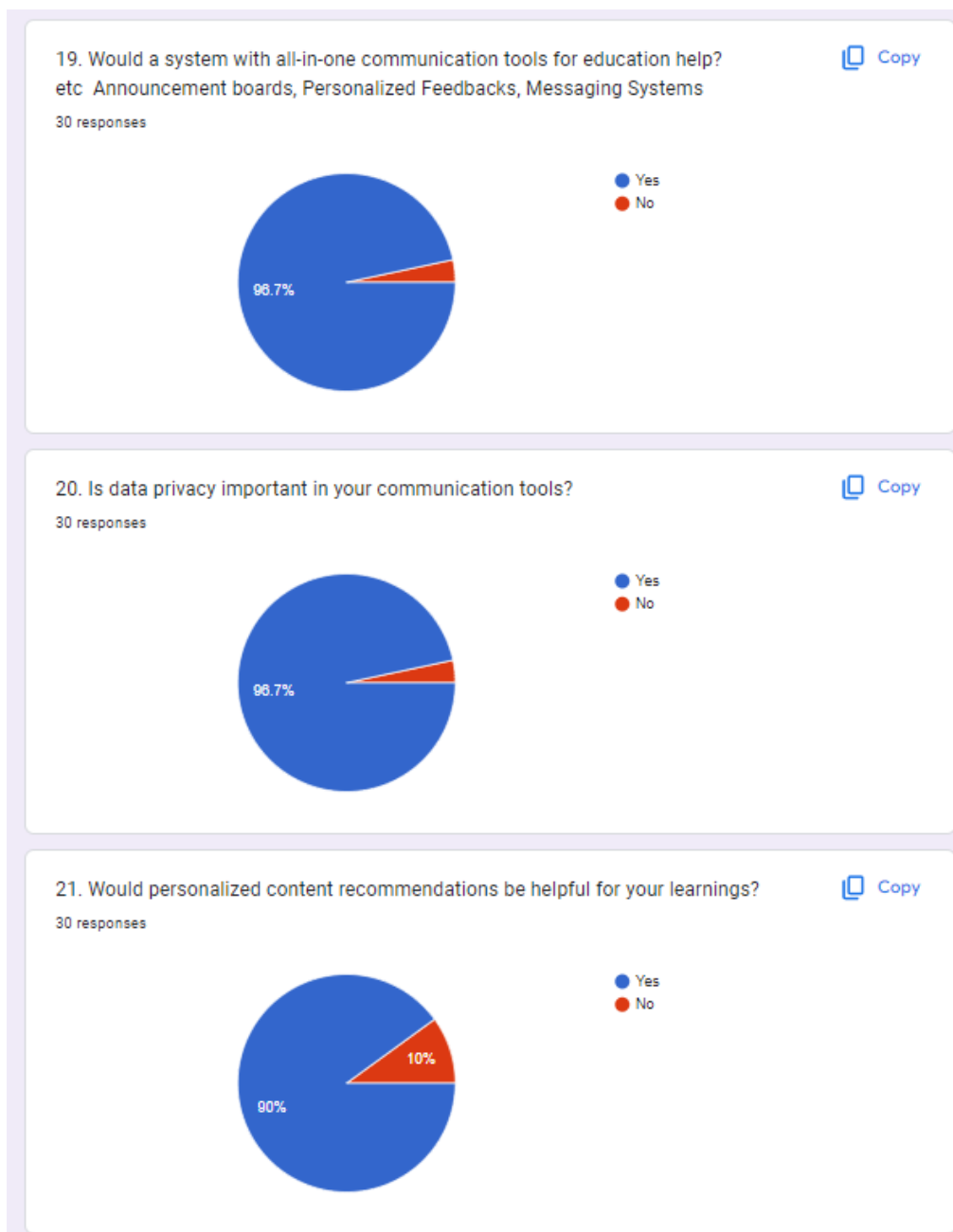


Figure 4.8: Importance of data privacy and all in one communication tool

For the Question 22 in figure 4.9, 100% of respondents agree that it is valuable to share content easily through the platform with the other users.

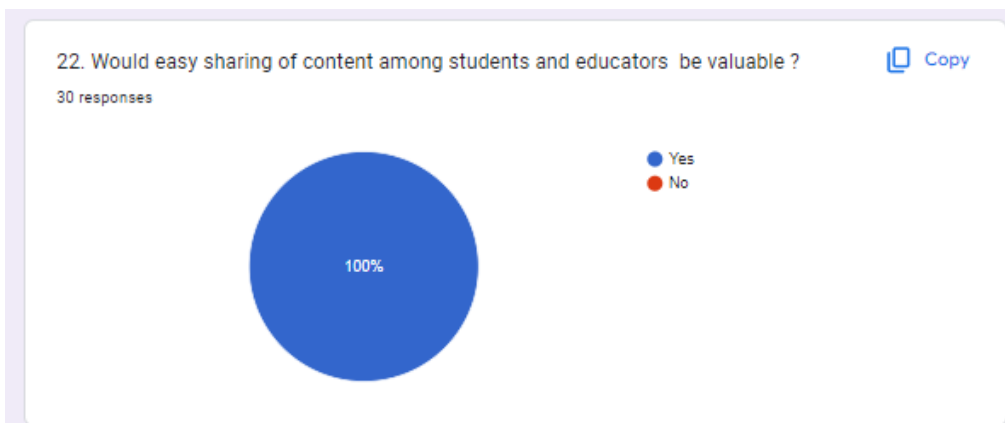


Figure 4.9: Importance of content sharing

4.2.4 Section C: Open Ended Questions

For the section C, questions are prepared to gain a deeper insights into the respondent. The questions are open ended questions and allows the respondent to answer their honest opinion towards the question. Therefore, gaining valuable insights towards the truthful thoughts from them.

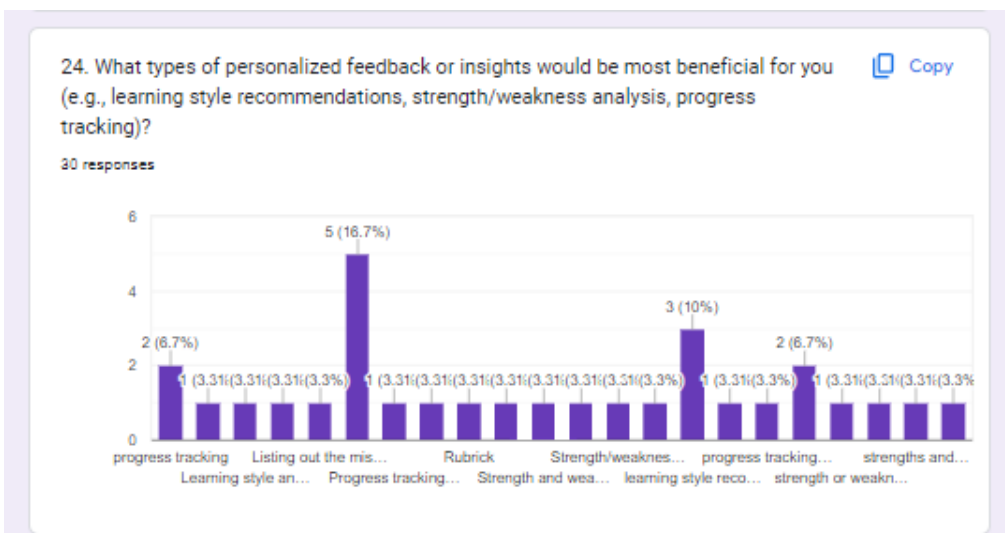


Figure 4.10: Type of personalized feedback

Figure 4.10, shows that majority of the responses agree that features such as discussion forum, announcement board and presonalized feedback would improve the learning and collaboration in the education environment.

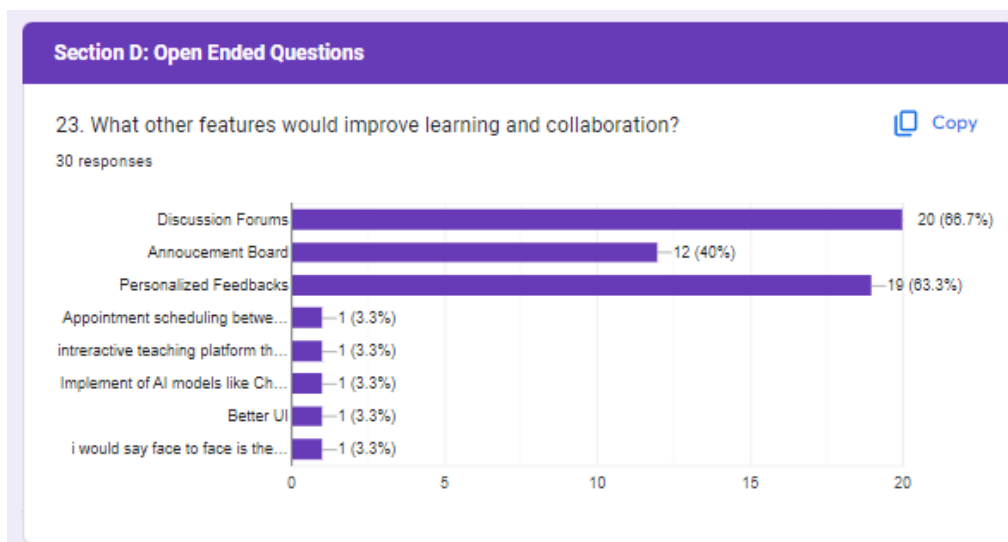


Figure 4.11: Features suggestions

In the figure 4.11, in the nature of open ended questions, majority of respondents have given their own answers towards the questions. But theres a pattern where the respondents would agree that strength/weakness analysis is beneficial for them. For the question 25, most respondents would like to have pdf file type to be supported in the system along side with common media type such as image and videos.

25. Is there a specific type of content you wish the system could access (e.g., pdf, images)?

30 responses

pdf

Images

multiple types of contents

Pdf

Images , videos , document files

all in one platform, i can use it to search my module, and then my online alss also will be using that platform too and etc

PDF & Images

PDF

imane

A screenshot of a survey question. The question is "25. Is there a specific type of content you wish the system could access (e.g., pdf, images)?" and it has received 30 responses. The responses are listed in a scrollable list: "pdf", "Images", "multiple types of contents", "Pdf", "Images , videos , document files", "all in one platform, i can use it to search my module, and then my online alss also will be using that platform too and etc", "PDF & Images", "PDF", and "imane".

Figure 4.12: Type of content distribution

Lastly from question 26 towards the end question 28, the feedback on the project are given from the respondents. Each of them has given their own concern and improvement that they would like to see and some of the features are very personalized towards their own interests such as custom QnA for the students. But mostly the respondent are concern on the usability and reliability of the system and hoping that the system would be free without any hidden fees. As majority of them would like to use this project for their own existing learning environment.

4.2.5 Conclusion

In conclusion, after conducting the survey and having a thorough analysis on the survey results, the project has gained a deeper insight of the target user frustrations where the data analysis functionalities need improvement, and they seek tools to provide personalized learning path. Besides that, student needs are shown with the help of the survey which they would like to have a clear communication channel with educators. Through these findings, it aligns with the goals of this proposed project where the project prioritizes functionalities that address the target user needs such as performance analysis and personalized learning, content and collaborative sharing features and seamless communication tools. The original proposed scope of this project may satisfy the target users' needs but there are some good feedback and concerns issued by the respondent through the survey. This feedback is taken note of and will be carefully analyzed for any future amendments.

4.3 Requirements Specification

For this section, the requirements specifications are divided into 2 key categories. These keys are the functional requirements and non-functional requirements. The functional requirements encompass the core features that the project must provide to fulfil the needs of its users. Non-functional requirement will address the aspects that the functional requirement did not cover such as the performance, availability, compatibility, security, and usability. These

requirements collectively contribute to the overall quality and performance of the final software system. By addressing both of functional and non-functional requirements correctly to the user's needs, a project that meet the user requirement and needs can be delivered.

4.3.1 Functional Requirements

1. The system shall allow educators and students to register and create user accounts.
2. The system shall allow educators and students log in securely.
3. The system shall allow educators and students to manage their profiles, including updating basic information.
4. The system shall allow educators to upload learning materials.
5. The system shall allow students to access and view uploaded learning materials.
6. The system shall allow educators to create classroom.
7. The system shall offer performance analytics for educators to track student progress.
8. The system shall provide features for generating personalized learning plan based on student performance data processed by AI.
9. The system shall allow students track their own learning progress.
10. The system shall allow educators to post announcements in classroom.
11. The system shall allow send and receive messages between educators and students within classroom.
12. The system shall allow educators and students to interact with each other through questions and answers.

4.3.2 Non-Functional Requirements

Performance:

1. The system shall function smoothly without unexpected crashes.
2. The system shall respond to user input within an acceptable timeframe to ensure a smooth user experience.
3. The system shall handle multiple simultaneous user requests effectively without crashing or degrading performance.

Availability:

1. The system shall have backup and recovery mechanisms in place to quickly restore operations in case of unexpected failures.

Compatibility:

1. The system shall be accessible and function smoothly different kinds of major browsers.
2. The system shall display correctly on various screen resolutions across different screen sizes and device types.

Security:

1. The system shall implement user authentication to ensure only authorized users can access their accounts.
2. The system shall follow best practices for data encryption and secure data storage.

Usability:

1. The system shall have consistent and clear color design to improve the user experience.
2. The system shall provide clear prompts and instructions to guide users through functionalities.
3. The system shall provide an intuitive user interface that is easy to navigate and understand without extensive training.

4.4 System Use Case

4.4.1 Use Case Diagram

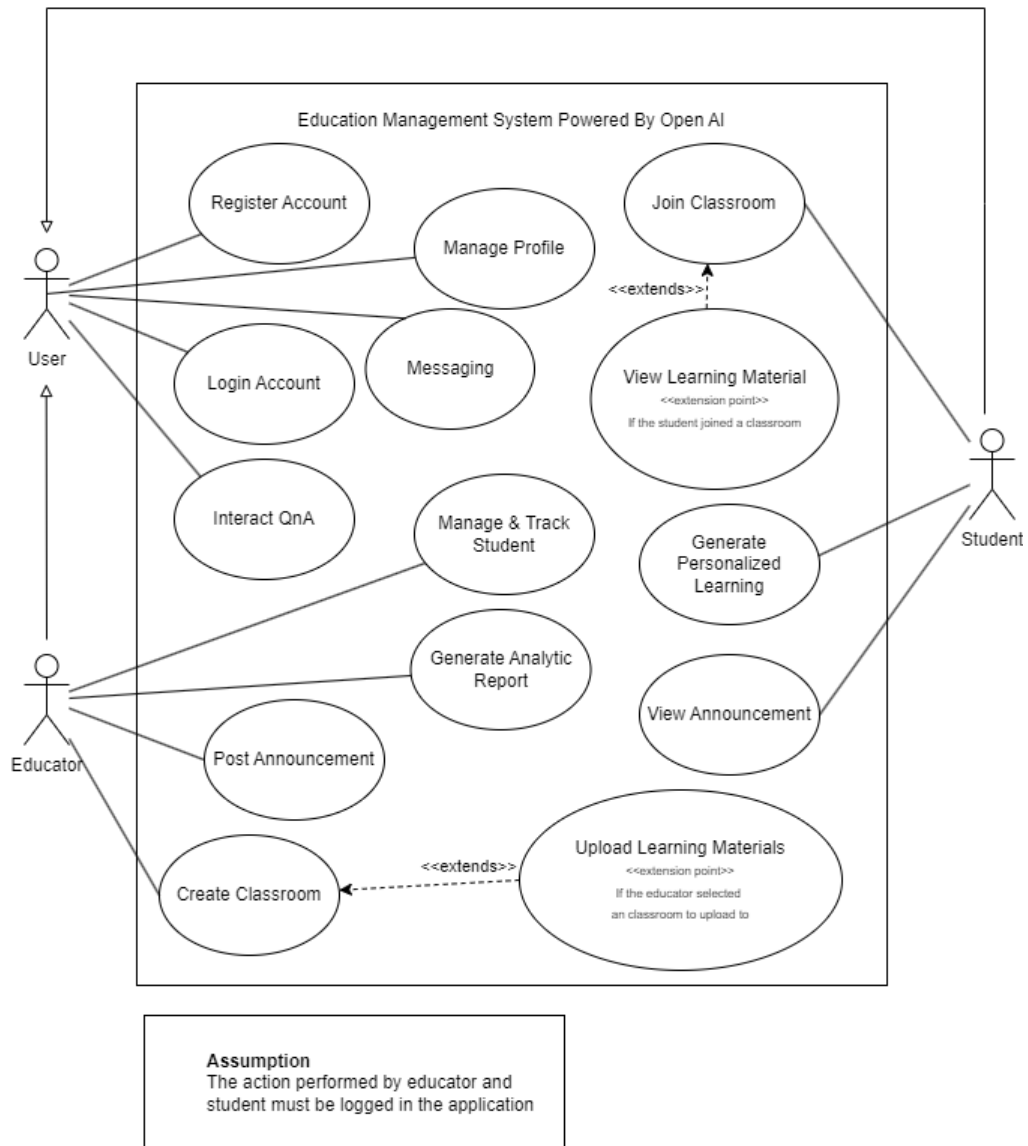


Figure 4.14: Use case diagram of the proposed system

4.4.2 Use Case Description

Table 4.1: Use Case of Log In Account.

Use Case Name: Login Account	ID: 1	Importance Level: High
Primary Actor: User	Use Case Type: Detail, Real	
Stakeholders and Interests: User – Want to securely access their accounts to use the platform's features.		
Brief Description: The user login into the system by entering their login credentials to access their account and use the platform features.		
Trigger: The user initiates the login process by selecting the login button on the landing page of the platform.		
Relationships: Association : User Include : - Extend : - Generalization : -		
Normal Flow of Events: <ol style="list-style-type: none"> 1. The user opens the application via the web browser. 2. The user selects the login option on the dashboard. 3. The system prompts the user to enter their username and password. 4. The user enters their username and password. 5. The system validates the user's credentials. 6. If the credentials are valid, the system grants access to the user's account and redirect user to the dashboard interface. 7. If the credentials are invalid, proceed to S-1. 		
Sub-flows:		

<p>Alternate/Exceptional Flows:</p> <p>4-1: Invalid credentials.</p> <ul style="list-style-type: none"> - The system displays an error message to the user, indicating that the credentials are incorrect. - The system allows the user to re-enter the username and password. <p>3-1: Create Account</p> <ul style="list-style-type: none"> - If the user does not have an account, Use Case ID:2 is performed
--

Table 4.2: Use Case of Register Account.

Use Case Name: Register Account	ID: 2	Importance Level: High
Primary Actor: User	Use Case Type: Detail, Real	
Stakeholders and Interests:		
User – Want to create a new account on the platform to access its features.		
Brief Description: The user creates a new account on the platform by providing their information and credentials.		
Trigger:		
The user initiates the register process by selecting the register button on the landing page of the platform.		
Relationships:		
Association : User		
Include : -		
Extend : -		
Generalization : -		
Normal Flow of Events:		
<ol style="list-style-type: none"> 1. The user opens the application via the web browser. 2. The user selects the create account option on the dashboard. 3. The system prompts the user to enter required information, including name, email, and password. 4. The user provides the required information and submits the registration form. 5. The system validates the provided information. 		

<p>6. If the information is valid, the system creates a new user account and confirms registration success.</p> <p>7. If the information is invalid or incomplete, proceed to 3-1. The user will redirect to the dashboard interface after a successful account creation.</p>
Sub-flows:
<p>Alternate/Exceptional Flows:</p> <p>5-1: Invalid or incomplete information.</p> <ul style="list-style-type: none"> - The system displays an error message indicating which fields need correction. - - The system allows the user to re-enter the required information and submit the form again. <p>3-1: Login</p> <ul style="list-style-type: none"> - If the user has already an account, Use Case: ID:1 is performed

Table 4.3: Use Case of Update Account.

Use Case Name: Update Account	ID: 3	Importance Level: Moderate
Primary Actor: User	Use Case Type: Detail, Real	
Stakeholders and Interests:		
User – Want to manage and update their profile information to keep their account current and accurate.		
Brief Description: The user updates their profile information such as personal details and other settings.		
Trigger:		
The user initiates the update profile process by navigating to their profile and click on the edit button.		
Relationships:		
Association	: User	
Include	: -	
Extend	: -	

Generalization : -
<p>Normal Flow of Events:</p> <ol style="list-style-type: none"> 1. The user navigates to their profile screen. 2. The user selects the update profile button. 3. The system displays the user's current profile information. 4. The user enters new information in the desired fields to update their profile. 5. The system validates the new information. 6. If the information is valid, the system updates the user's profile and confirms success. 7. If the information is invalid or incomplete, proceed to Alternate/Exceptional Flows. 8. The system displays a confirmation message indicating successful profile update.
Sub-flows:
<p>Alternate/Exceptional Flows:</p> <p>5-1: Invalid or incomplete information.</p> <ul style="list-style-type: none"> - The system displays an error message indicating which fields need correction. - - The system allows the user to re-enter the required information and submit the form again.

Table 4.4: Use Case of Messaging.

Use Case Name: Messaging	ID: 4	Importance Level: High
Primary Actor: User	Use Case Type: Detail, Real	
Stakeholders and Interests:		
User – Want to communicate with each other for educational purposes		

Brief Description: The messaging feature users to send and receive messages to facilitate communication within the classroom.
Trigger: The user enters a chatroom inside a classroom to start messaging with other users.
Relationships: Association : User Include : - Extend : - Generalization : -
Normal Flow of Events: <ol style="list-style-type: none"> 1. The user selects the classroom to start messaging. 2. The system displays the messaging interface. 3. The user composes a message and sends it in the classroom. 4. The system delivers the message to the other users in the classroom. 5. The recipient receives the message and can respond back if desired. 6. The user can view message history and manage ongoing conversations.
Sub-flows:
Alternate/Exceptional Flows: 4-1: The system fails to deliver the message. - The system displays an error message indicating that the message could not be delivered. - - The system may suggest the user to try again later

Table 4.5: Use Case of Interact QnA.

Use Case Name: Interact QnA	ID: 5	Importance Level: High
Primary Actor: User	Use Case Type: Detail, Real	
Stakeholders and Interests:		

User – Want to participate in question forums to share ideas, ask questions, and collaborate on educational topics.
Brief Description: This use case allows users to engage in discussions within a structured forum environment, fostering interaction and collaboration on various topics related to the learning material.
Trigger: The users click on the qna section on the application.
Relationships: <ul style="list-style-type: none"> Association : User Include : - Extend : - Generalization : -
Normal Flow of Events: <ol style="list-style-type: none"> 1. The user selects the qna feature on the platform. 2. The system displays the list of available question. 3. The user chooses a specific question to enter. 4. The user can view existing question and answer. 5. The educator can start a new thread by providing an answer. 6. The user can upvote question to show approval. 7. The system posts the user's qna for other users to view
Sub-flows:
Alternate/Exceptional Flows: <ul style="list-style-type: none"> 2-1: The system does not display any available forums. <ul style="list-style-type: none"> - The system displays a message indicating that there are no active forums. - The user may choose to create a new forum if they have the permissions. 7-1: The system fails to post a new thread or reply. <ul style="list-style-type: none"> - The system displays an error message indicating that the post could not be submitted. - The user may be prompted to retry submitting the message.

Table 4.6: Use Case of Create Classroom.

Use Case Name: Create Classroom	ID: 6	Importance Level: High
Primary Actor: Educator	Use Case Type: Detail, Real	
Stakeholders and Interests: Educator – Want to create a virtual classroom for students to join and participate in educational activities.		
Brief Description: This use case describes how the educators can set up a new virtual classroom where students can join		
Trigger: The educators create a new classroom by selecting the create classroom button on the application.		
Relationships: Association : Educator Include : - Extend : Upload Learning Materials (ID: 7) Generalization : -		
Normal Flow of Events: <ol style="list-style-type: none"> 1. The educator selects the to create a new classroom button on the platform. 2. The system prompts the educator to enter details for the new classroom, such as name, description, and settings. 3. The educator provides the necessary details and settings for the classroom. 4. The system processes the creation of the new classroom. 5. The system generates a unique classroom ID or code that students can use to join the classroom. 		
Sub-flows:		
Alternate/Exceptional Flows: 4-1: The system fails to create the classroom due to invalid input.		

<p>- The system displays an error message indicating which fields need to be corrected.</p> <p>- The educator is prompted to provide valid input and retry.</p>

Table 4.7: Use Case of Upload Learning Materials.

Use Case Name: Upload Learning Materials	ID: 7	Importance Level: High
Primary Actor: Educator	Use Case Type: Detail, Real	
Stakeholders and Interests: Educator – Want to upload various types of learning materials for students to access.		
Brief Description: This use case describes how the educator can upload different types of learning materials to the classroom		
Trigger: The educator initiates the process by selecting the option to upload learning materials within a classroom.		
Relationships: Association : Educator Include : - Extend : - Generalization : -		
Normal Flow of Events: <ol style="list-style-type: none"> 1. The educator selects the option to upload learning materials. 2. The system prompts the educator an input option to upload the materials. 3. The educator chooses the desired file(s) to upload from their local device. 4. The system verifies the selected file(s) and confirms the upload action. 5. The system uploads the learning material and stores it in the appropriate location within the classroom. 		

6. The system confirms successful upload to the educator and allows for optional tagging and categorization.
Sub-flows:
<p>Alternate/Exceptional Flows:</p> <p>5-1: Invalid File Format</p> <ul style="list-style-type: none"> - The system detects an invalid file format or unsupported file type. - The system displays an error message indicating the file is invalid. - The educator selects a new file to upload. <p>5-2: File Size Exceeds Limit</p> <ul style="list-style-type: none"> - The system detects the file size exceeds the allowable limit. - The system displays an error message indicating the file size is too large. - The educator chooses a different file to upload.

Table 4.8: Use Case of Post Announcement.

Use Case Name: Post Announcement	ID: 8	Importance Level: High
Primary Actor: Educator	Use Case Type: Detail, Real	
<p>Stakeholders and Interests:</p> <p>Educator – Want to inform students about important announcements or updates related to the classroom.</p>		
<p>Brief Description: This use case describes how the educator can post announcements within the classroom to communicate important information, updates, or reminders to the students.</p>		
<p>Trigger:</p> <p>The educator clicks on the post an announcement section within the classroom.</p>		

<p>Relationships:</p> <p>Association : Educator</p> <p>Include : -</p> <p>Extend : -</p> <p>Generalization : -</p>
<p>Normal Flow of Events:</p> <ol style="list-style-type: none"> 1. The educator selects the to post an announcement section in classroom. 2. The system prompts the educator to enter the announcement content. 3. The educator composes the announcement message, including relevant details. 4. The system verifies the announcement content and confirms the posting action. 5. The system displays the posted announcement in the classroom interface for all students to view.
<p>Sub-flows:</p>
<p>Alternate/Exceptional Flows:</p> <p>4-1: Empty Announcement Content</p> <ul style="list-style-type: none"> - The educator attempts to post an announcement without entering any content. - The system displays an error message indicating that the announcement content cannot be empty. - The educator revises the announcement content and proceeds with posting.

Table 4.9: Use Case of Manage & Track Student.

Use Case Name: Manage & Track Student	ID: 9	Importance Level: High
Primary Actor: Educator	Use Case Type: Detail, Real	
Stakeholders and Interests:		
Educator – Want to effectively manage and track student performance.		

<p>Brief Description: This use case describes how the educator can manage and track students' progress and performance within the platform.</p>
<p>Trigger: The educator selecting the performance and analytics section on the application.</p>
<p>Relationships:</p> <p>Association : Educator</p> <p>Include : -</p> <p>Extend : -</p> <p>Generalization : -</p>
<p>Normal Flow of Events:</p> <ol style="list-style-type: none"> 1. The educator accesses the Performance & Analytics section. 2. The system displays a list of students and overview of the overall performance in the classroom. 3. The educator selects a student to view their performance details. 4. The system displays the selected student's learning progress. 5. The educator reviews the student's performance and progress. 6. The educator can provide feedback or adjust learning plans based on the student's performance.
<p>Sub-flows:</p> <p>6-1: Provide Feedback</p> <ol style="list-style-type: none"> 1. The educator provides feedback towards the student. 2. The system records the feedback and makes it available to the student.
<p>Alternate/Exceptional Flows:</p> <p>4-1: No Available Student Data</p> <ul style="list-style-type: none"> - If there is no data available for the selected student, the system displays an appropriate message. - The educator can select a different student to manage and track.

Table 4.10: Use Case of Generating Analytic Report.

Use Case Name: Generate Analytic Report	ID: 9	Importance Level: High
Primary Actor: Educator	Use Case Type: Detail, Real	
Stakeholders and Interests: Educator – Want to effectively analyze and track users performance.		
Brief Description: This use case describes how the educator can generate analysis report and performance within the platform.		
Trigger: The educator selecting the analytics section on the application.		
Relationships: Association : Educator Include : - Extend : - Generalization : -		
Normal Flow of Events: 7. The educator accesses the Performance & Analytics section. 8. The system displays a list of classroom to analyze. 9. The educator selects a classroom and click generate report. 10. The system displays the selected classroom and generate the analysis. 11. The educator reviews the classroom analytic report. 12. The educator can provide feedback or adjust learning plans based on the analytic.		
Sub-flows: 6-1: Provide Feedback 3. The educator provides feedback towards the student. 4. The system records the feedback and makes it available to the student.		
Alternate/Exceptional Flows: 4-1: No Available Student Data		

<ul style="list-style-type: none"> - If there is no data available for the selected student, the system displays an appropriate message. - The educator can select a different student to manage and track.

Table 4.11: Use Case of Join Classroom.

Use Case Name: Join Classroom	ID: 11	Importance Level: High
Primary Actor: Student	Use Case Type: Detail, Real	
Stakeholders and Interests: Student – Wants to join a classroom to access classroom features and materials provided by educators.		
Brief Description: This use case describes how the system allows students to join a classroom using a specific code or invitation link provided by the educator.		
Trigger: The student clicking on join classroom button.		
Relationships: <ul style="list-style-type: none"> Association : Student Include : - Extend : View Learning Material (ID:12) Generalization : - 		
Normal Flow of Events: <ol style="list-style-type: none"> 1. The student clicks on the join classroom button. 2. The system prompts the student to enter the classroom code or follow the invitation link. 3. The student provides the code or follows the link to join the classroom. 4. The system verifies the code or link to check if the classroom exists. 5. If successful, the student will join the classroom. 6. The student can view and interact all the features that the classroom and educators have provided. 		

Sub-flows:
Alternate/Exceptional Flows: 4-1: Verification Error <ul style="list-style-type: none"> - If there is an error during the verification process, the system displays an error message to the student. - The student may try again or contact the educator for assistance.

Table 4.12: Use Case of View Learning Material.

Use Case Name: View Learning Material	ID: 12	Importance Level: High
Primary Actor: Student	Use Case Type: Detail, Real	
Stakeholders and Interests: Student – Wants to access and view learning materials uploaded by educators within the classroom.		
Brief Description: This use case describes how students can view learning materials uploaded by educators within the classroom.		
Trigger: The student accesses the classroom and selects the option to view learning materials		
Relationships: Association : Student Include : - Extend : - Generalization : -		
Normal Flow of Events: <ol style="list-style-type: none"> 1. The student navigates to the classroom where learning materials are available. 2. The student selects to view learning materials. 3. The system retrieves and displays a list of available learning materials. 		

<ol style="list-style-type: none"> 4. The student selects a specific learning material from the list. 5. The system retrieves and displays the selected learning material. 6. The student can now view and interact with the learning material.
Sub-flows:
<p>Alternate/Exceptional Flows:</p> <p>3-1: No Learning Materials Available</p> <ul style="list-style-type: none"> - If there are no learning materials uploaded by educators in the classroom, the system displays a message indicating the absence of materials. - The student may return to the classroom or select another learning materials

Table 4.13: Use Case of View Announcement.

Use Case Name: View Announcement	ID: 13	Importance Level: High
Primary Actor: Student	Use Case Type: Detail, Real	
Stakeholders and Interests: Student – Wants to access and view announcements posted by educators within the classroom.		
Brief Description: This use case describes how students can view announcements posted by educators within the classroom.		
Trigger: The student views the announcement by selecting the announcement section within a specific classroom		
Relationships: Association : Student Include : - Extend : - Generalization: -		
Normal Flow of Events:		

<ol style="list-style-type: none"> 1. The student selects specific a classroom. 2. The student clicks on view announcements. 3. The system retrieves and displays a list of posted announcements. 4. The student selects a specific announcement from the list to view details. 5. The system retrieves and displays the selected announcement with detailed information.
Sub-flows:
Alternate/Exceptional Flows: 3-1: No Announcements Available <ul style="list-style-type: none"> - If there are no announcements available, the system displays a message indicating an error message. - The student may return to the classroom to select another classroom

Table 4.14: Use Case of Generate Personalized Learning Journey.

Use Case Name: Generate Personalized Feedback	ID: 14	Importance Level: High
Primary Actor: Student	Use Case Type: Detail, Real	
Stakeholders and Interests: Student – Wants to generate personalized learning plan		
Brief Description: This use case describes how students can generate personalized learning plan on based on their learning progress.		
Trigger: The student clicks on the generate button to requests personalized learning plan		
Relationships: Association : Student Include : -		

Extend : - Generalization: -
Normal Flow of Events: <ol style="list-style-type: none">1. The student requests personalized learning plan from the system.2. The system gathers data on the student's learning progress.3. The system send data to Open AI API to analyzes the data to generate personalized learning plan for the student.4. The system displays the personalized learning plan to the student.5. The student reviews the feedback and acts based on the recommendations provided.
Sub-flows:
Alternate/Exceptional Flows: <p>4-1: No Feedback Available</p> <ul style="list-style-type: none">- If the Open AI API does not function properly, it informs the student that feedback is not available now.- The student may continue with other learning activities and request feedback again later.

4.5 Interface Flow Diagram

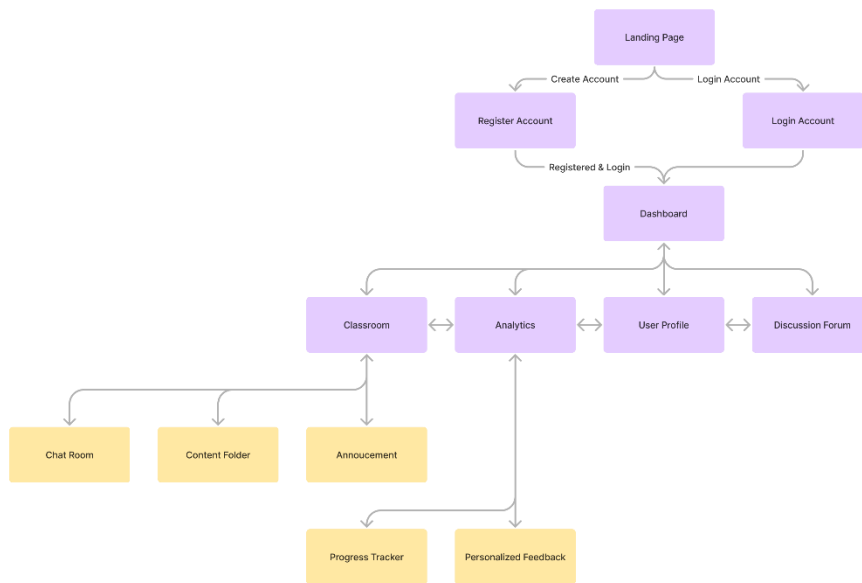


Figure 4.15: Interface flow diagram of the proposed system

4.6 ERD Diagram

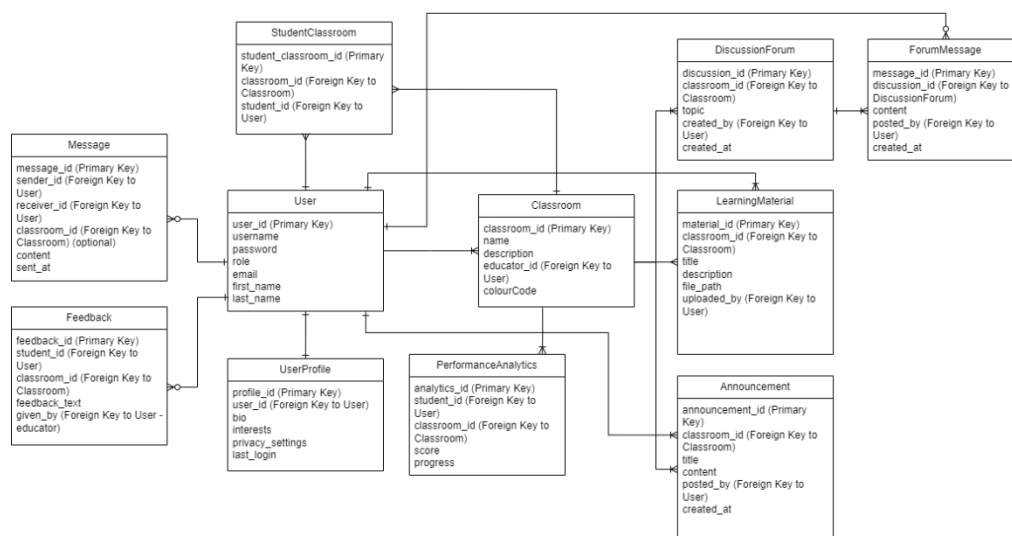


Figure 4.16: ERD diagram of the proposed system

4.7 Prototype

For this section, a user interface prototype design is prepared to visualize the overall concept of the proposed project. The prototype design will cover all the functional requirements and the project scope. It can greatly help the development process as it provides a framework to follow when developing the project. All the design schemes and guides of the project are drafted out to guide on the front end which will be the interface that the user will be interacting with.

1. Landing Page

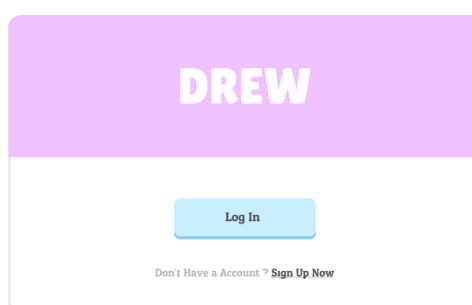


Figure 4.17: Landing Page Screen.

2. Login Page

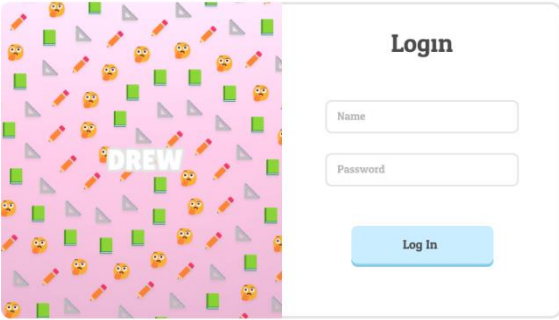
The image shows a login page with a decorative background on the left and a white form on the right. The background features a repeating pattern of colorful geometric shapes (triangles, squares, circles) and the word "DREW" in white capital letters. The form is titled "Login" and contains three input fields: "Name", "Password", and a "Log In" button.

Figure 4.18: Login Page Screen.

3. Sign Up Page

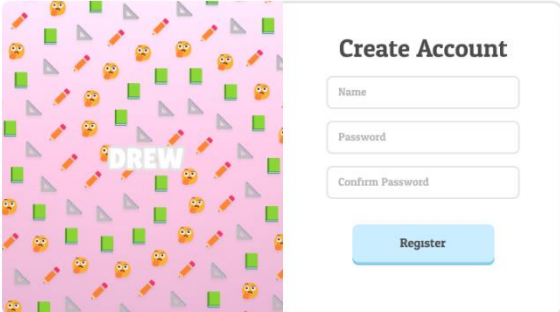
The image shows a sign-up page with a decorative background on the left and a white form on the right. The background features a repeating pattern of colorful geometric shapes (triangles, squares, circles) and the word "DREW" in white capital letters. The form is titled "Create Account" and contains three input fields: "Name", "Password", and "Confirm Password", followed by a "Register" button.

Figure 4.19: Sign Up Screen

4. Dashboard Page

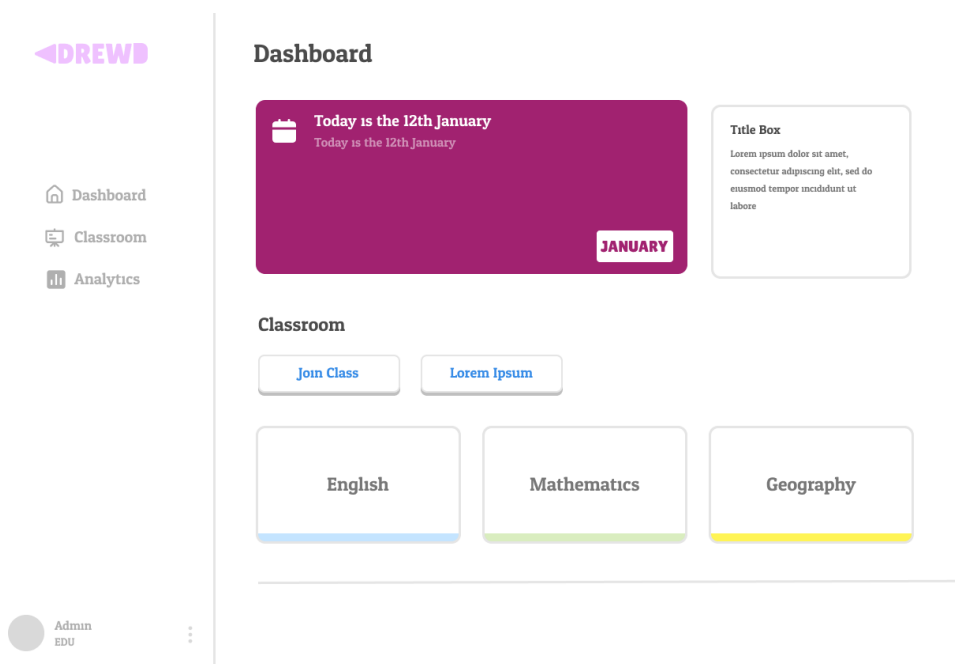


Figure 4.20: Dashboard Screen

5. User Profile Page

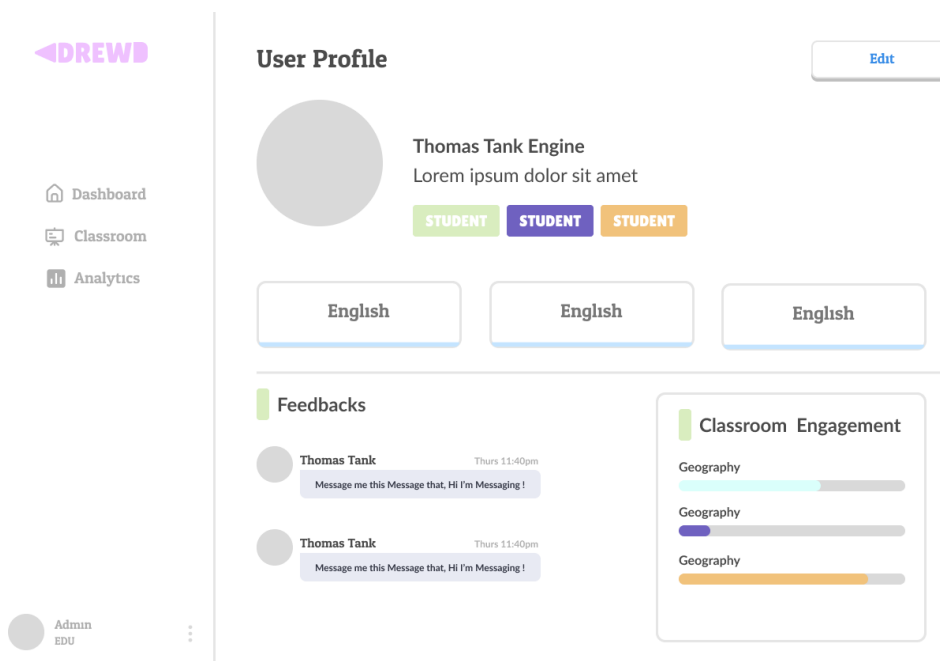


Figure 4.21: User Profile Screen

6. Performance Analytics Page

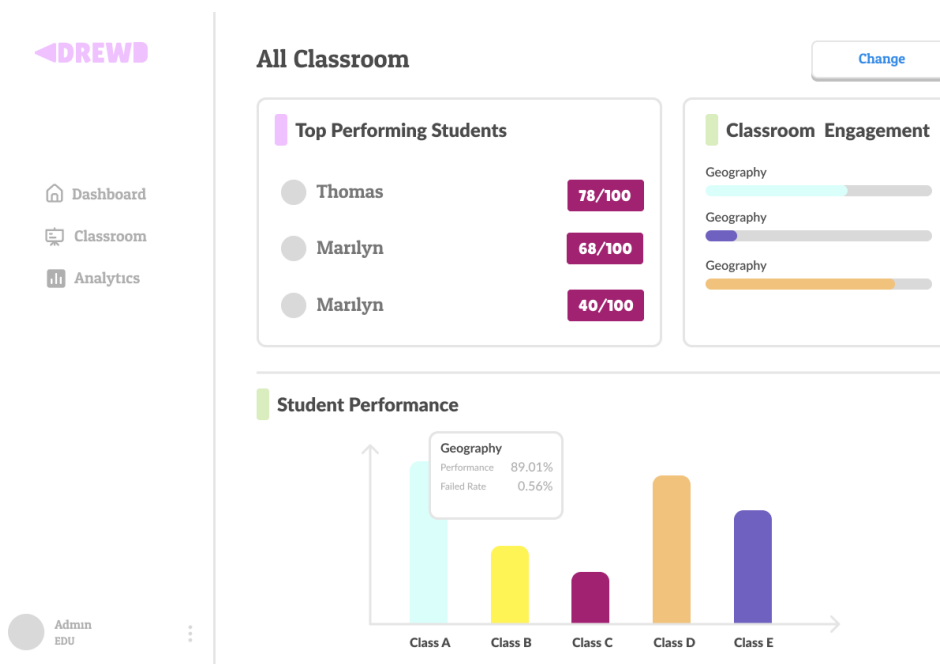


Figure 4.22: Performance Analytics Screen

7. Personalized Feedback Page

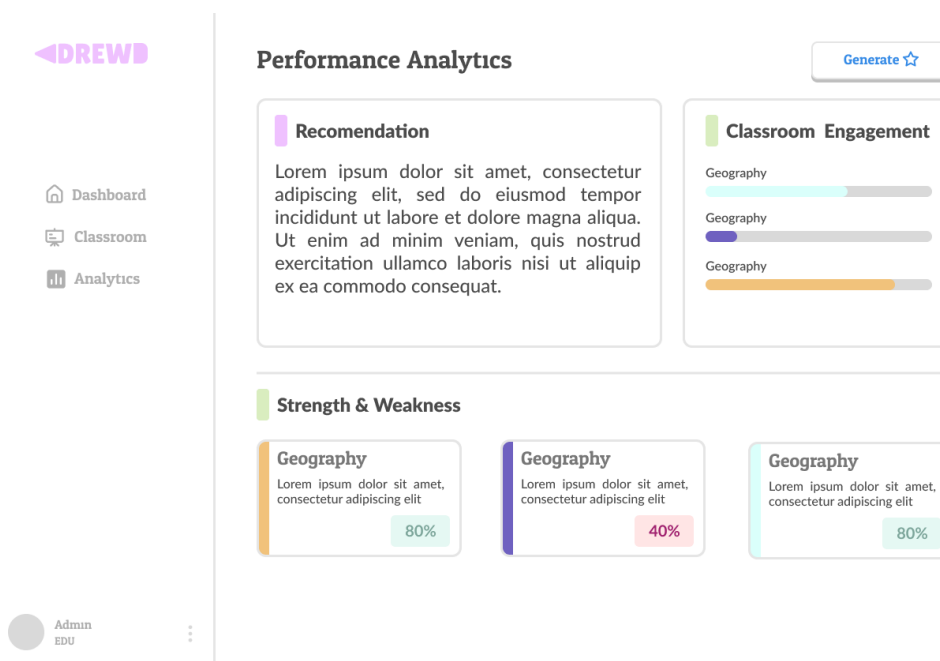


Figure 4.23: Personalized Feedback Screen.

8. View Classroom Page

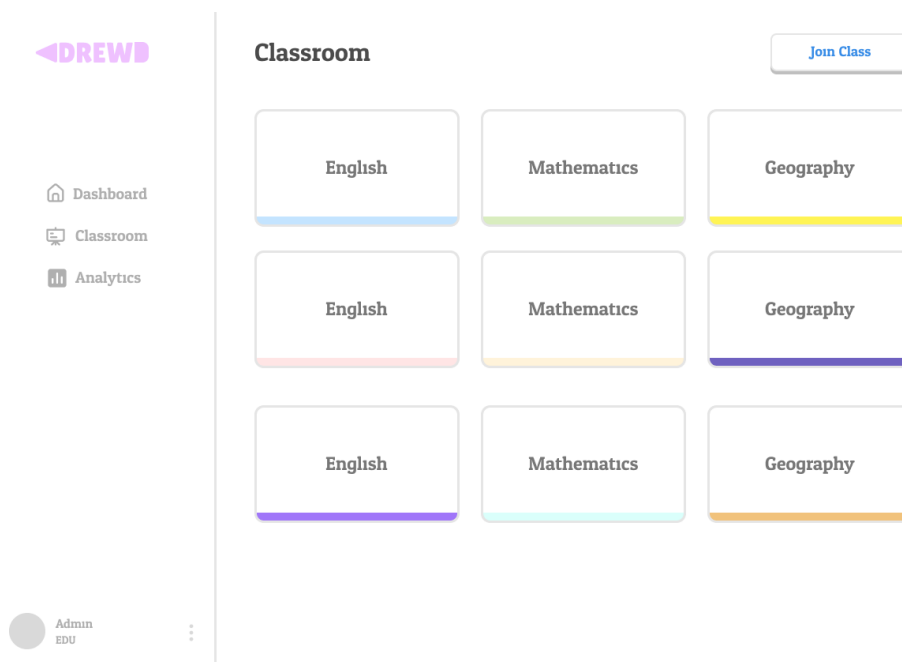


Figure 4.24: View Classroom Screen.

9. Create Classroom Page

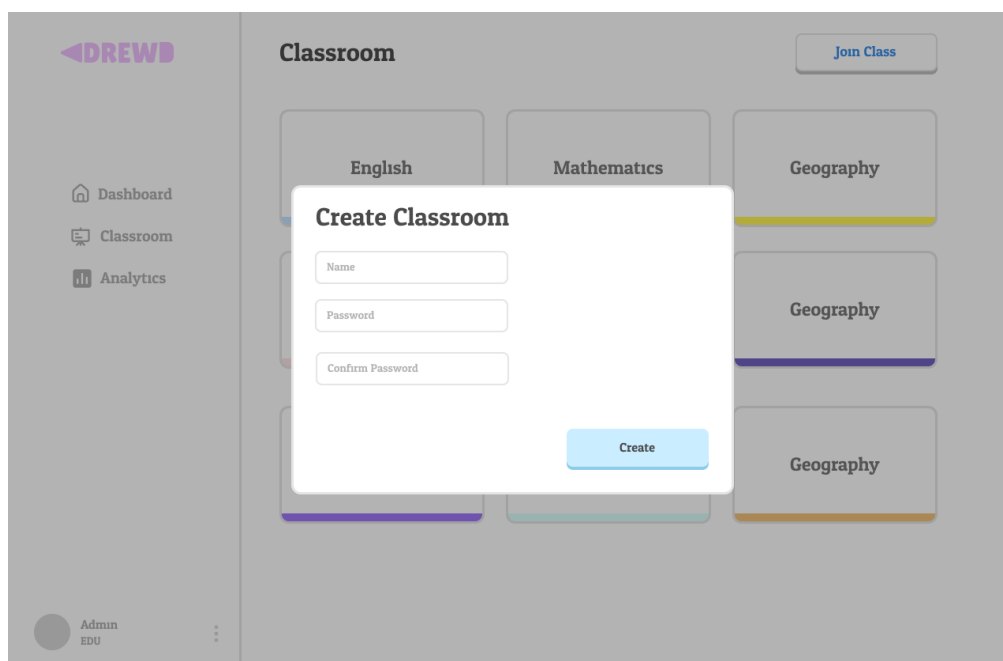


Figure 4.25: Create Classroom Screen.

10. Edit Classroom Page

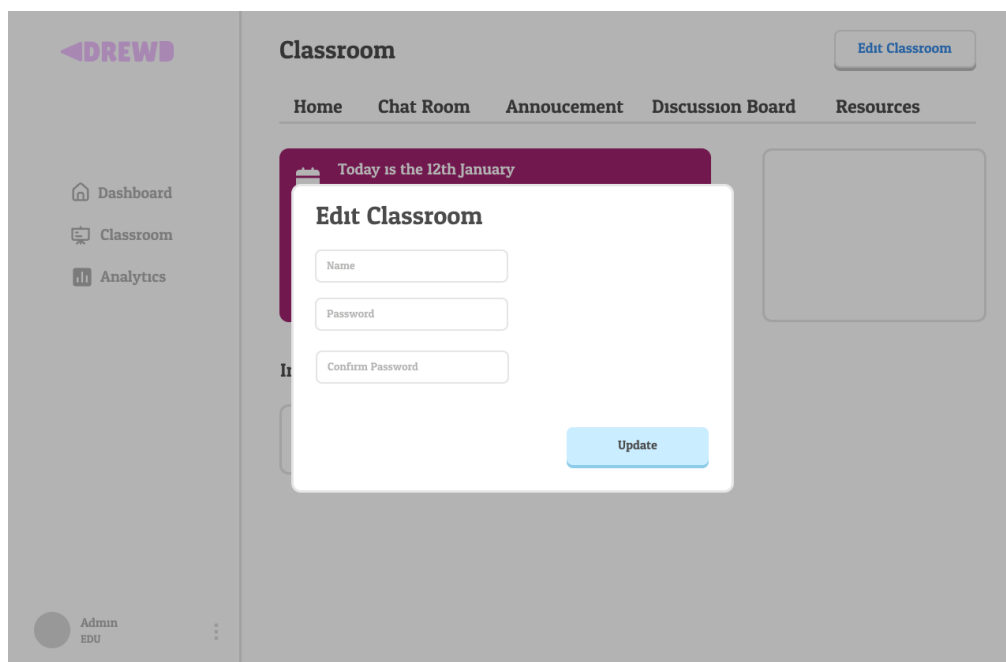


Figure 4.26: Edit Classroom Screen.

11. View Specific Classroom Page

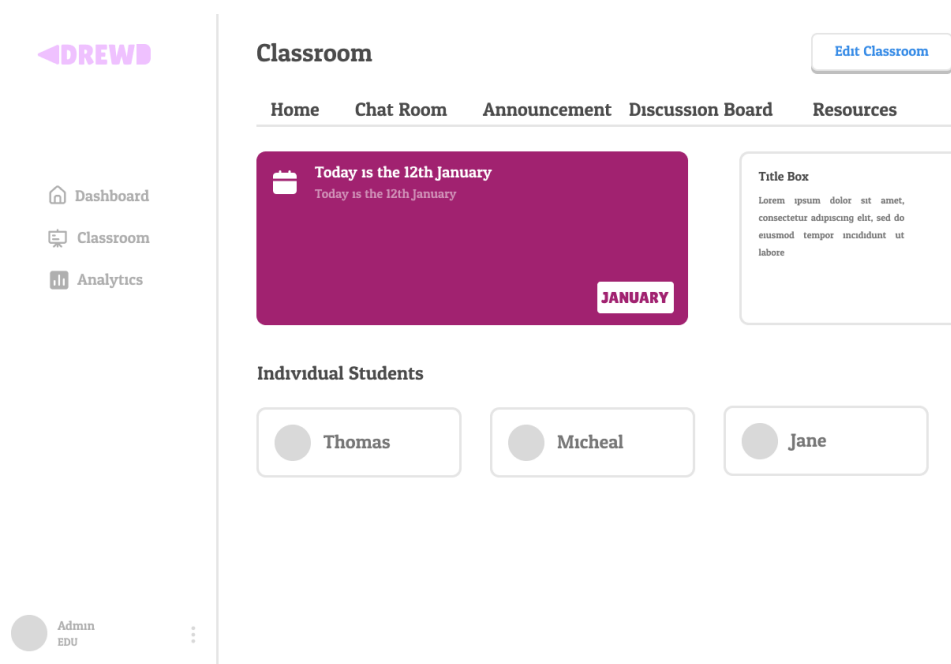


Figure 4.27: View Individual Classroom Screen.

12. Messaging

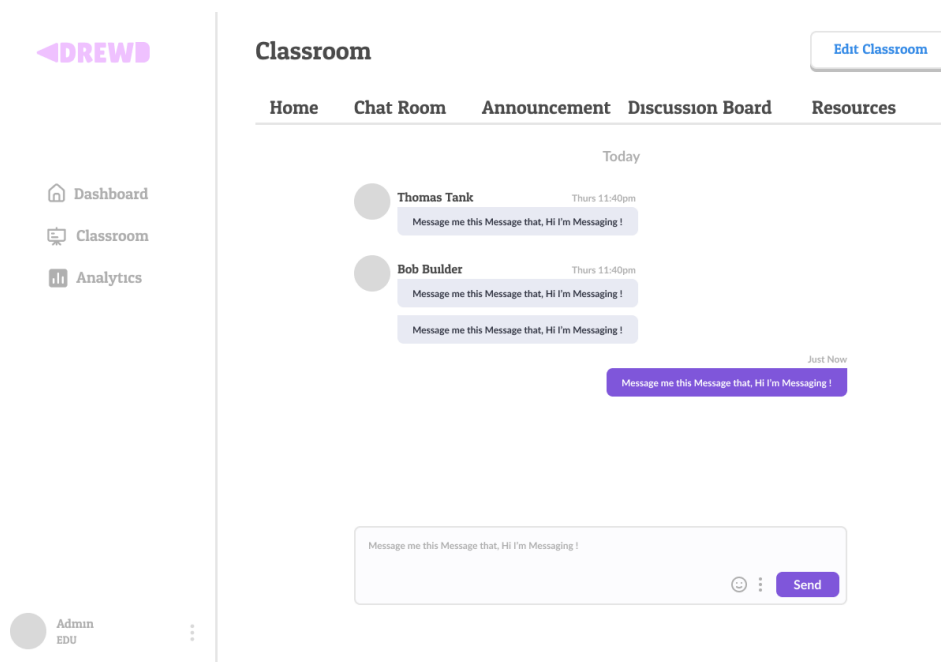


Figure 4.28: Messaging Screen.

13. Announcement Page

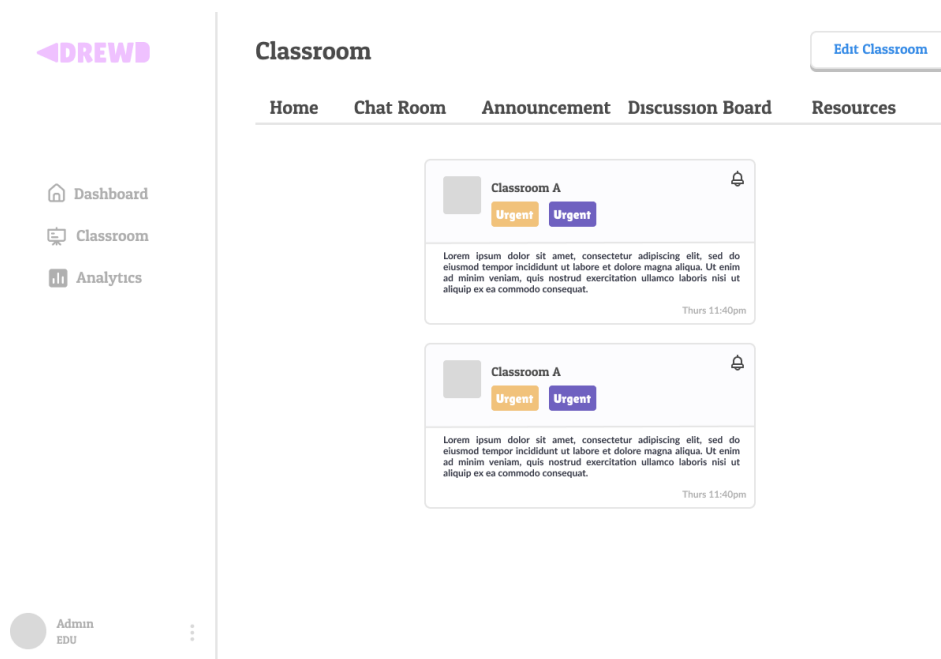


Figure 4.29: Announcement Screen.

14. Discussion Page

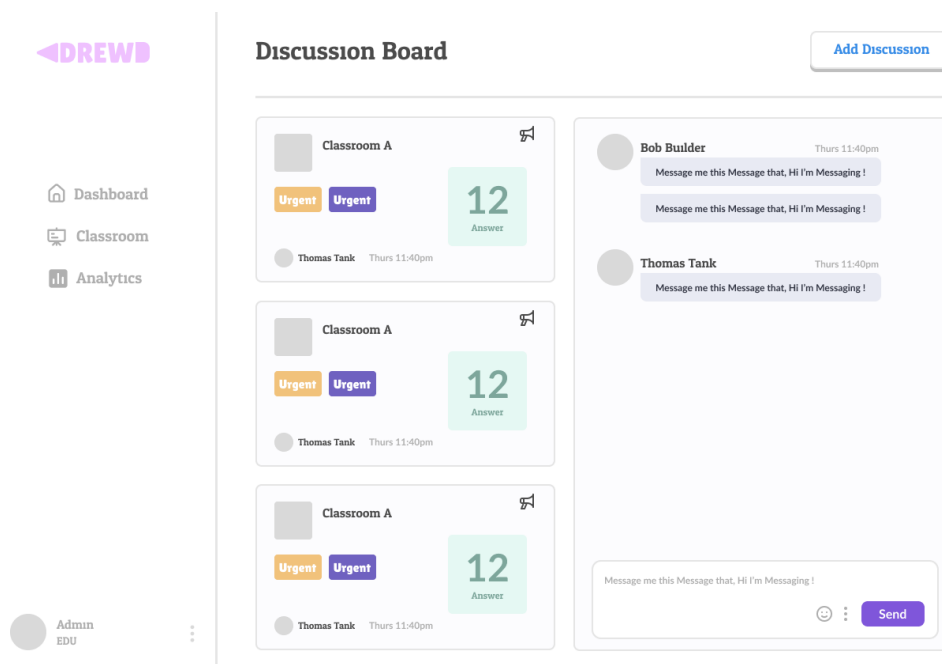


Figure 4.30: Discussion Screen.

15. Content Sharing

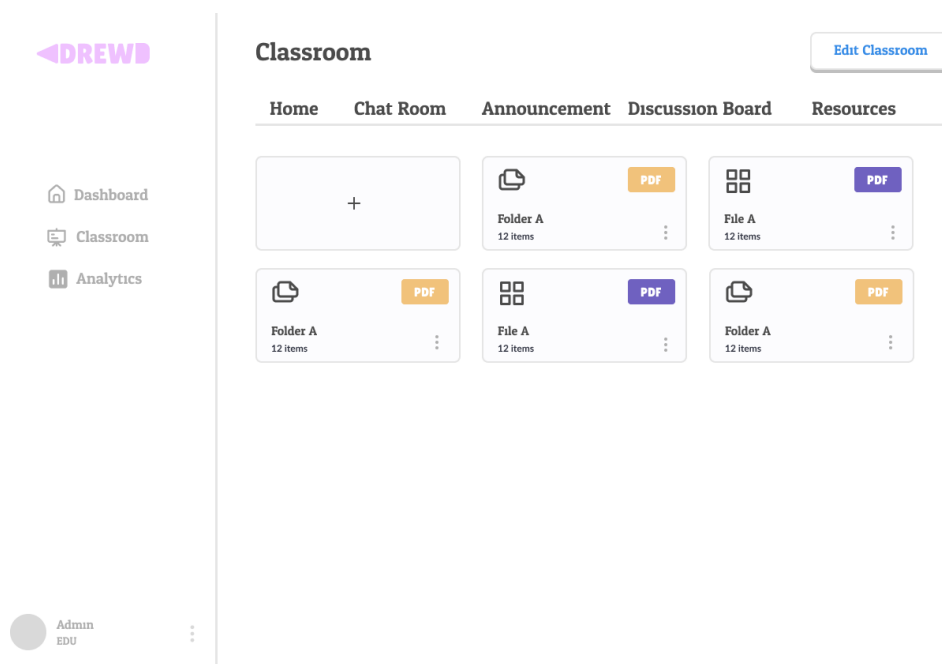


Figure 4.31: Content Sharing Screen.

16. Logo Concept



Figure 4.32: Logo Concept 1.



Figure 4.33: Logo Concept 2.

4.8 Summary

In conclusion, this chapter has completed the requirement specifications by conducting a survey. This survey has collected information from a representative sample of the target user which allow the project to analyze and summarize the data collected to produced much deeper insights towards the users' needs. The results of the survey suggest that the problem statement proposed by this project does exists and needed a solution. Thus, allowing the project scope to undergo some amendments to fit the target users needs.

Furthermore, a list of requirement specifications that consist of functional requirements and non-functional requirements produced to create the use case diagram along with the use case descriptions. Lastly, the interactive flow diagram and user interface prototype is created to visualize the idea and layout of the overall project. With this, the development and testing phase will soon be carried out according to the incremental methodology mentioned above. The complete project solution will be developed in the next phase.

CHAPTER 5

SYSTEM DESIGN

5.1 Introduction

In this chapter, the architecture of the application is discussed in detailed to further explain the overall process and importance of each component in designing the system architecture. Additionally, the database schema model is also be included in this chapter to visualize how the data are documented and stored. Late stages of the UI of the application are also included to better understand the dataflow of the overall application.

5.2 System Architecture Design

The architecture of the Education Management System powered by OpenAI can be categorized as a modular architecture. This architecture is very popular due to the benefits that it provides. The goal of modular architecture is to break down large, complex systems into smaller parts, or in this context called modules. Every module has a unique purpose and point of interaction. A large system can be divided into smaller ones so that each component can be understood, changed, debugged, and used again more easily.

At its core, the Education Management System is built with React, Nodejs, Expressjs and MongoDB. The front end which is React uses a component-based architecture at the same time the backend , Expressjs allows the creation of modular APIs and routes that can be organized to its own modules based on their functionality. This allows the application to be built in a more scalable way and simple to maintain. An image below shows a visualization of the architecture.

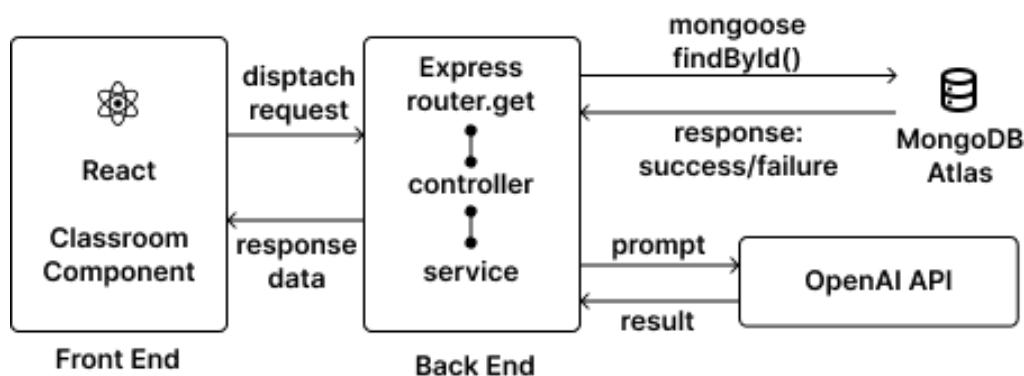


Figure 5.1: Data Flow of the System

With the imagine above, the flow of the data can be visualized. For example, when a client makes a request, it first reaches the Express.js server. The request is processed through middleware for tasks like authentication and request parsing. If the request is authenticated, it is routed to the appropriate route based on the URL path. Each route is associated with a specific controller responsible for handling the request logic. Controllers interact with the services layer, where the core business logic resides. Services perform operations such as querying or updating the database through Mongoose models, which define the data structure and validation rules.

Once the service completes its task, the controller formulates a response, which is sent back to the client. The data will be handled by properly and stored in a global state managed by redux. These data can be dynamically rendered based on the user preference in a modularized manner.

5.2.1 Front-End Architecture

In this section, the front-end architecture of the Education Management system design will be discussed. A combination of React, TypeScript, Redux and Axios are used to construct the front end, all of which work together to provide an efficient client-side experience. The architecture is modular and scalable while focusing on maintaining a clean separation of concerns between the UI, state management and the data fetching layers.

React is utilized for building user interface through component-based development. Each component represents a distinct piece of the UI in the system. One of the biggest benefits of component is its reusability, where the component can be reused or combined with other react component to build more complex and functional layouts. In default, react components are written in JavaScript. While JavaScript is good enough, it raises some concerns where runtime errors will occur during development. Thus, TypeScript which is a superset of JavaScript is integrated throughout the react components, offering strong typing and checking the compile time. With the help of Typescript, it can catch errors before executing it in the runtime where it will be too late.

There are some essential tools that is included in react to further improve the functionality of the modularity of react components which are redux and react router DOM. Firstly redux, redux is a global state management, where the state of the application is stored in a centralized store. This feature makes the state management less hassle compared to handling state between components where data is passed as props. The use of Redux also facilitates a consistent and predictable state flow, where actions dispatched from the UI trigger state transitions, leading to UI updates. On the other hand, react router DOM is used to handle client-side routing. This tool is a must to manage the routing within the react components allowing components to navigate properly among each other. User are allowed to access multiple components without refreshing the entire page which improve the user experiences. It offers faster navigation while preserving the application state between different views. For example , as switching between the dashboard, class management, and analytics views.

Besides that, a library called Axios is utilized as the HTTP client for making API request to the backend server. The restClient instance of Axios is configured with a base URL which point sot the backend server endpoint either in production or development. To ensure a secure communication between the client which is front-end and the server which is called back-end, Axios interceptors are employed to attach the Authorization bearer token to its header to maintain a secure session by sending the token which is stored on the client local storage with every API request.

The interceptors are also responsible for handling response errors. In such scenarios such as 404 page not found or 401 unauthorized access status is returned, the interceptor will trigger the logout action. This effectively logging the user out of the application which indicates the token is expired or invalid. Thus, adding a layer of security by ensuring that only authenticated users can access the protected routes and data within the application.

An example of the API call with Axios is when a message is sent in the chat room by a user, the `sendMessage` thunk is dispatched which triggers the API call to send the message. Upon successful completion, the thunk updates the Redux state. The new message will append to the message list in the chat and update the UI of the message component.

The Education Management System lifecycle is centered around how the data flows from the front and to the backend and the other way around too. This flow includes a series of well-defined steps which involve from user interaction, state management to data persistence. For example, when a user clicks the `generating analysis report` button at the analytic performance page, a corresponding action is dispatched with Redux. This action is intercepted by a Redux Thunk, which then initiates an API call using Axios. Once the API call is made, the state will be updated to a pending state which is managed by setting a loading flag in the corresponding redux store. During this time, the UI may use this flag to display a loading indicator to inform the user that an operation is in progress in the background. Upon receiving a response from the server, the redux store is updated with the new data. The new data will be reflected and update in the UI such as displaying the generated report of the analysis in the application.

Throughout this process, Redux ensures that the flow of the state is predictable and Axios handles the communication with the backend server. This approach allows the application to remain responsive and user-friendly, even when dealing with asynchronous operations like API calls. Additionally, the application includes features like real-time messaging, enabled by Socket.IO, This allows the application to receive messaging from the server in real-time from other users, further enhancing the user experience by providing instantaneous feedback and interaction.

5.2.2 Back-End Architecture

In this section, the back-end architecture of the Education Management system design is discussed. The server architecture of the system is designed to be modular, scalable and maintainable. This architecture is centered around Expressjs, Nodejs and Mongoose.

Similarly, the backend architecture can be categorized as modular architecture. This can be seen as the modular route handling and how the controllers and services are separated to become its own modules. For example, the server routes are organized into separate module, each are responsible for a specific function of the application such as authentication, messaging or classroom related operation. Through this, the codebase is much more maintainable. Each route module contains all the logic that related to its particular feature (controller and service), ensuring that changes in one module or feature does not inadvertently affect the others which may cause collateral damage towards the server.

A typical request lifecycle will look like the image shown below. When a request such as retrieving the information for a specific user from the front end, the request will search for its corresponding route path. In this situation, it is “/auth/profile/:id”, where the id is the parameter passed with the request. The route will handle this request and call the related controller method.

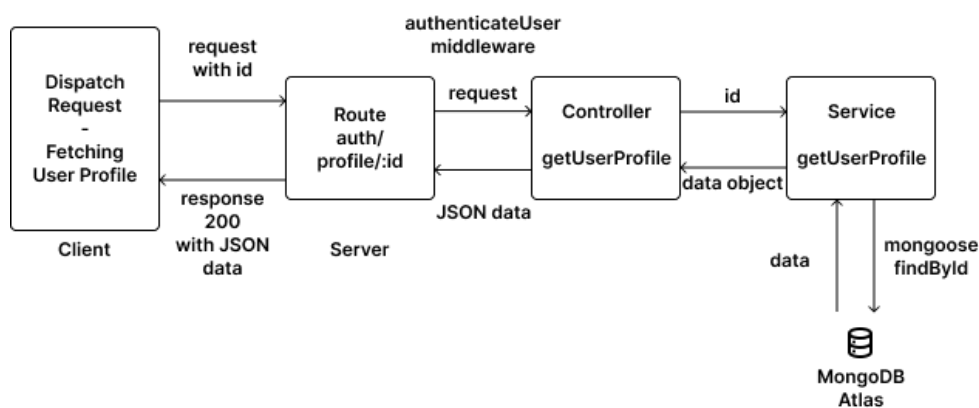


Figure 5.2: Business Logic of the System

From the image above, the business logic of the application is separated into 2 components which are controllers and services. Controllers are responsible for handling incoming HTTP request from the router and interacting with the services to perform the necessary operations and sending responses back to the client. Controllers will also handle the data extracting from the request body, header, query to pass the appropriate data to the service. Meanwhile, services are responsible to handle the actual business operations which is to interact with the database or processing and manipulating data. Continuing the example above, the `getUserProfile` method called by the router will extract the `id` from the parameter within the controller and call the `getUserProfile` method in service. The service will interact with the MongoDB and retrieve the information of the user and return it as an object. Controller will then return the data with a HTTP status 200 indicate the request lifecycle complete and success.

Beside the modularity, another important architecture design that is implement is the RESTful API. At its core, this architecture is based on the principles of Representational State Transfer (REST), where each part of the application, such as users, classes, media, analytics, and journeys, is treated as a resource that can be accessed through the standard HTTP methods. By following the RESTful principles, the backend server can ensure that each of the resource is accessed via a URL route. This URL route can help the maintainability and scalability of the API much more manageable as the REST allow each request from the client contains all the information needed to process it, promoting scalability and reliability.

Middleware also plays a crucial role in the backend architecture, handling the tasks of request parsing, authentication and error handling. In the server of the education management system, an authentication middleware has been integrated to ensure each request made by a client is who they are and not random users. This is accomplished by adding each route that required authentication with the `authenticateUser` middleware function. Other features such as error handling and body parser are also included in the middleware to make sure all requests are properly formatted before being handled by the controllers.

Furthermore, to support real time features such as messaging within the classroom, socket io is integrated into the backend server. The server initializes a socket io instance that listens for connections from clients. With this, our client is able to communicate with other client in real time such as new messages which needed to be delivered instantly to them. The Socket.IO setup is initialized alongside the HTTP server, ensuring that both HTTP and WebSocket requests are handled concurrently.

5.2.3 Database Architecture

For this section, the architecture of the database of the education management system is discussed. For this system, MongoDB which is a NoSQL database is selected. MongoDB differ significantly from traditional SQL databases.

MongoDB is a document-oriented storage. It stores data in a document-oriented format using BSON (Binary JSON). Each document can be viewed as a JSON object, which can include nested fields and arrays. This document model is more dynamic compared to the row-based storage of SQL databases. For example, single MongoDB document can represent an entire entity with its associated sub-documents, providing a more intuitive way to model hierarchical data relationships. MongoDB also has Mongoose which is the object data modeling tool. Mongoose acts like the extension of MongoDB capabilities by providing a simple and structured way to define schemas that interact with the database. With the help mongoose, it allows users to create schema with validation, default values and methods which are not native to MongoDB itself. This approach help ensure that the data follow the specific formats and constraints set by the author. It could be said that Mongoose with MongoDB is the perfect middleware between the flexibility and of a MongoDB's schema and the rigidity provided by Mongoose.

With the understanding on how the overall the architecture of the server, we can see that the backend architecture is very clean and efficient. After some observations, it can be concluded that this architecture closely resembles the principles of Clean Architecture as it emphasizes separation of concerns and

decoupling of business logic from frameworks and external dependencies. The core logic of the server which are the controllers and service kept its independent of the Expressjs and MongoDB. What this mean is that when a decoupling occurs in the outer layer of the server (like the routing or data access layers), it won't affect the core logic of the server. In this situation, it adheres to the Clean Architecture's principle of keeping the core unaffected by external changes. For Instance, the use of the controller is to handle request and delegate tasks to services aligns with the Clean Architecture's use cases.

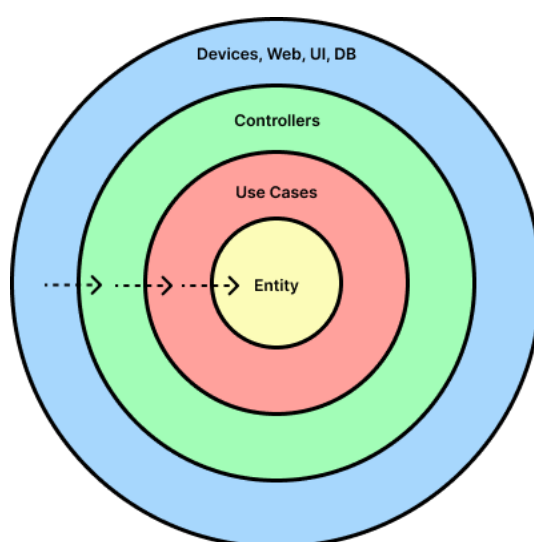


Figure 5.3: Clean Architecture

Based on the image above of the Clean Architecture, properly structuring the server with their own distinct layers such as routes, controller, services, models will create a system where each layer has its own clear responsibilities and dependencies point inwards. This promotes a more robust, maintainable, flexible architecture. This structure proves the "screaming architecture" idea where your application reflects its primary purpose which is the server of an education management system rather than simply being an Express.js app.

5.2.3.1 Mongoose Schema

Table 5.1: Student Analytic Schema

Field Name	Data Type	Description
studentId	ObjectId	Reference to the User document (student)
summary	String	Overall summary of the student's performance
strength	String	Identified strengths of the student
weakness	String	Identified weaknesses of the student
improvement	String	Suggested areas for improvement
changes	String	Recommended changes for the student's learning approach
data	Mixed	Additional data related to the analysis for charts (format may vary)
generatedAt	Date	Date and time the analysis was generated

Table 5.2: Class Analytic Schema

Field Name	Data Type	Description
classId	ObjectId	Reference to the Class document
userId	ObjectId	Reference to the User document (teacher who created)
classroomName	String	Name of the classroom
summary	String	Overall summary of the class performance
strength	String	Identified strengths of the class as a whole
weakness	String	Identified weaknesses of the class as a whole
improvement	String	Suggested areas for improvement for the class
changes	String	Recommended changes for the class's learning approach

data	Mixed	Additional data related to the analysis for charts (format may vary)
generatedAt	Date	Date and time the analysis was generated

Table 5.3: Student Journey Schema

Field Name	Data Type	Description
studentId	ObjectId	Reference to the User document (student)
studentName	String	Name of the student
goal	String	Overall goal the student is working towards
steps	Array(ObjectId)	References to Journey Step documents (steps in the journey)
status	String	Current status of the student's journey (complete, progress, active)
generatedAt	Date	Date and time the journey was created

Table 5.4: Classroom Journey Schema

Field Name	Data Type	Description
classId	ObjectId	Reference to the Class document
creator	ObjectId	Reference to the User document (teacher who created)
className	String	Name of the classroom
goal	String	Overall goal the class is working towards
description	String	Description of the classroom journey
steps	Array(ObjectId)	References to Journey Step documents (steps in the journey)
status	String	Current status of the classroom journey (complete, progress, active)
generatedAt	Date	Date and time the journey was created

Table 5.5: Journey Step Schema

Field Name	Data Type	Description
step	Number	Step number within the journey
topic	String	Topic covered in this step
timeline	String	Estimated timeframe for completing this step
additionaltips	String	Additional tips or resources for the student
learningMaterial	Mixed	Learning materials associated with this step (format may vary)
status	String	Current status of this step (complete, progress)

Table 5.6: Announcement Schema

Field Name	Data Type	Description
title	String	Title of the announcement
content	String	Content of the announcement
tag	String	Type of announcement (Test, Quiz, Announcement, Update)
postedBy	ObjectId	Reference to the User document (who posted)
classroom	ObjectId	Reference to the Class document (where it's posted)
createdAt	Date	Date and time the announcement was created

Table 5.7: Classroom Schema

Field Name	Data Type	Description
name	String	Name of the classroom

code	String	Unique code for the classroom
details	ObjectId	Reference to the Class Details document (optional details)
tests	Array(ObjectId)	References to Test documents (associated tests)
students	Array(ObjectId)	References to User documents (students enrolled)
educators	Array(ObjectId)	References to User documents (educators assigned)

Table 5.8: Class Details Schema

Field Name	Data Type	Description
description	String	Optional description of the classroom
backgroundColor	String	Optional background color for the classroom display

Table 5.9: Media Schema

Field Name	Data Type	Description
name	String	Name of the media file
url	String	URL for accessing the media file
public_id	String	Unique identifier for the media file on the storage platform
fileType	String	Type of media (image, video, audio, document)
uploader	ObjectId	Reference to the User document (who uploaded)
classroom	ObjectId	Reference to the Class document (where it's uploaded)
createdAt	Date	Date and time the media file was uploaded

Table 5.10: Message Schema

Field Name	Data Type	Description
classroom	ObjectId	Reference to the Class document (where the message is sent)
sender	ObjectId	Reference to the User document (who sent the message)
message	String	Content of the message
timestamp	Date	Date and time the message was sent

Table 5.11: Question Schema

Field Name	Data Type	Description
question	String	Text of the question
classroom	ObjectId	Reference to the Class document (where the question is asked)
student	ObjectId	(Optional) Reference to the User document (who asked)
upvotes	Array(Object)	Array of upvote objects (userId & date)
answered	Boolean	Flag indicating if the question has been answered (true/false)
answer	ObjectId	(Optional) Reference to the Answer document
createdAt	Date	Date and time the question was created

Table 5.12: Upvote Schema

Field Name	Data Type	Description
userId	ObjectId	Reference to the User document (who upvoted)
date	Date	Date and time the question was upvoted

Table 5.13: Answer Schema

Field Name	Data Type	Description
answer	String	Text of the answer
answeredBy	ObjectId	Reference to the User document (who answered)
question	ObjectId	Reference to the Question document (answering which question)
createdAt	Date	Date and time the answer was created

Table 5.14: TestScore Schema

Field Name	Data Type	Description
score	Number	Score achieved in the test
test	ObjectId	Reference to the Test document (which test)
student	ObjectId	Reference to the User document (who took the test)
classroom	ObjectId	Reference to the Class document (where the test was given)

Table 5.15: Test Schema

Field Name	Data Type	Description
name	String	Name of the test
date	Date	Date when the test was conducted
score	Array(ObjectId)	Array of references to TestScore documents (student scores)
classroom	ObjectId	Reference to the Class document (where the test is given)

Table 5.16: User Schema

Field Name	Data Type	Description
username	String	Unique username for the user
password	String	User's password (hashed and secured)
type	String	User type (EDU - Educator, STU - Student, PAR - Parent)
profile	ObjectId	(Optional) Reference to the UserProfile document
testScores	Array(ObjectId)	Array of references to TestScore documents (user's scores)
feedbacks	Array(ObjectId)	Array of references to Feedback documents (received feedback)
classroom	Array(ObjectId)	Array of references to Class documents (user's classrooms)

Table 5.17: UserProfile Schema

Field Name	Data Type	Description
color	String	(Optional) User's preferred UI color theme
image	String	(Optional) URL for the user's profile picture

Table 5.18: Feedback Schema

Field Name	Data Type	Description
title	String	(Optional) Title of the feedback
content	String	Content of the feedback
rating	Number	Rating value for the feedback (numerical)
student	ObjectId	Reference to the User document (who received the feedback)
givenBy	ObjectId	Reference to the User

5.3 Data Model Diagram

5.3.1 Context Diagram

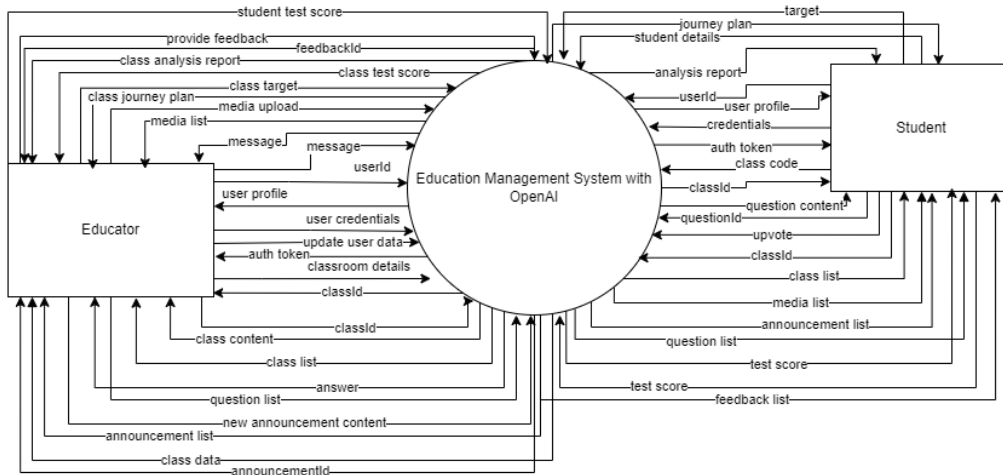


Figure 5.4 Context Diagram

5.3.2 Data Flow Diagram Level-0

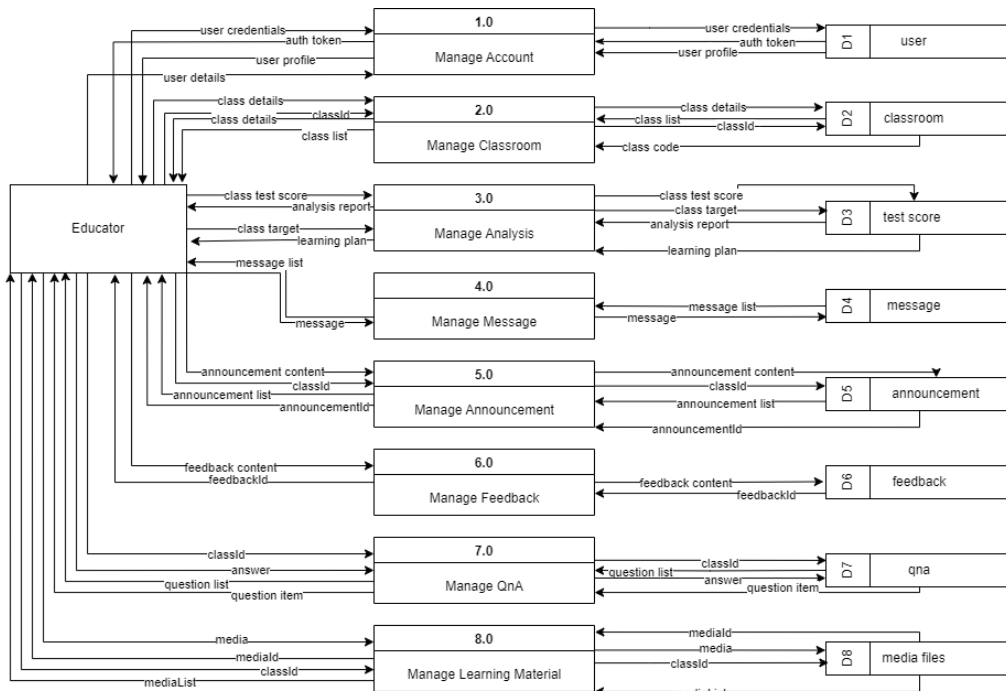


Figure 5.5 Data Flow Diagram Level-0

5.3.3 Data Flow Diagram Level-1

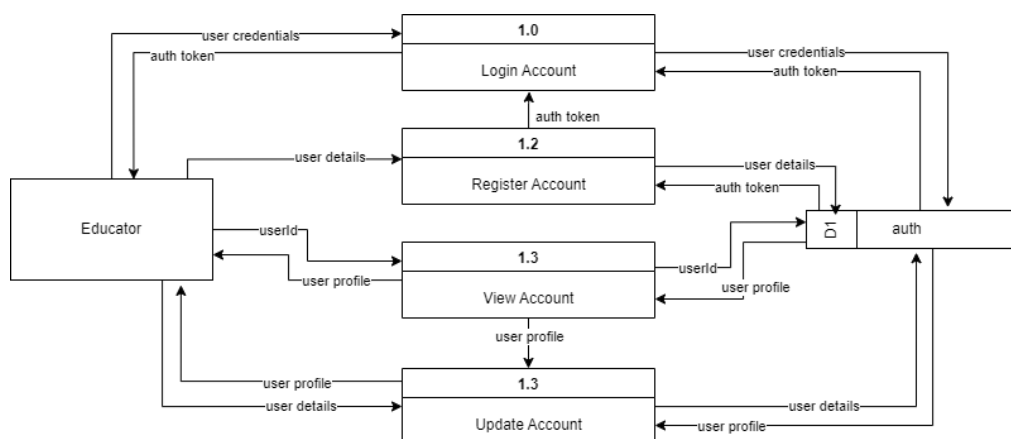


Figure 5.6 Data Flow Diagram Level-1

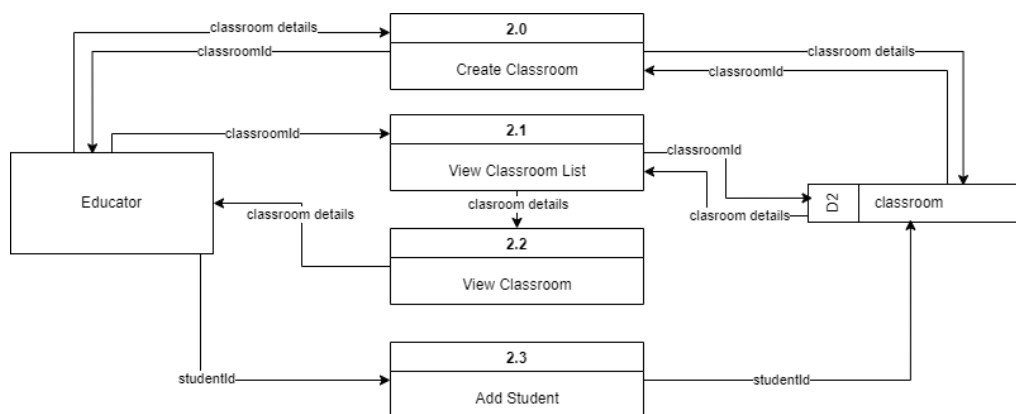


Figure 5.7 Data Flow Diagram Level-1 (Account Management)

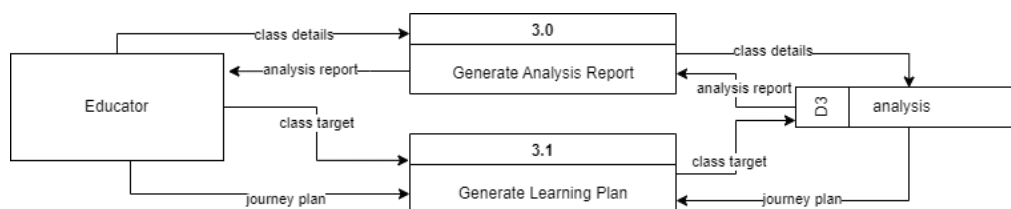


Figure 5.8 Data Flow Diagram Level-1 (Classroom Management)

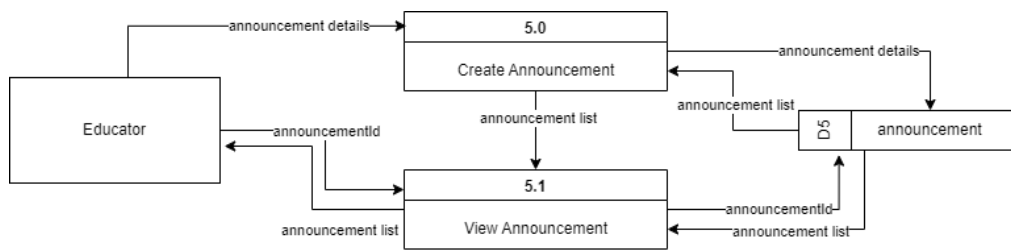


Figure 5.9 Data Flow Diagram Level-1 (Announcement Management)

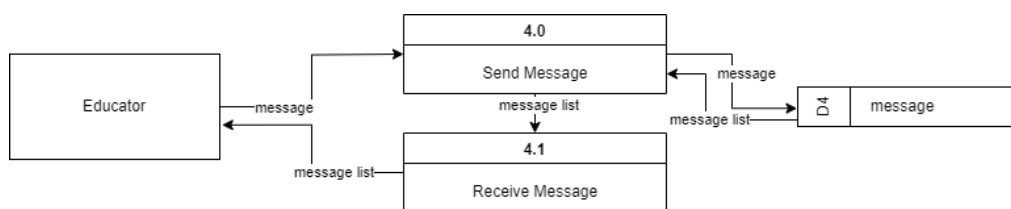


Figure 5.10 Data Flow Diagram Level-1 (Messaging)

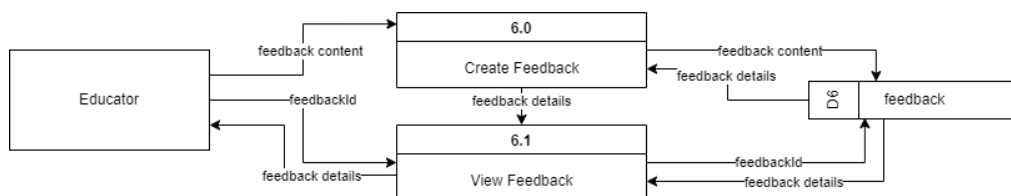


Figure 5.11 Data Flow Diagram Level-1 (Feedback Management)

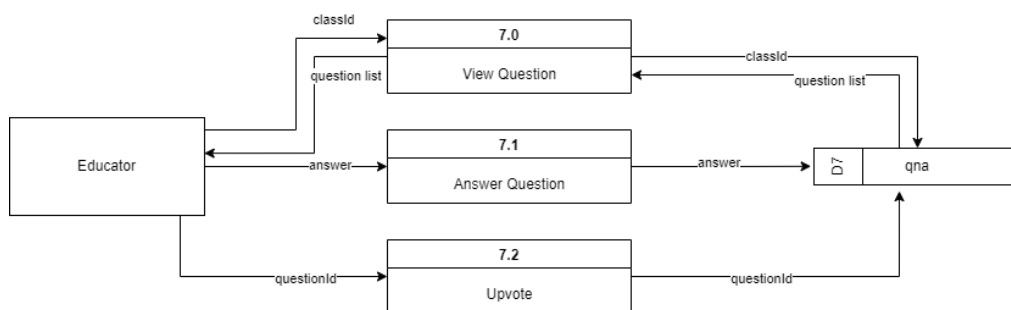


Figure 5.12 Data Flow Diagram Level-1 (QnA)

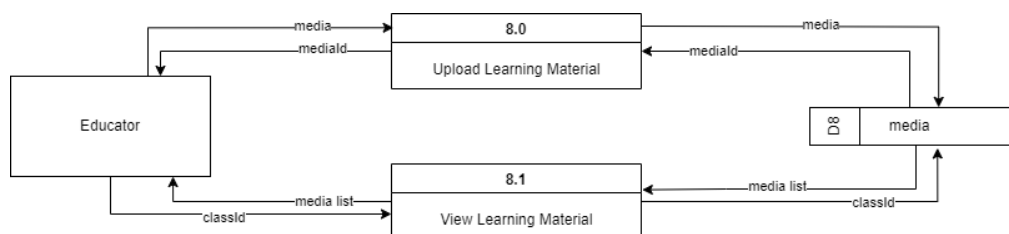


Figure 5.13 Data Flow Diagram Level-1 (Learning Material Management)

5.3.4 Activity Flow Diagram

The activity flow diagram visually represents the sequence of activities, actions, and decision points within the system, showing how users interact with different functionalities. It provides a clear overview of the workflow, helping to understand the system's processes.

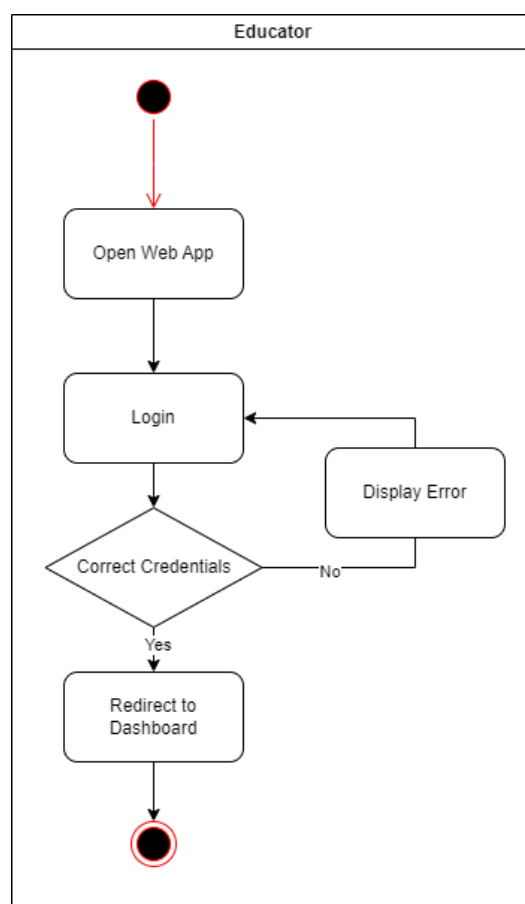


Figure 5.14 Activity Diagram for Login Account

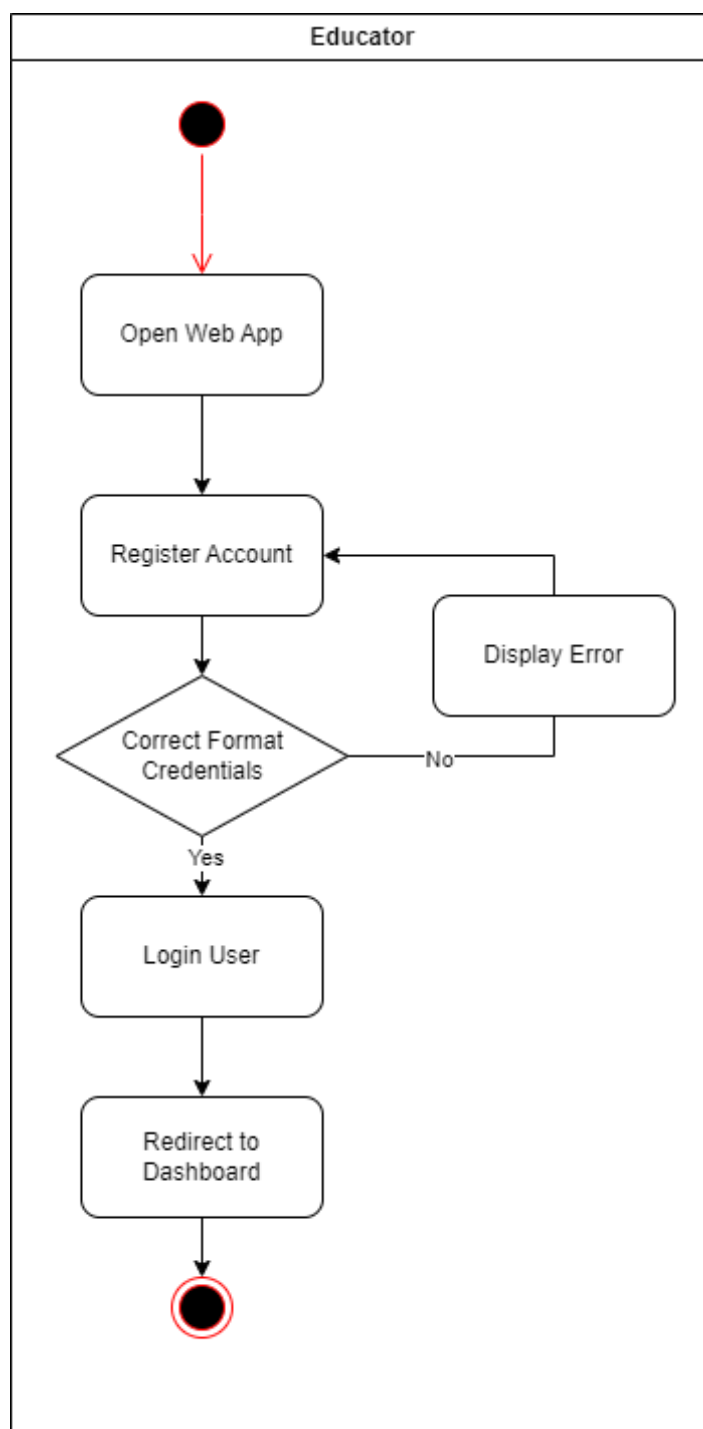


Figure 5.15 Activity Diagram for Register Account

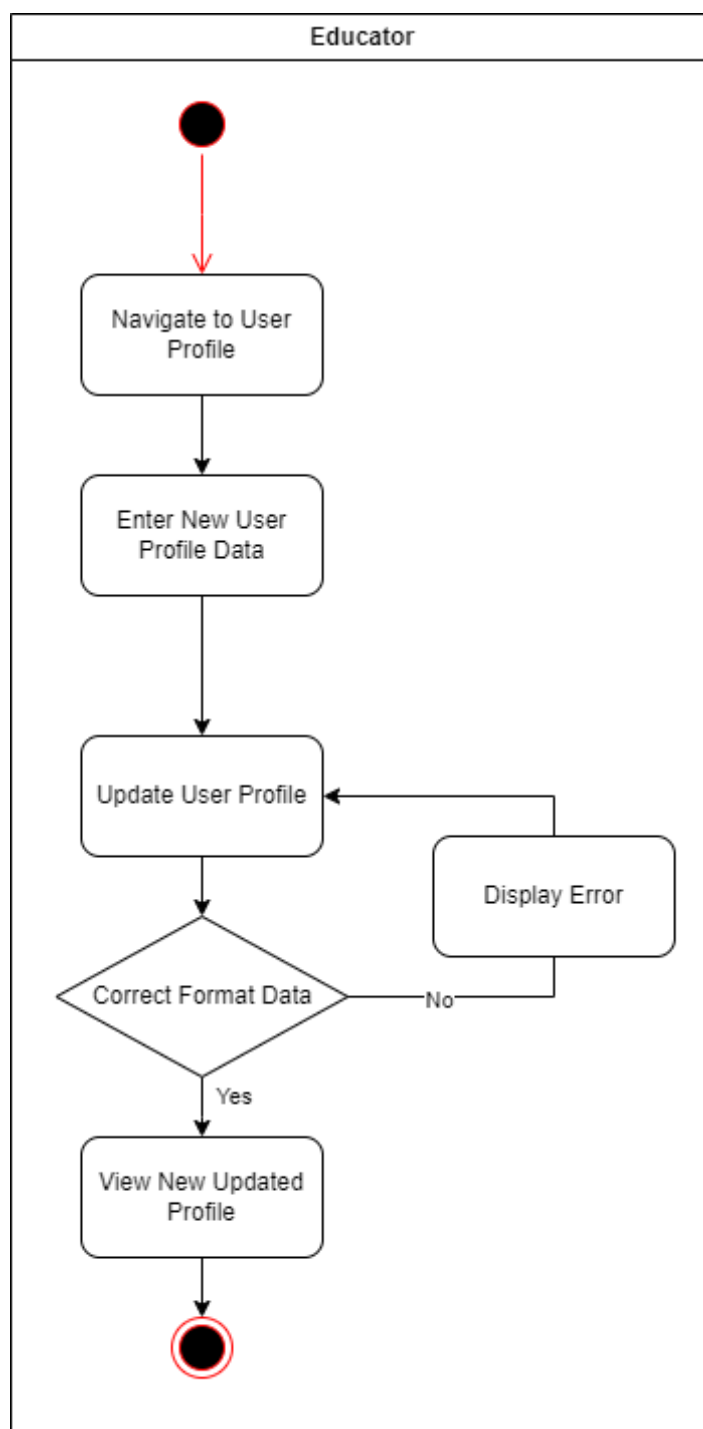


Figure 5.16 Activity Diagram for Updating Account

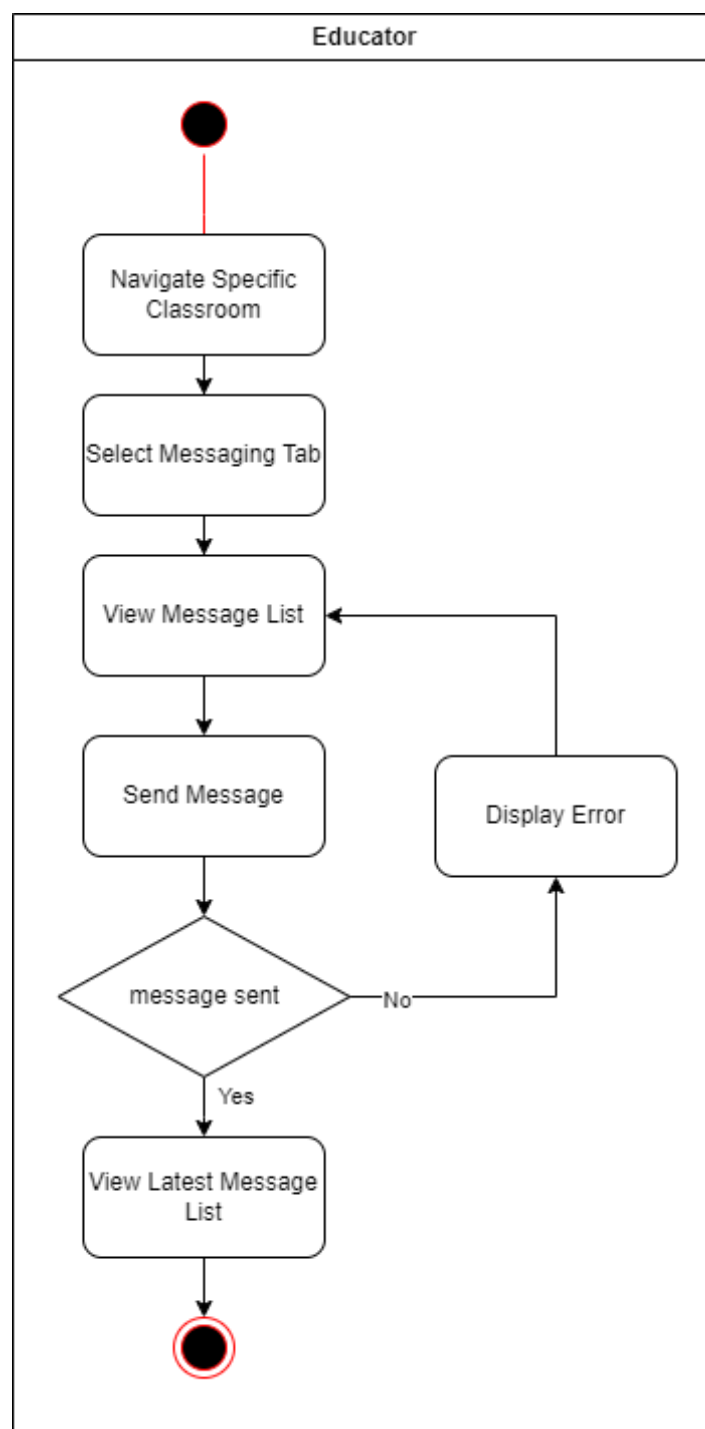


Figure 5.17 Activity Diagram for Messaging

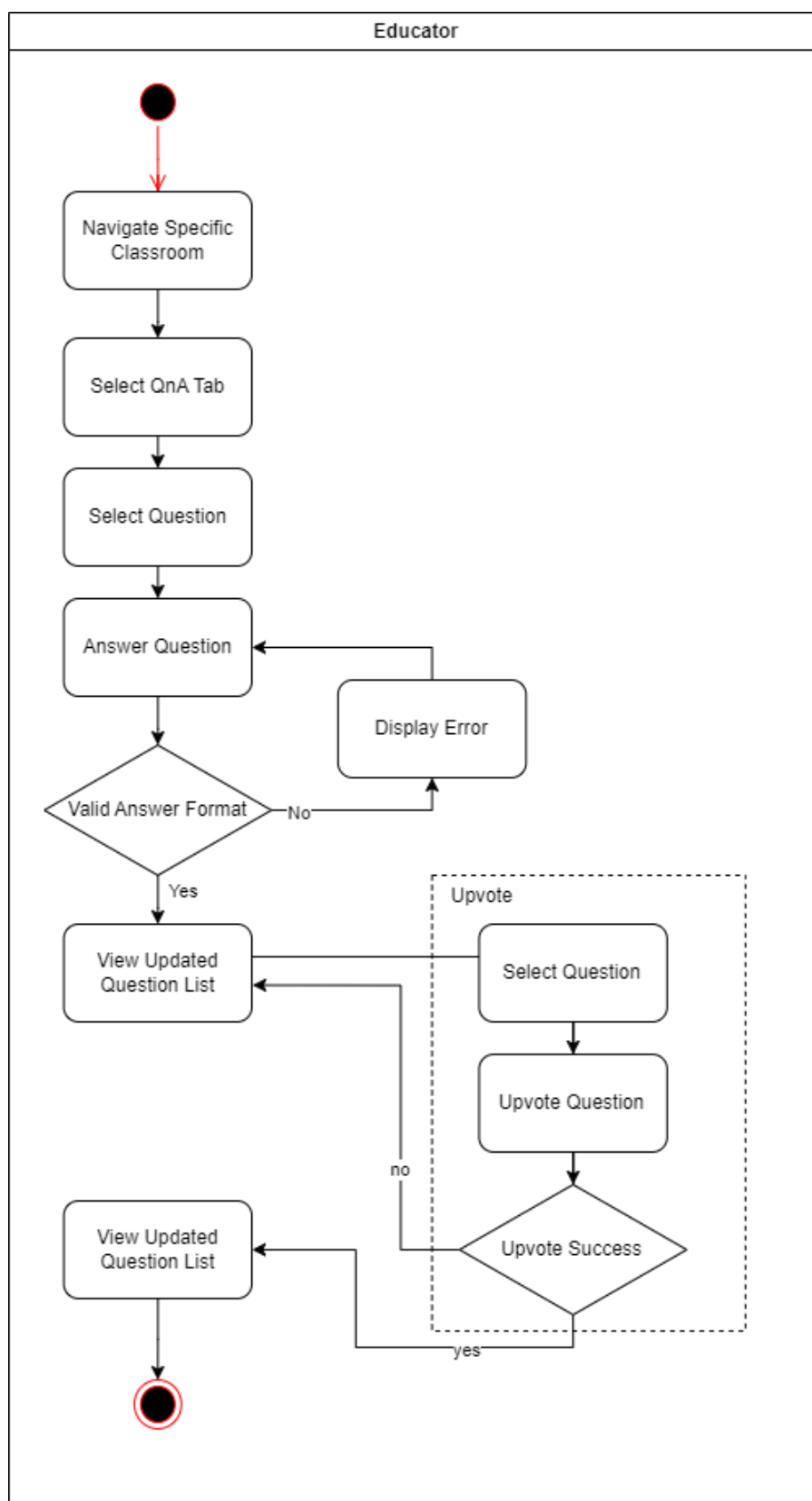


Figure 5.18 Activity Diagram for QnA Interaction

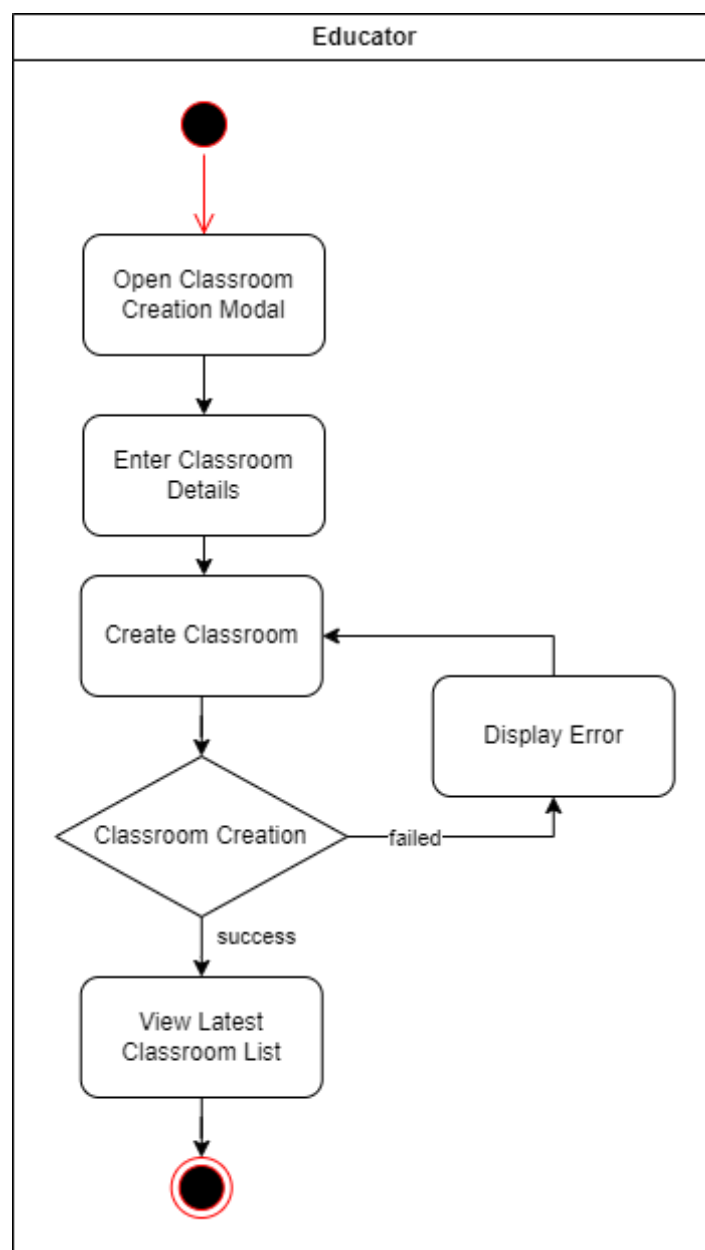


Figure 5.19 Activity Diagram for Classroom Creation

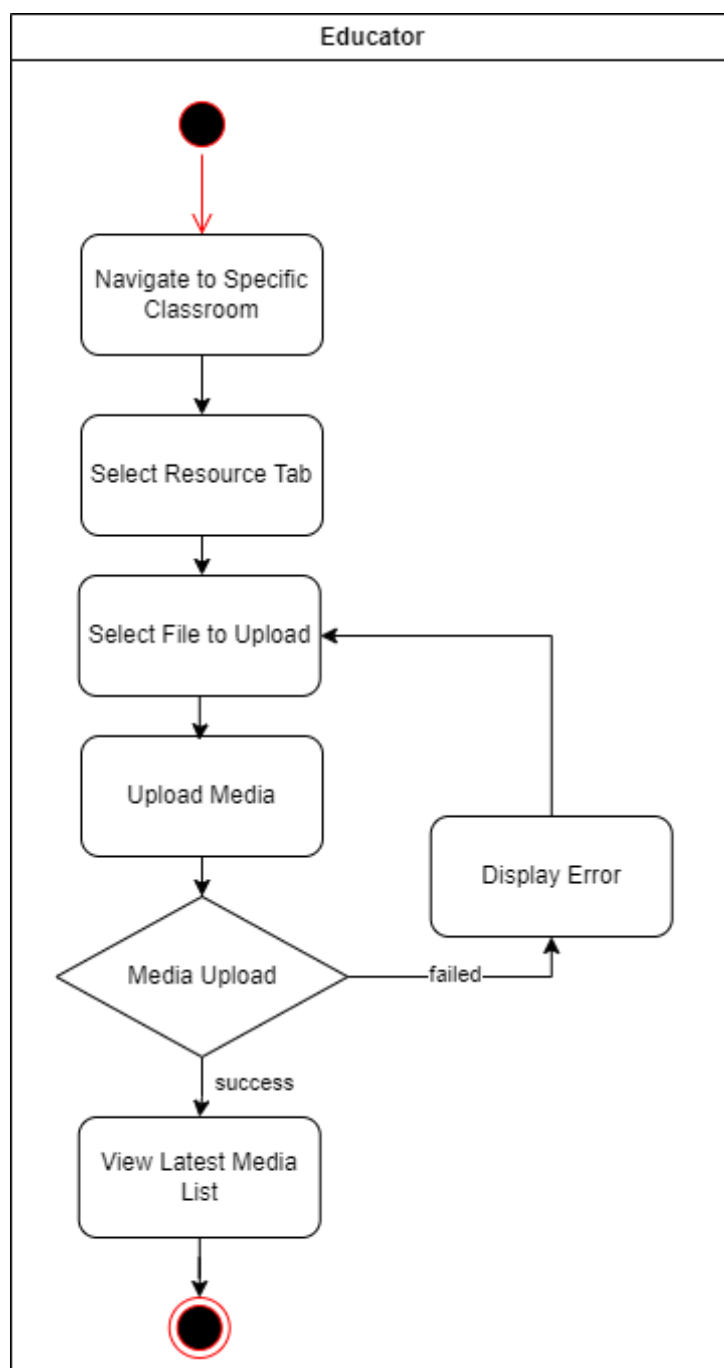


Figure 5.20 Activity Diagram for Media Upload

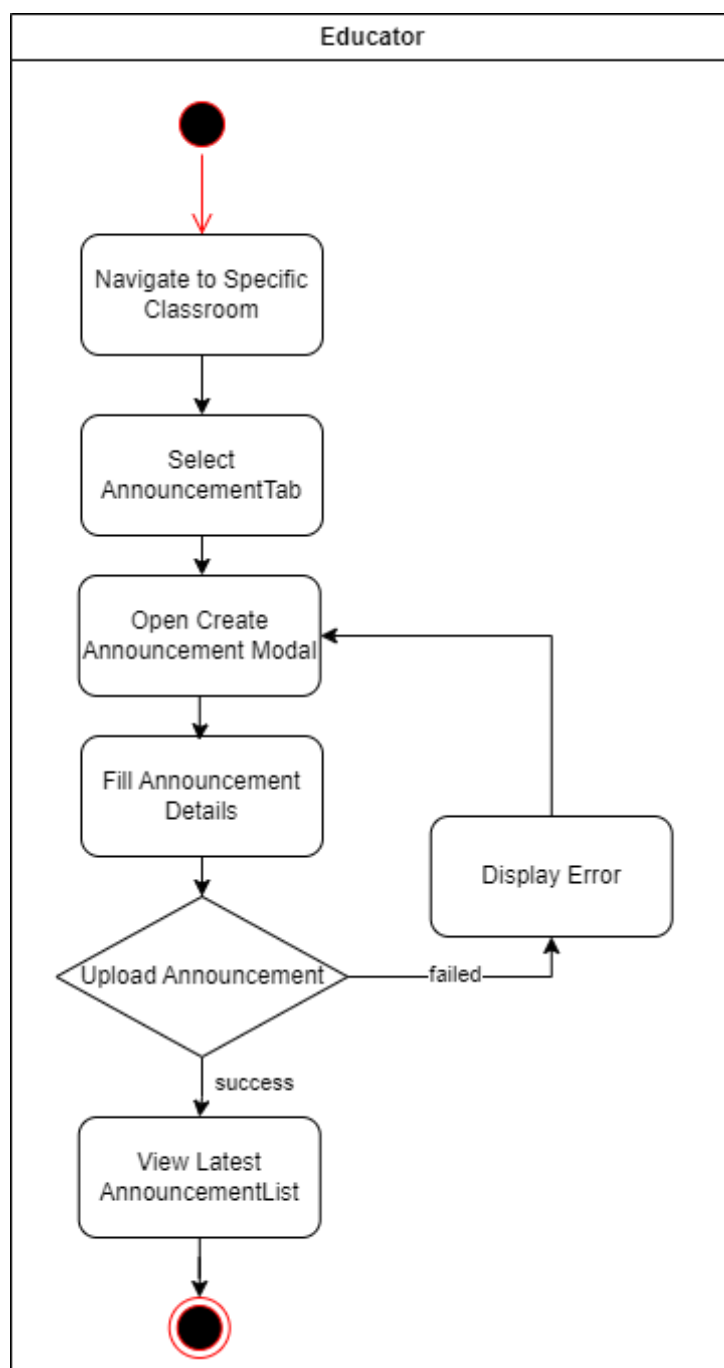


Figure 5.21 Activity Diagram for Announcement Creation

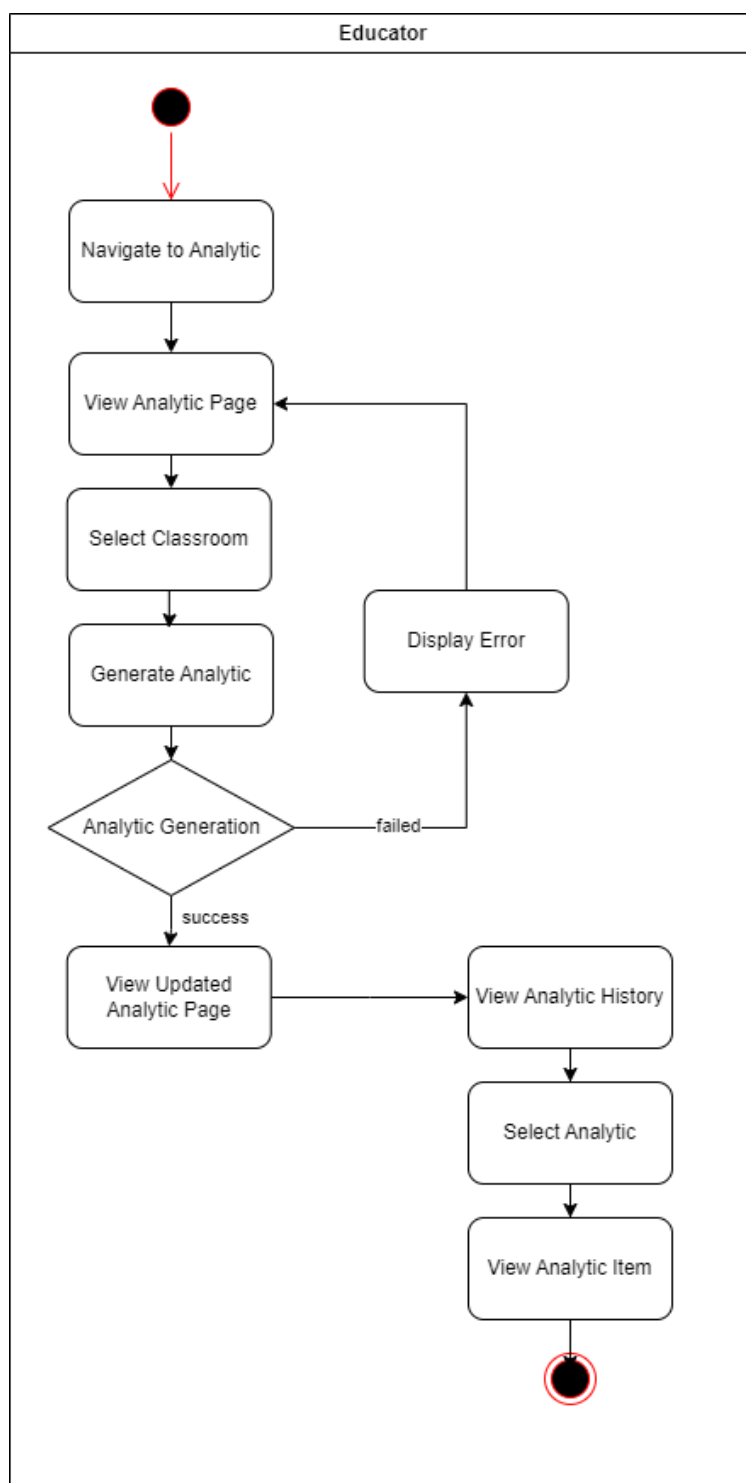


Figure 5.22 Activity Diagram for Generate Analytic Performance

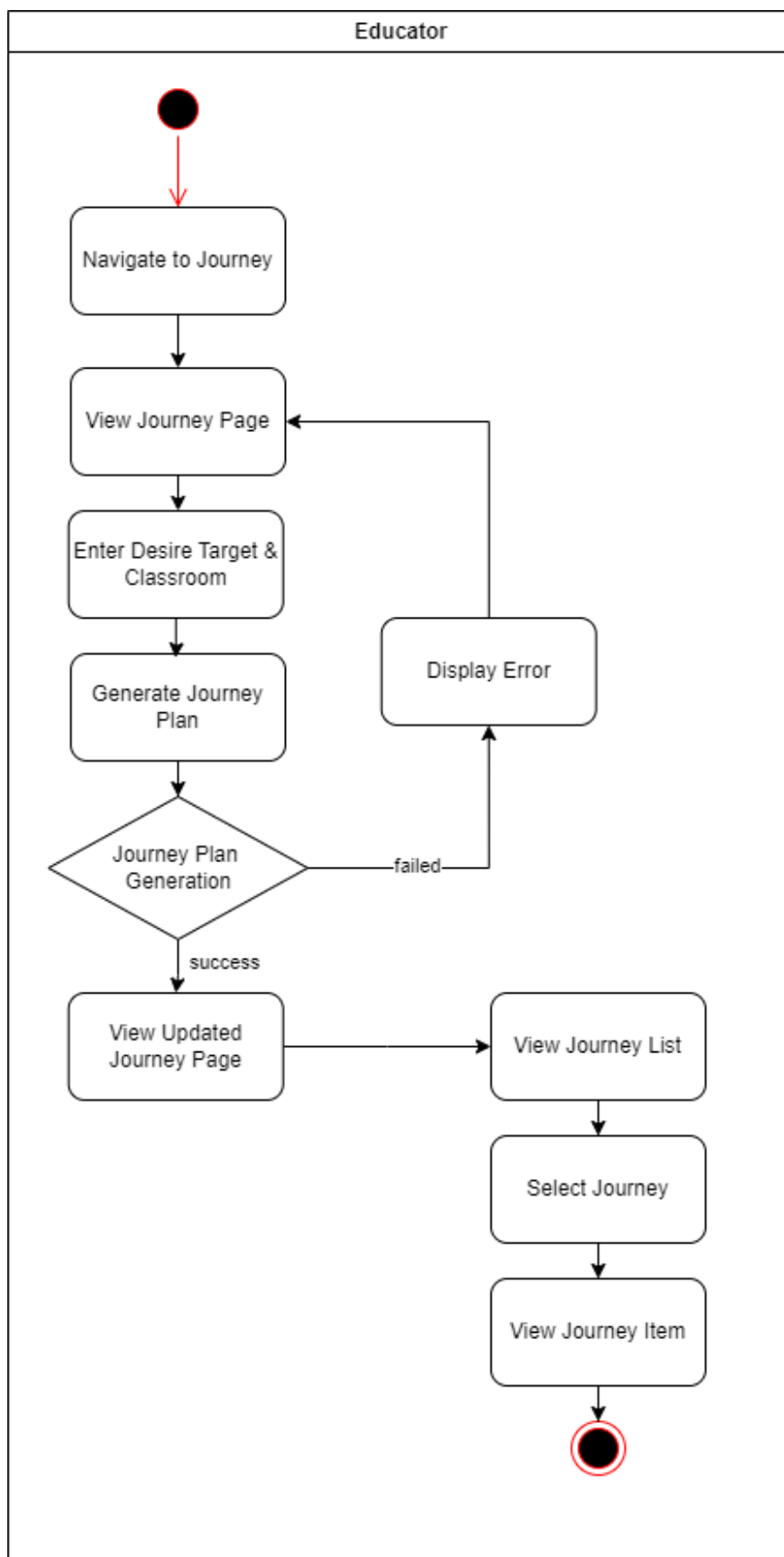


Figure 5.23 Activity Diagram for Generate Journey Plan

5.4 User Interface Designs

The screenshot of the user interface design will split into 2 view which is the web view for viewing the application in a desktop environment and a mobile view for viewing it in a mobile environment. Each of the environments have 2 different types of user which consist of educator and student.

5.4.1 Web View

Figures below show the screen of authentication such as login, sign up mentioned in the first 2 use case (Functional Requirement 1 & 2).

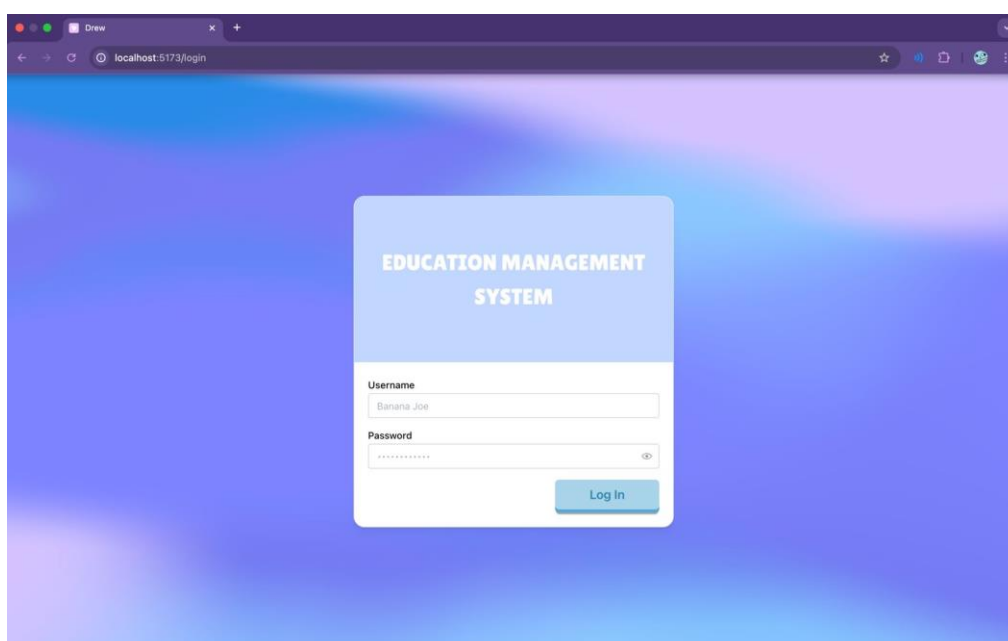


Figure 5.24 Login Page

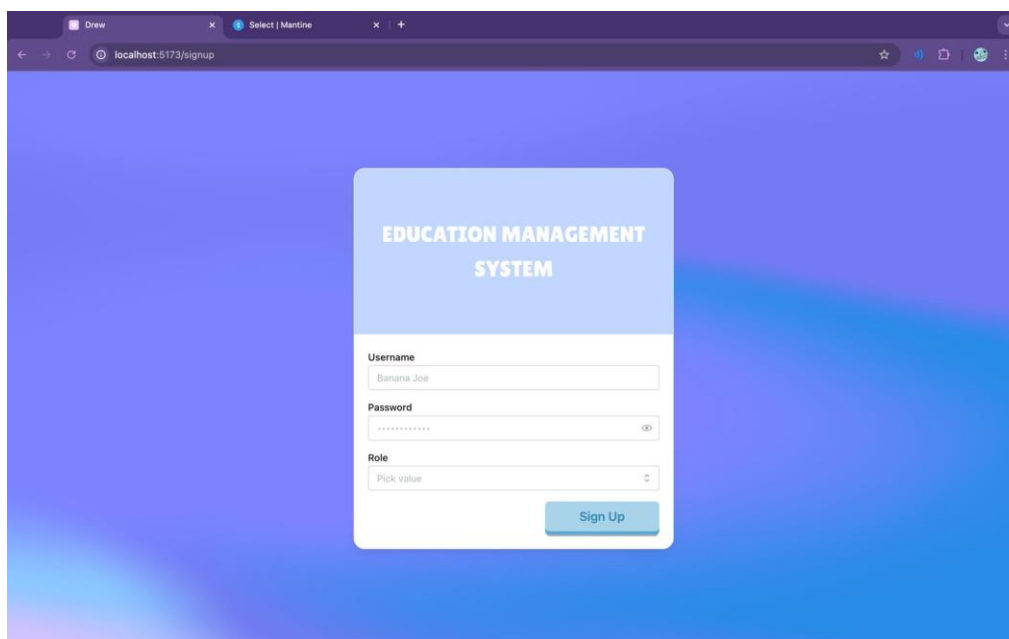


Figure 5.25 Sign Up Page

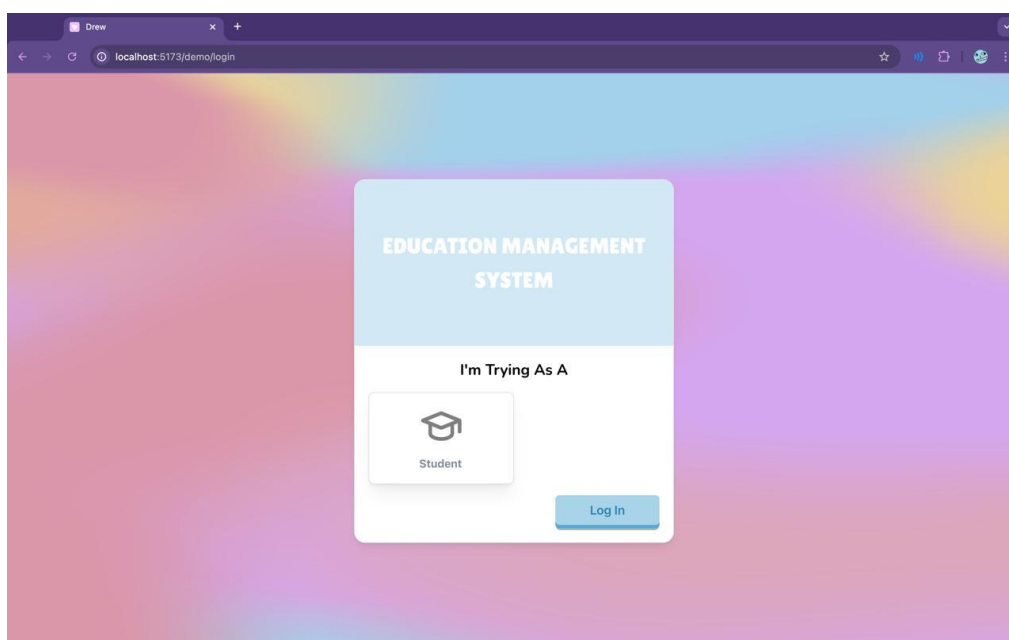


Figure 5.26 Demo Login Page

Figure below show the landing page which is the page that the user will see after a successful login or signup.

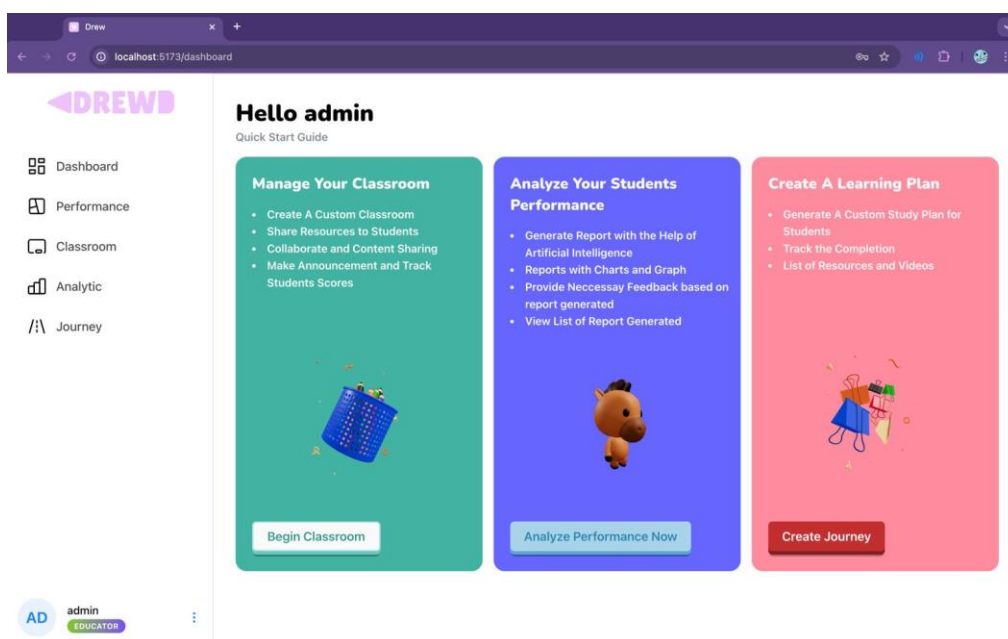


Figure 5.27 Dashboard Page for Educator & Student

Figures below show the Performance page which include all the information of the current user about their latest test score, announcements, feedback etc. User can track their desire information here below (Functional Requirement 9)

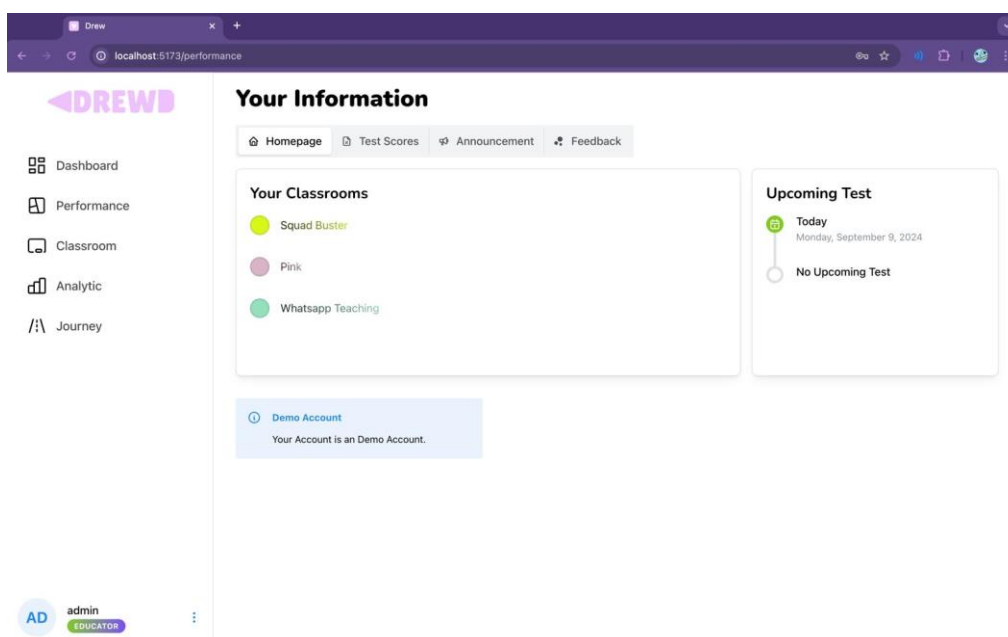


Figure 5.28 Home Page for Educator

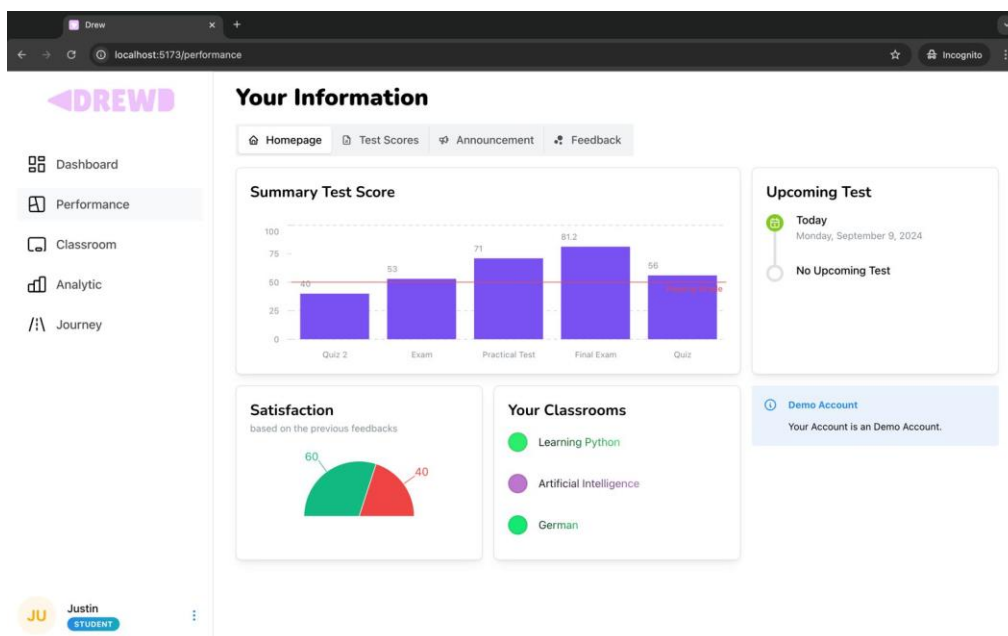


Figure 5.29 Home Page for Student

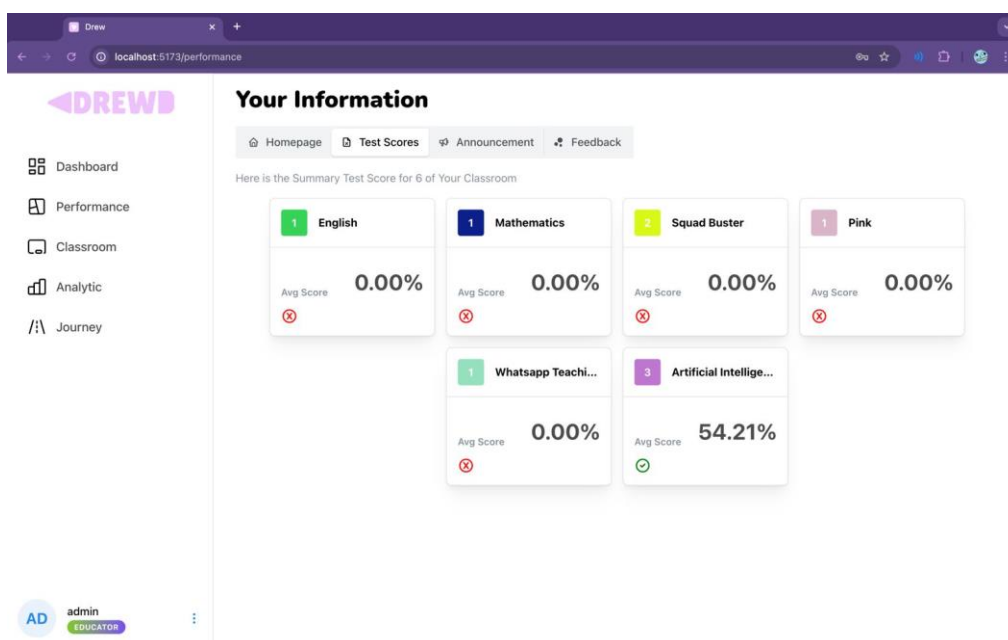


Figure 5.30 Test Score Page for Educator

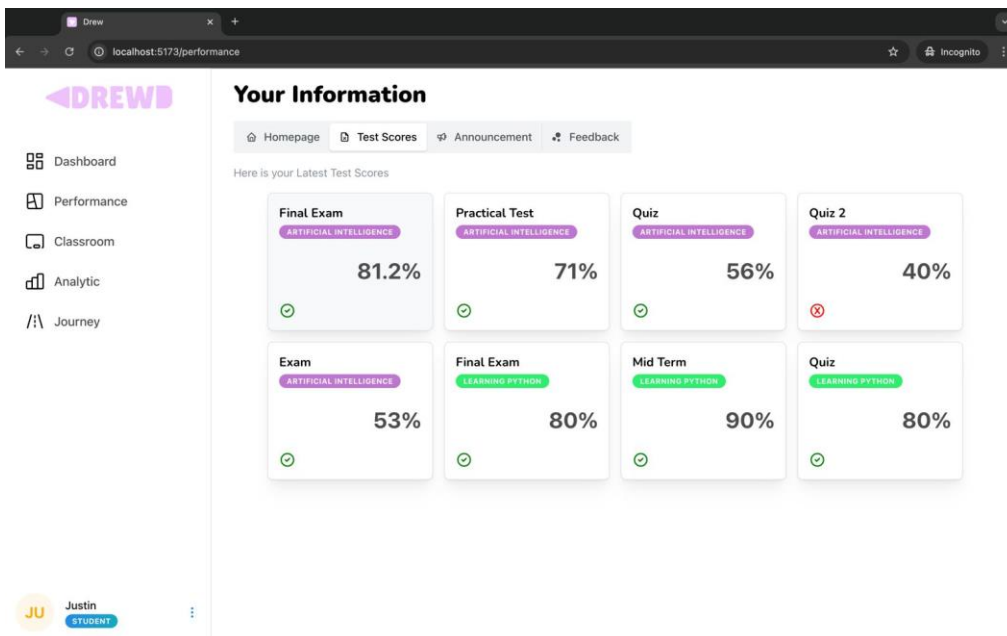


Figure 5.31 Test Score Page for Student

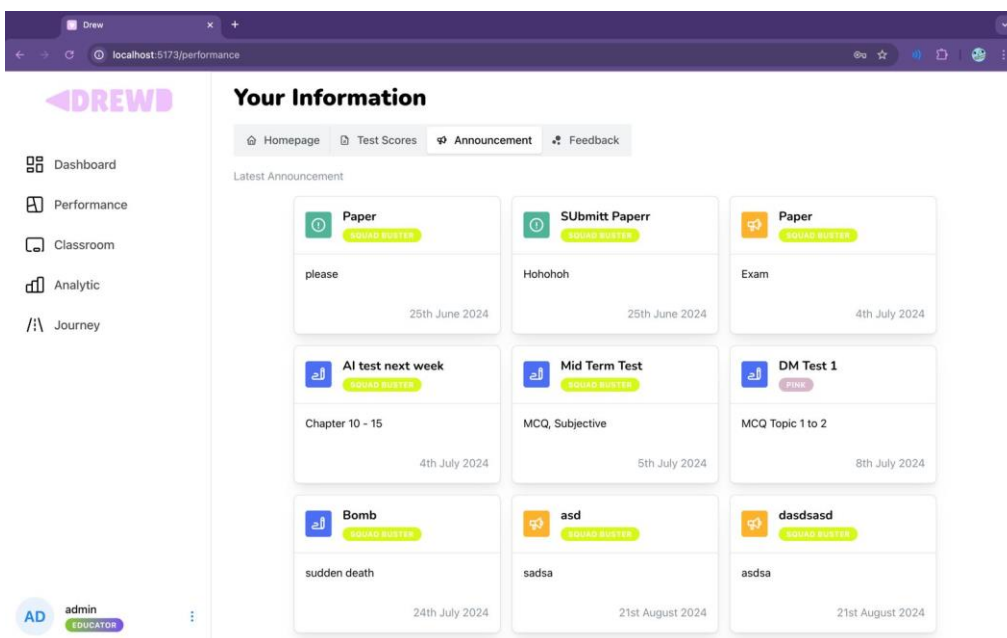


Figure 5.32 Announcement Page for Educator

The screenshot shows a web browser window with the URL `localhost:5173/performance`. The page title is "Your Information" and it features a navigation menu with "Homepage", "Test Scores", "Announcement", and "Feedback". The "Announcement" tab is active, displaying a "Latest Announcement" section with a 3x3 grid of cards. Each card contains a title, a description, and a date. The user profile at the bottom left shows "Justin" as a "STUDENT".

Announcement Title	Description	Date
Paper	please	25th June 2024
SUBmitt Paperr	Hohohoh	25th June 2024
Paper	Exam	4th July 2024
AI test next week	Chapter 10 - 15	4th July 2024
Mid Term Test	MCQ, Subjective	5th July 2024
Mid Term Test	Chapter 5-7	11th July 2024
Bomb	sudden death	24th July 2024
asd	sadsa	21st August 2024
dasdsasd	asdsa	21st August 2024

Figure 5.33 Announcement Page for Student

The screenshot shows the same web browser window, but the user profile at the bottom left now shows "admin" as an "EDUCATOR". The "Your Information" page displays a "Provided Feedback" section with a grid of feedback cards. Each card shows a status, a message, and a star rating. The user profile at the bottom left shows "admin" as an "EDUCATOR".

Feedback Status	Message	Star Rating
You are performing Well	Keep It Up	4 stars
Quiz Need Attention	Attend Your Classes	3 stars
Doing Alright	All left	4 stars
Dont Send NSFW Gif	Not suitable	1 star
Perfect	100%	5 stars

Figure 5.34 Feedback Page for Educator

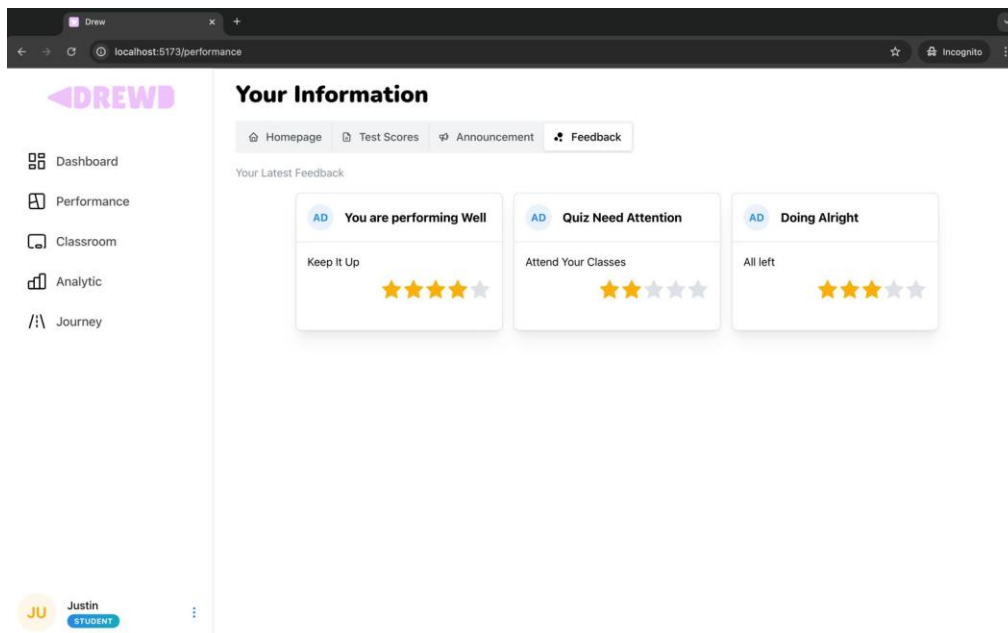


Figure 5.35 Feedback Page for Student

Figures below show the classroom list that consists of all the classrooms that the user has join. By clicking any classes below, classroom management tools will be shown.

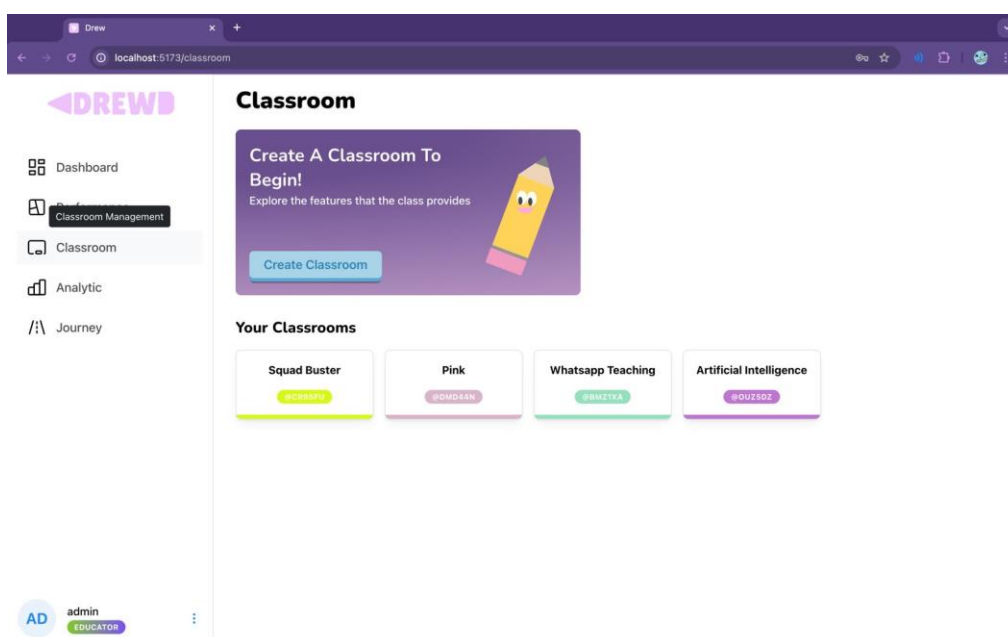


Figure 5.36 Classroom List Page for Educator

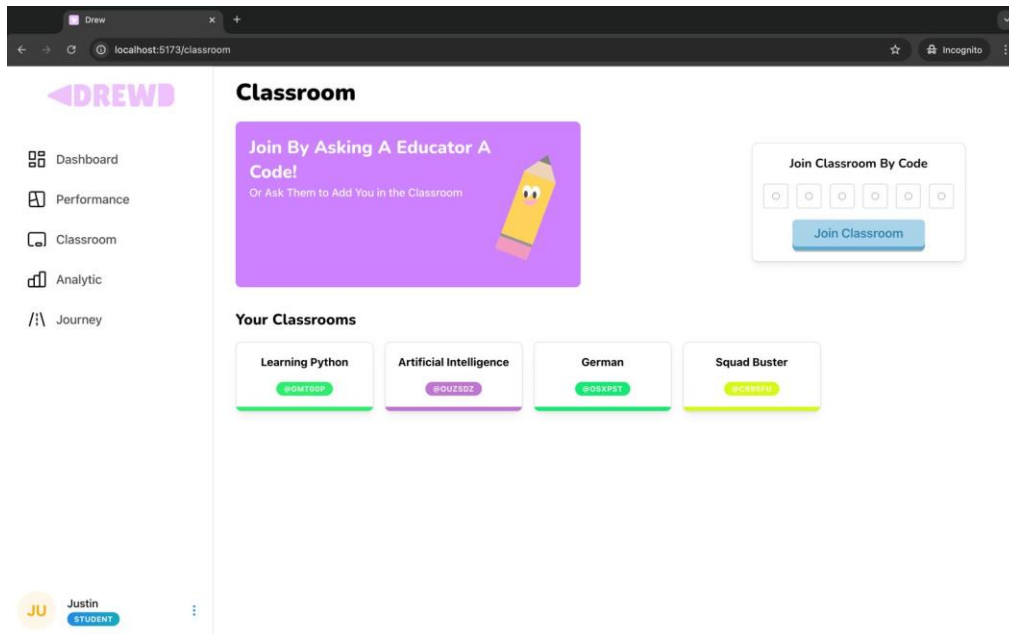


Figure 5.37 Classroom List Page for Student

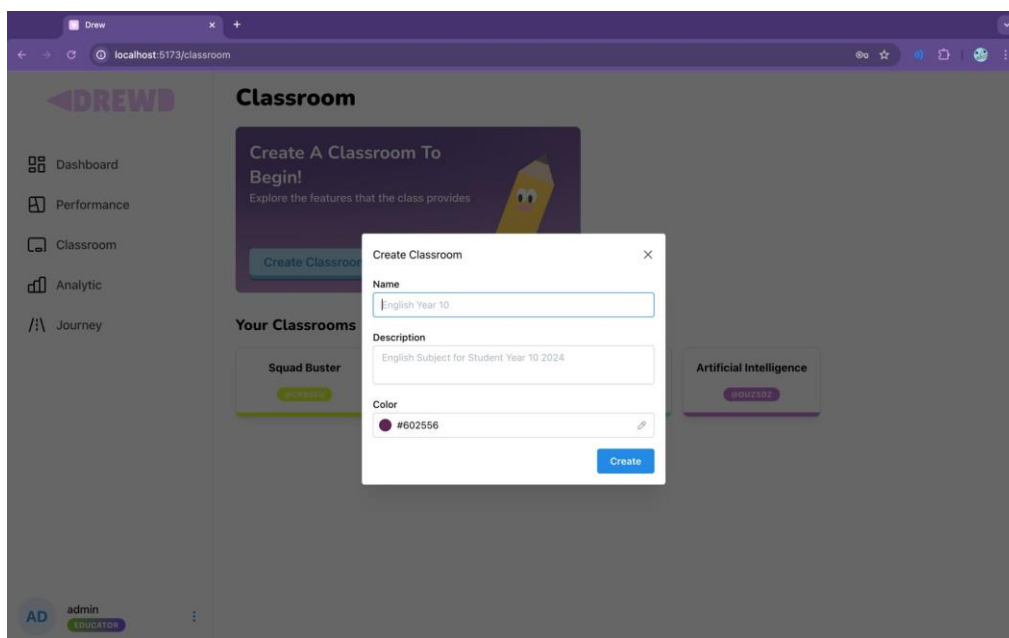


Figure 5.38 Classroom Creation Modal

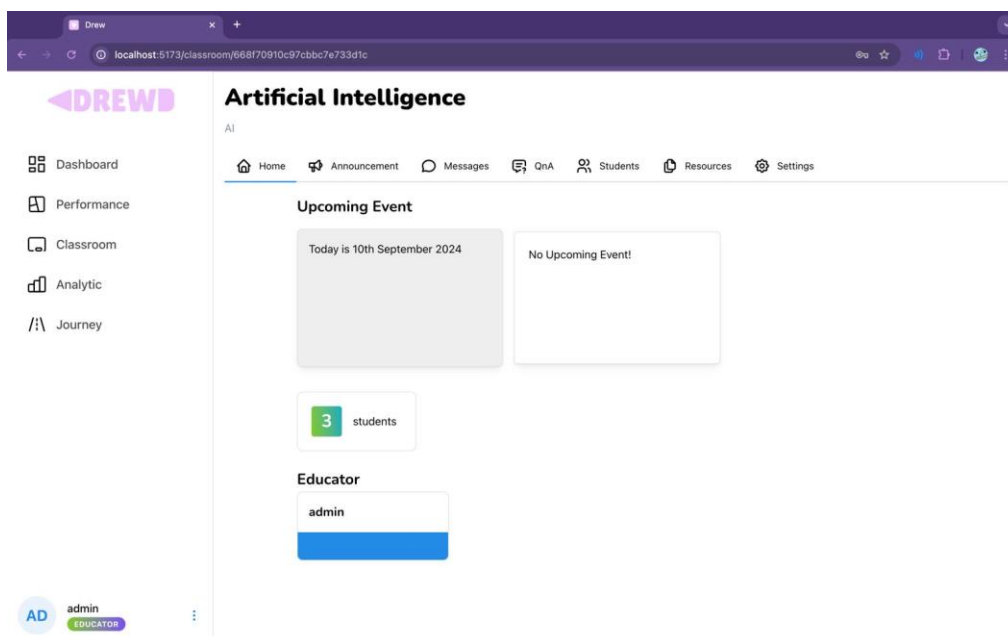


Figure 5.39 Classroom Details Page for Educator

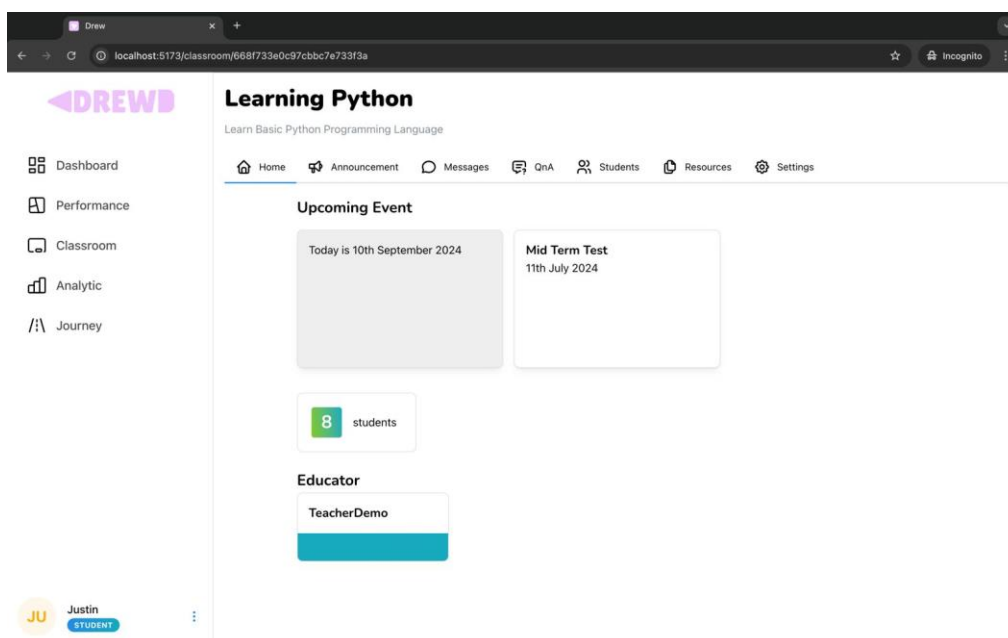


Figure 5.40 Classroom Details Page for Student

Figures below show the announcement page where educators can create new announcements and students can view them within the specific classroom (Functional Requirement 10).

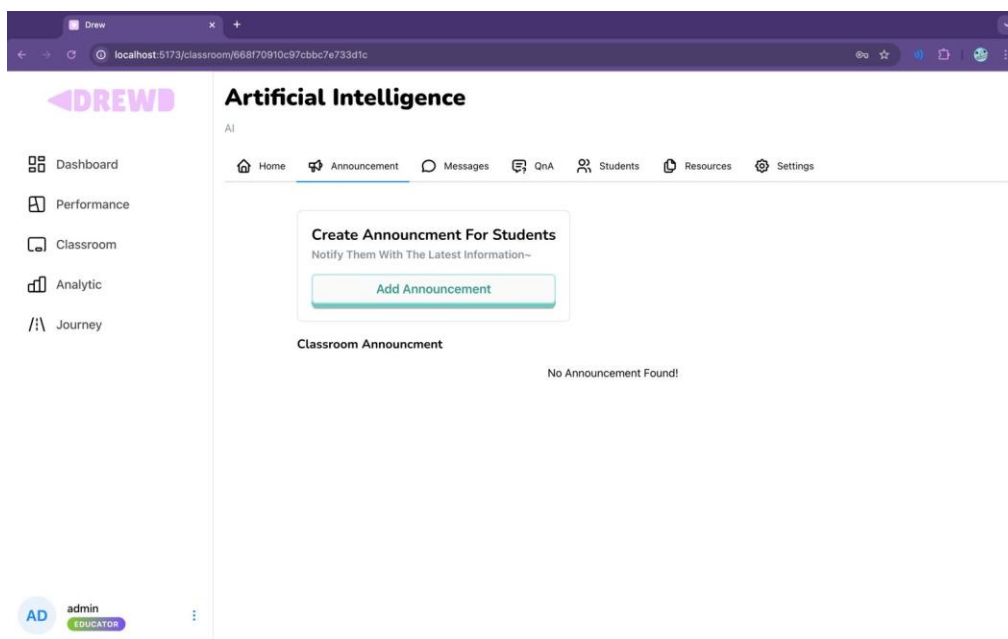


Figure 5.41 Announcement Page in Specific Classroom for Educator

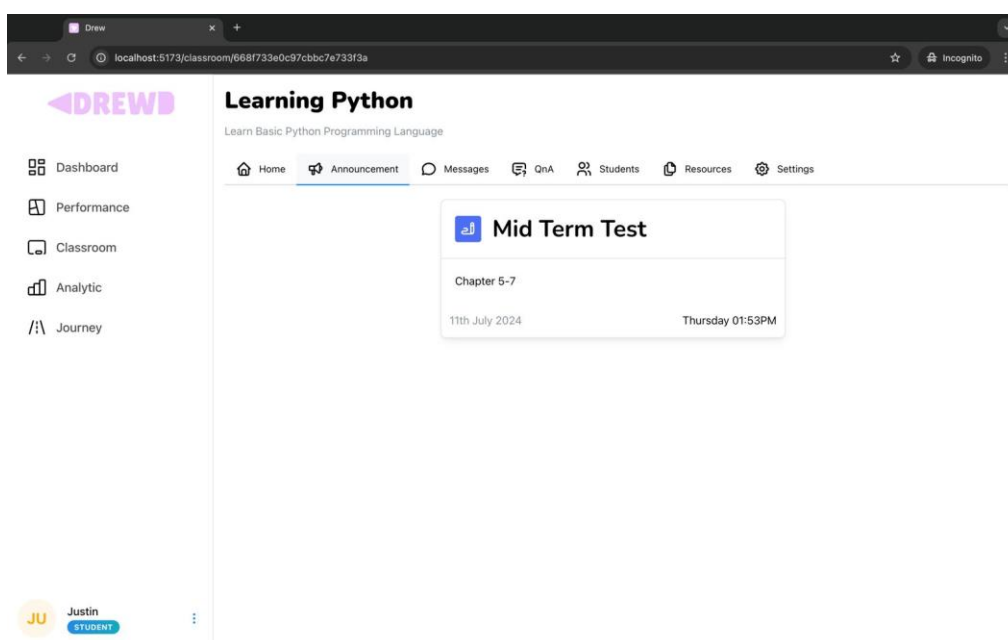


Figure 5.42 Announcement Page in Specific Classroom for Student

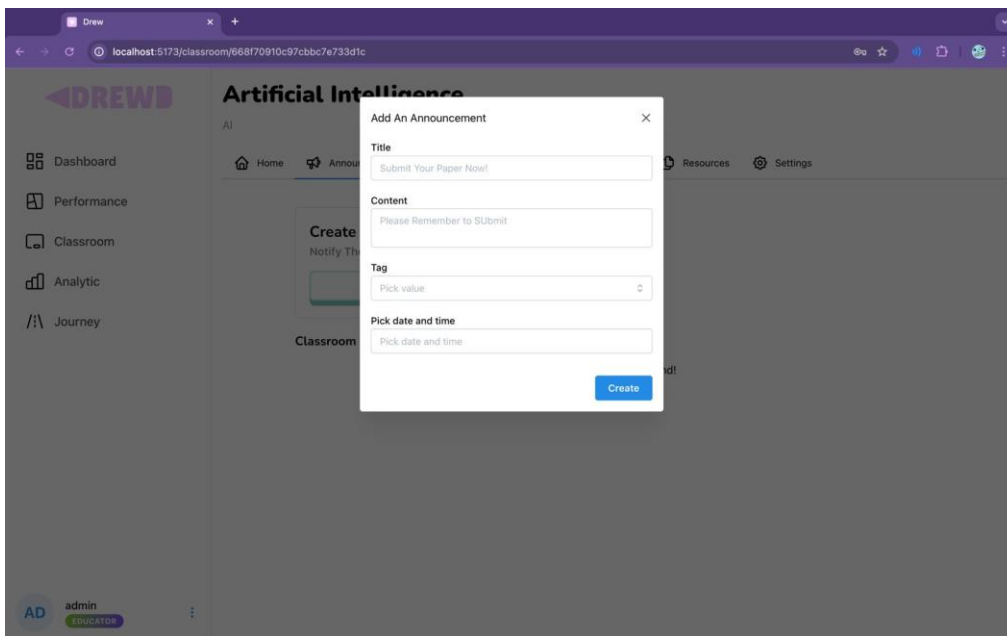


Figure 5.43 Announcement Creation Modal

Figures below show the messaging between students and educators that is being sent and receive in real time (Functional Requirement 11).

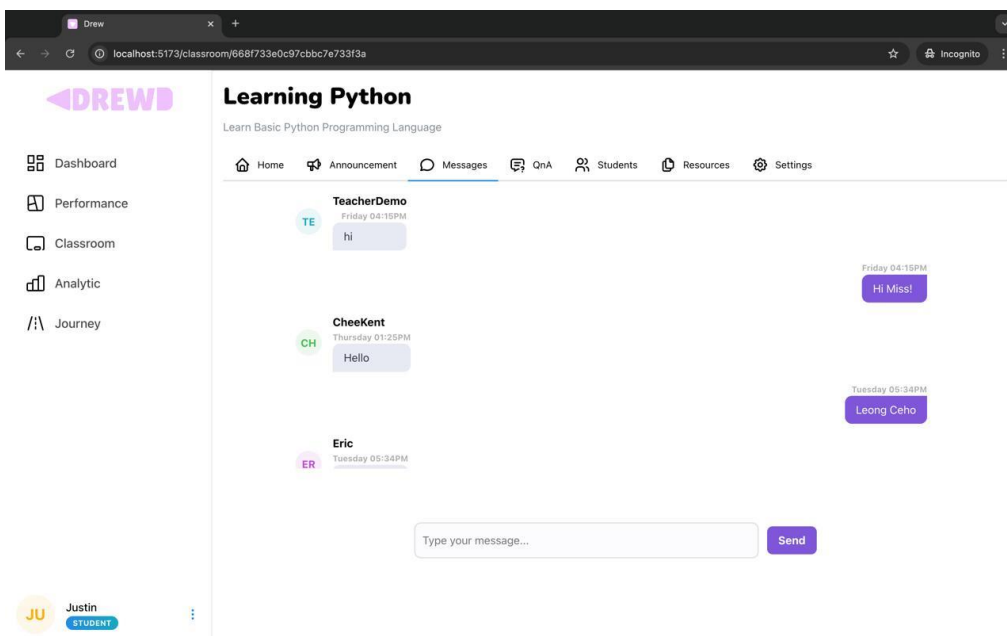


Figure 5.44 Messaging Page for Student

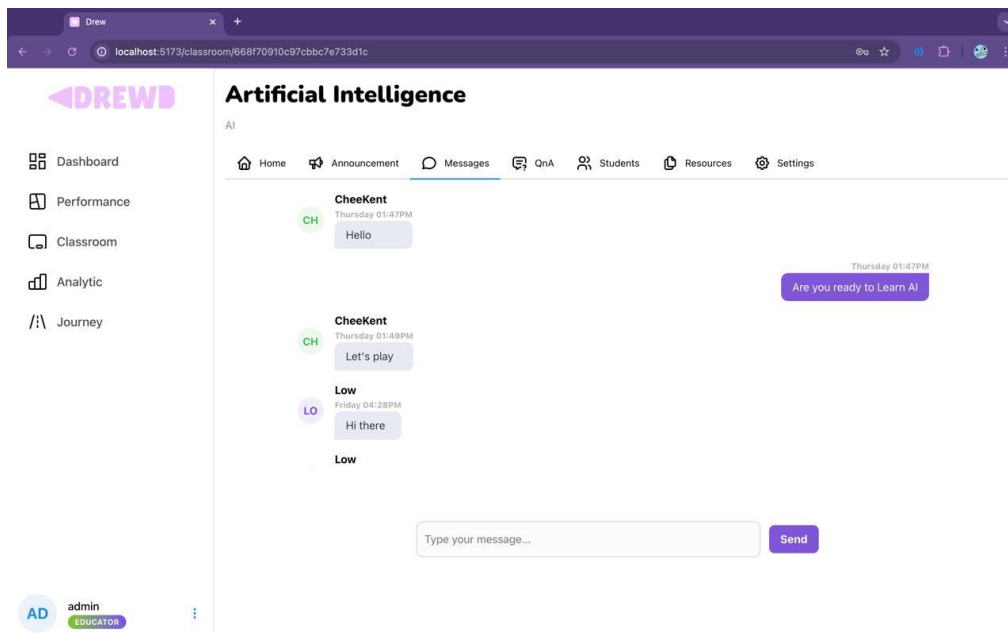


Figure 5.45 Messaging Page for Educator

The screenshot below is the interaction of the question and answer where students are allowed to ask questions with the option of anonymous. Educators then can answer these questions. Both users can upvote questions of their liking (Functional Requirement 12).

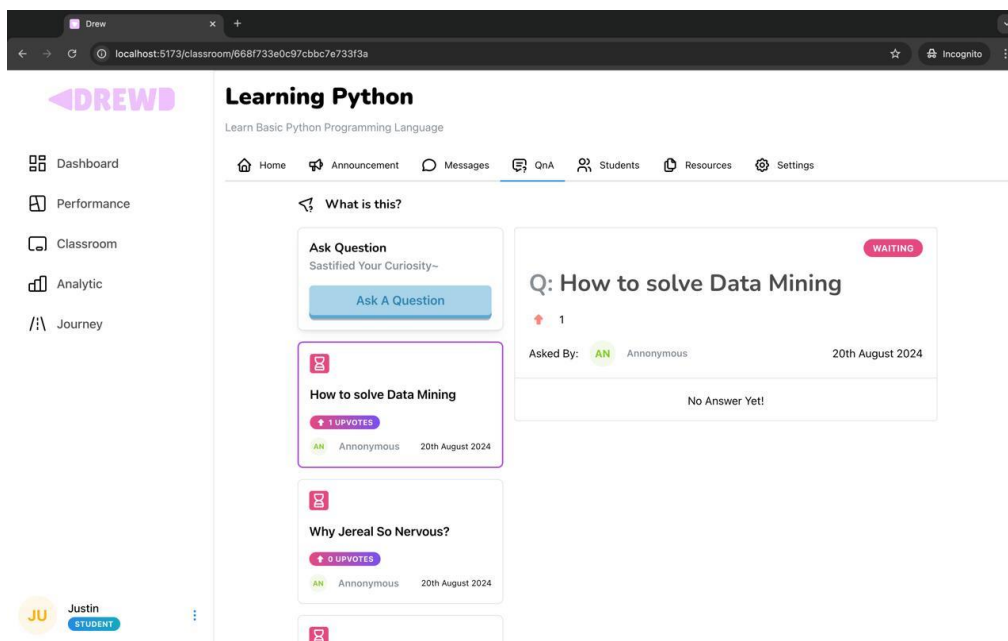


Figure 5.46 QnA Page for Student

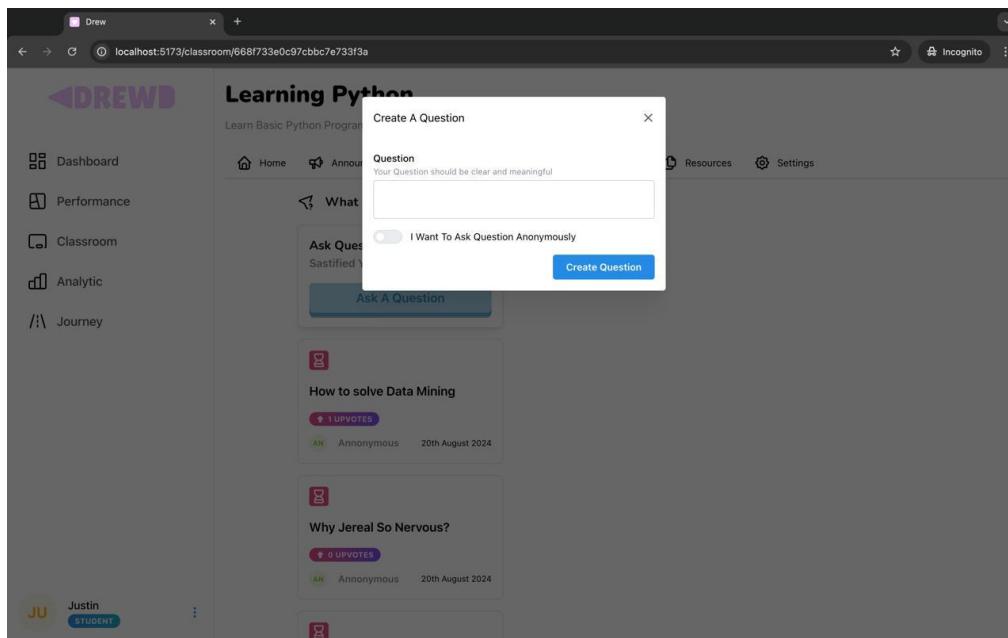


Figure 5.47 Asking a Question

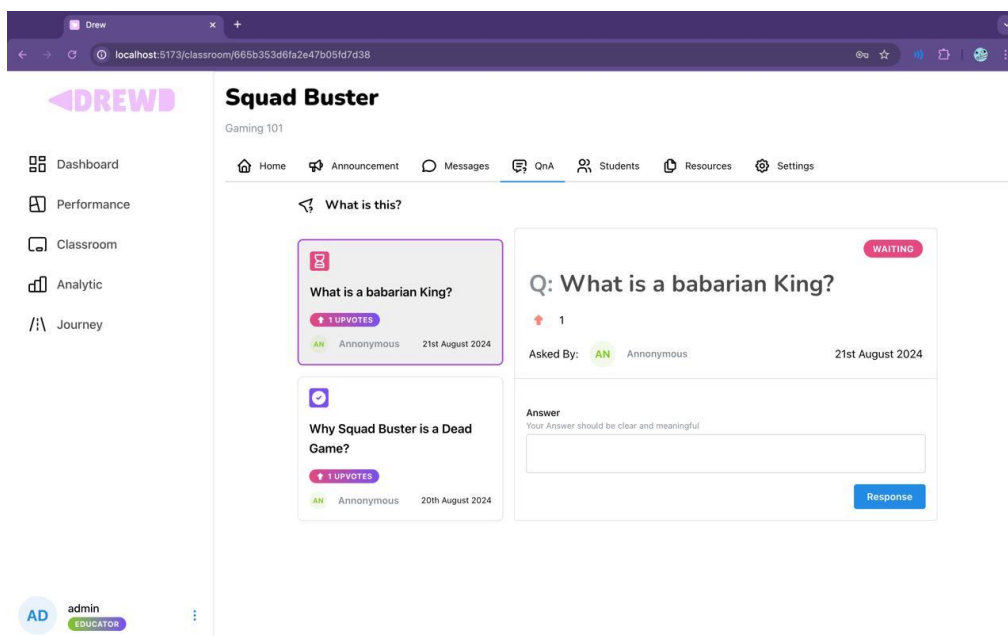


Figure 5.48 QnA Page for Educator

Within a classroom, students and educators can track and manage their score a the students tab, where a table of all test score is shown in a orderly manner.

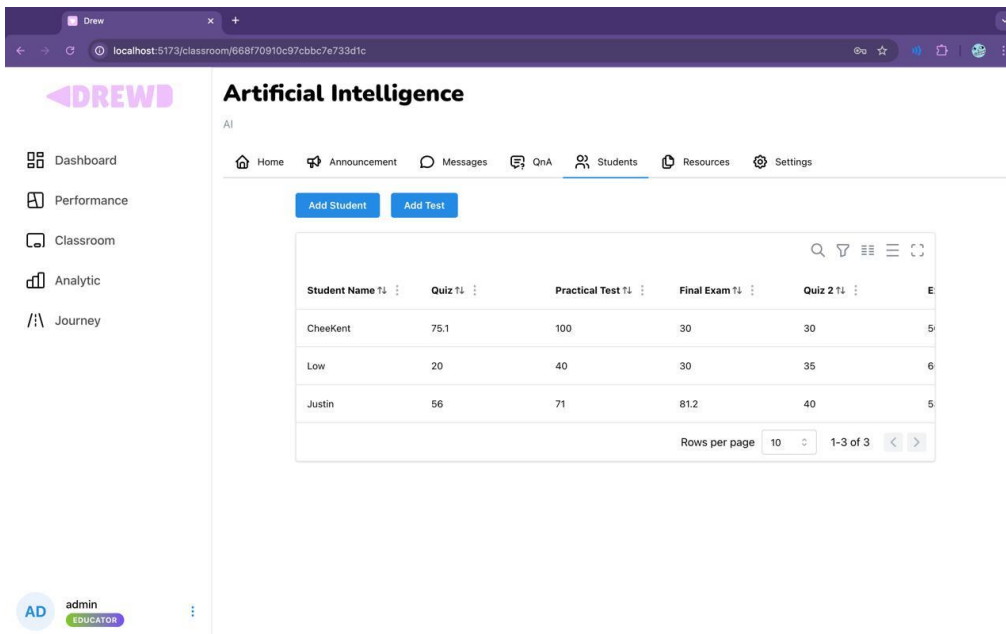


Figure 5.49 Student Details Page for Educator

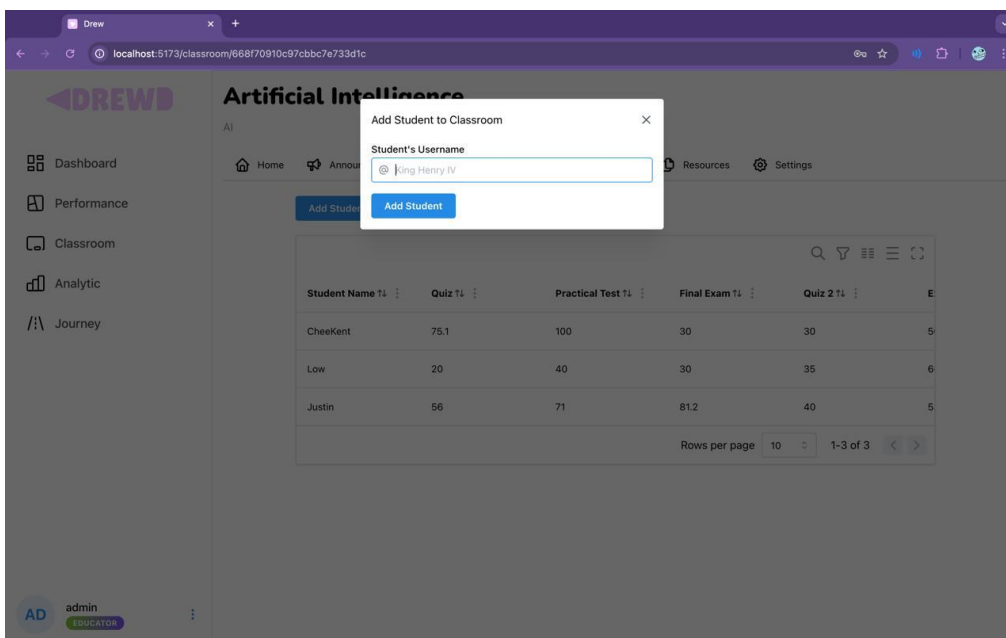


Figure 5.50 Add Student to Classroom

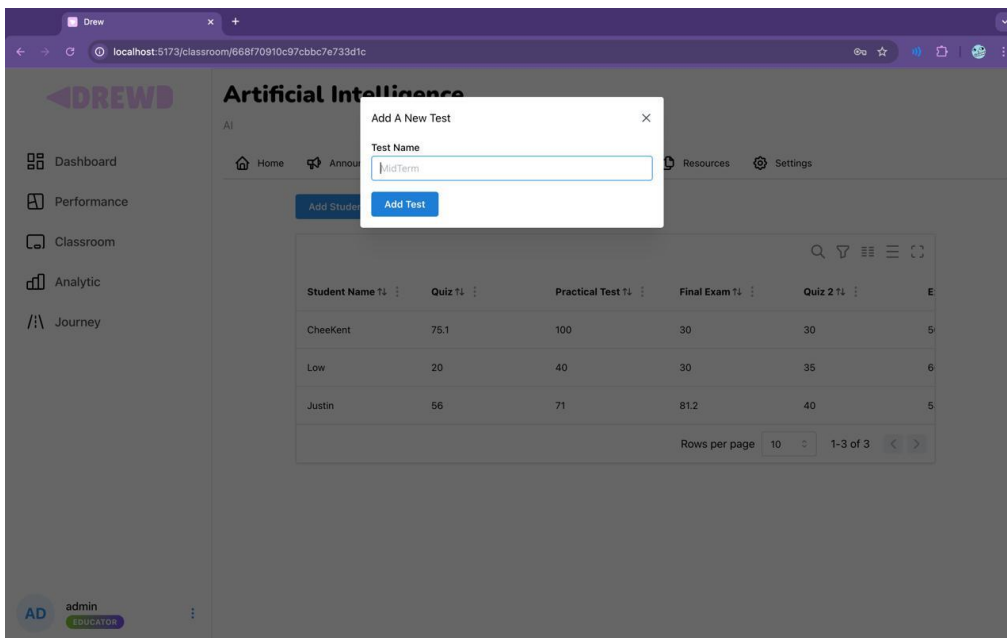


Figure 5.51 Add Test to Classroom

Figure below show how the educator can manage and update the students test score within a classroom.

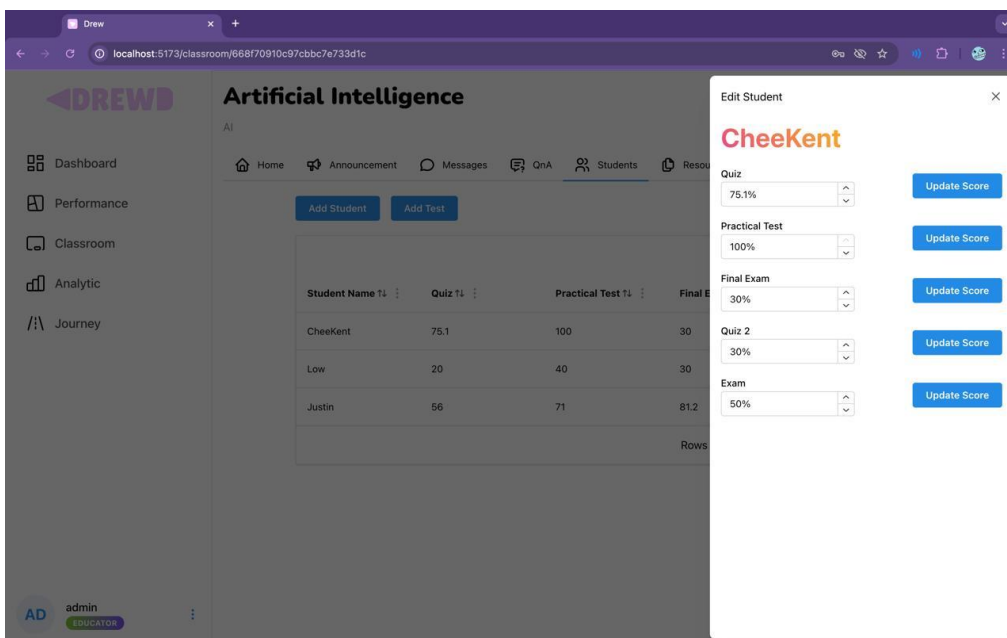
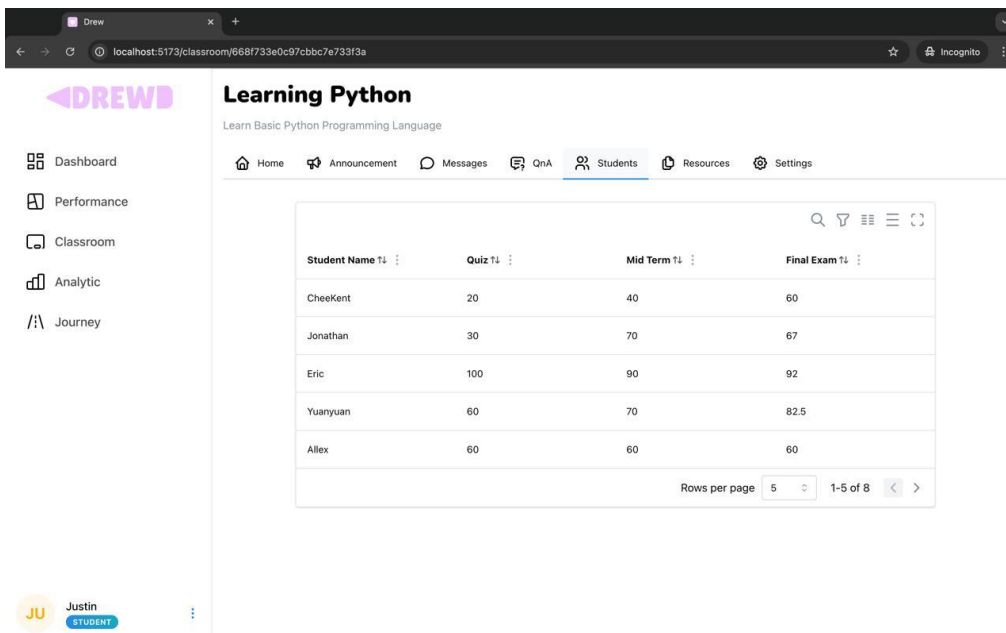


Figure 5.52 Edit Student Score Drawer



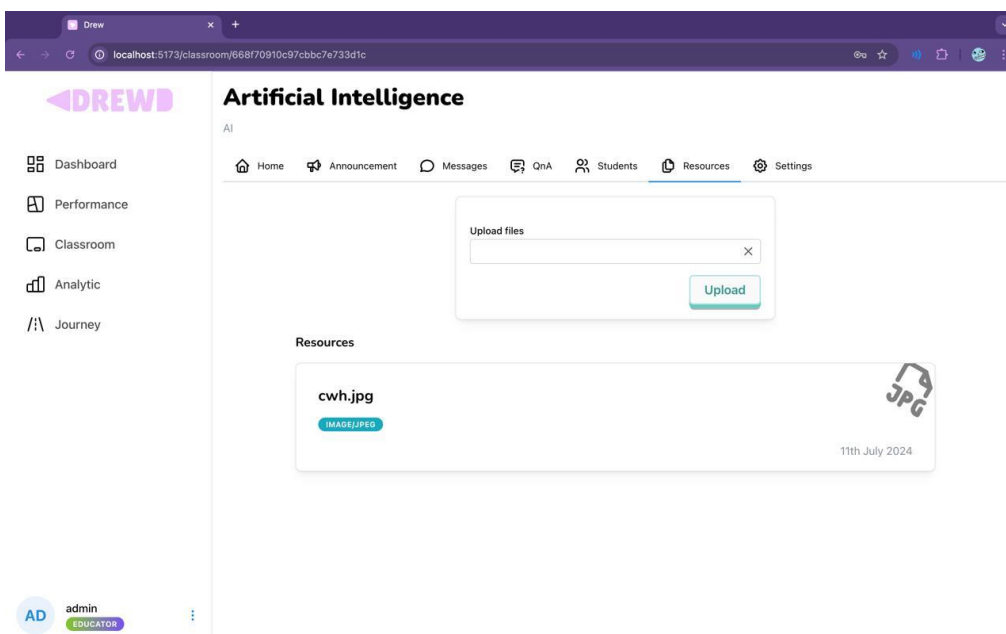
The screenshot shows a web browser window with the URL `localhost:5173/classroom/668f733e0c97cbbc7e733f3a`. The page title is "Learning Python" and the subtitle is "Learn Basic Python Programming Language". The navigation menu includes Home, Announcement, Messages, QnA, Students, Resources, and Settings. The "Students" tab is active, displaying a table of student scores.

Student Name	Quiz	Mid Term	Final Exam
Cheekent	20	40	60
Jonathan	30	70	67
Eric	100	90	92
Yuanyuan	60	70	82.5
Allex	60	60	60

At the bottom of the table, there is a "Rows per page" dropdown set to 5 and a pagination indicator "1-5 of 8". A user profile for Justin (Student) is visible in the bottom left corner.

Figure 5.53 View Student Score for Student

The pages below are the resource tabs that allow educators to share the learning materials to all users within the classroom allowing students to view these resources uploaded (Functional Requirement 5).



The screenshot shows a web browser window with the URL `localhost:5173/classroom/668f70910c97cbbc7e733d1c`. The page title is "Artificial Intelligence" and the subtitle is "AI". The navigation menu includes Home, Announcement, Messages, QnA, Students, Resources, and Settings. The "Resources" tab is active, displaying an upload form and a list of resources.

The "Upload files" form has an input field and an "Upload" button. Below the form, the "Resources" section shows a list of uploaded files:

- File name: `cwh.jpg`
- File type: `IMAGE/JPEG`
- Upload date: 11th July 2024

A user profile for admin (Educator) is visible in the bottom left corner.

Figure 5.54 Resource List for Educator

The screenshot shows a web browser window with the URL `localhost:5173/classroom/668f733e0c97cbbc7e733f3a`. The page title is "Learning Python" and the subtitle is "Learn Basic Python Programming Language". The navigation menu includes Home, Announcement, Messages, QnA, Students, Resources, and Settings. The "Resources" section displays a card for "dummies.pdf" with a red "APPLICATION/PDF" label and a PDF icon. The date "11th July 2024" is shown at the bottom right of the card. On the left sidebar, there are links for Dashboard, Performance, Classroom, Analytic, and Journey. At the bottom left, a user profile for "Justin" (STUDENT) is visible.

Figure 5.55 Resource List for Student

These screenshots below show the analytics module that allow students and educators to generate analytics powered by OpenAI (Functional Requirement 7).

The screenshot shows a web browser window with the URL `localhost:5173/analytic`. The page title is "Your Analytics". The navigation menu includes Dashboard, Performance, Classroom, Analytic, and Journey. The "Your Analytics" section features a "Choose Classroom" dropdown menu with "Artificial Intelligence" selected and a red "Generate Classroom Analysis" button. To the right, an "About" section states: "This Analytic Report is generated via OpenAI. Your selected classroom details such as student's test scores will be analyzed." Below this is a "See My Analysis History" button. The "Report Feedback" section includes a "Summary" box with text: "The analysis shows varying performance levels across students, with notable highs and lows. CheeKent exhibited significant highs in the Practical Test but struggled in the Final Exam, indicating inconsistency. Low consistently scored at the lower end of the spectrum, while Justin demonstrated a moderate performance, suggesting room for improvement in tests." Below the summary are expandable sections for Strength, Weakness, and Improvement. On the right, a radar chart displays performance metrics for "students analyzed", "total tests taken", "highest", and "lowest". A success message at the bottom right reads: "Success Analysis Successfully Generated!". The user profile at the bottom left is for "admin" (EDUCATOR).

Figure 5.56 Analytic Page for Educator

The screenshot shows a web browser window with the URL `localhost:5173/analytic`. The page features a sidebar with navigation options: Dashboard, Performance, Classroom, Analytic, and Journey. The main content area is titled "Your Analytics" and includes a dark blue header with a brain icon and the text "Dear Mr Artificial Intelligence, Please Generate My Analysis". To the right, an "About" section explains that the report is generated via OpenAI and provides a "See My Analysis History" button. Below this is a "Report Feedback" section with five expandable categories: Summary, Strength, Weakness, Improvement, and Changes. The user profile at the bottom left shows "JU Justin STUDENT".

Figure 5.57 Analytic Page for Student

The screenshot shows a web browser window with the URL `localhost:5173/history`. The page features a sidebar with navigation options: Dashboard, Performance, Classroom, Analytic, and Journey. The main content area is titled "Analytic History" and displays a list of five analytics on the left: Analytic 1 (3rd August 2024), Analytic 2 (3rd August 2024), Analytic 3 (19th August 2024), Analytic 4 (19th August 2024), and Analytic 5 (10th September 2024). The right side of the page shows a large empty area with the text "No Analytic Selected" and a 3D brain icon. The user profile at the bottom left shows "AD admin EDUCATOR".

Figure 5.58 Analytic History Page for Educator & Student

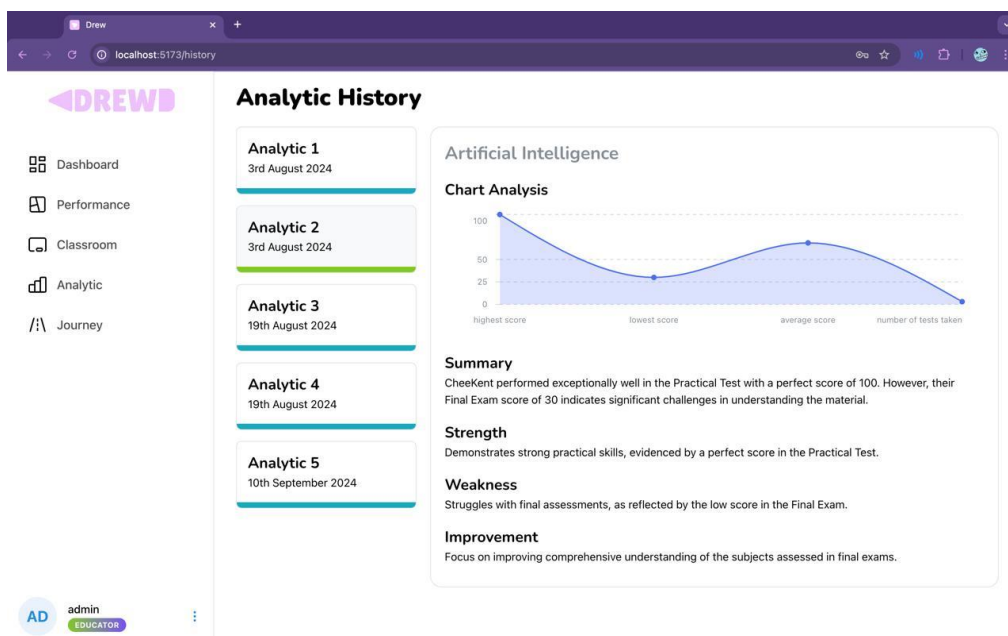


Figure 5.59 Analytic History Item for Educator

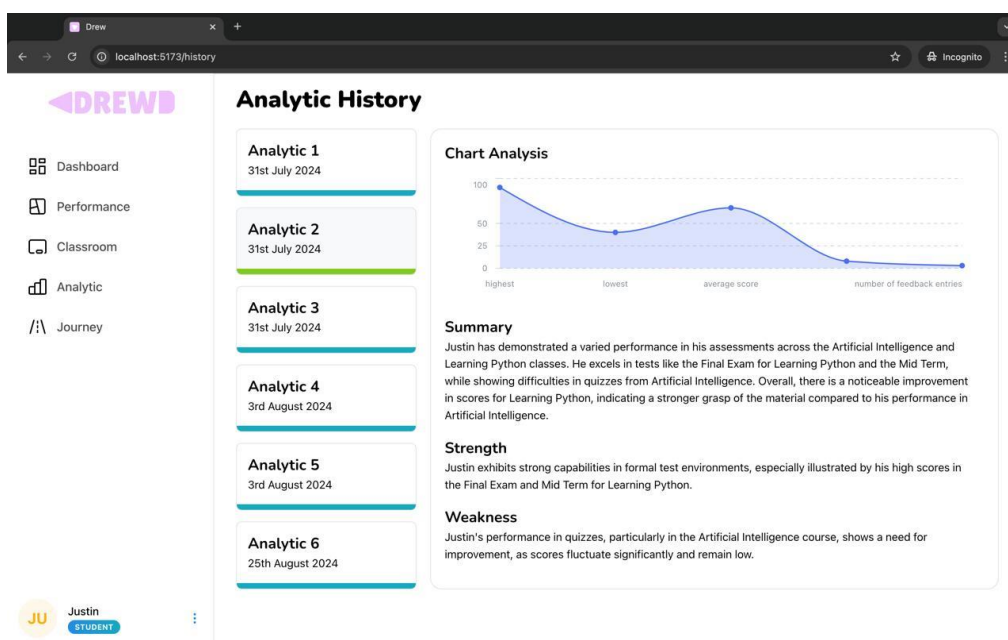


Figure 5.60 Analytic History Item for Educator

These screenshots below show the analytics module that allow students and educators to generate personalized learning plan powered by OpenAI (Functional Requirement 7).

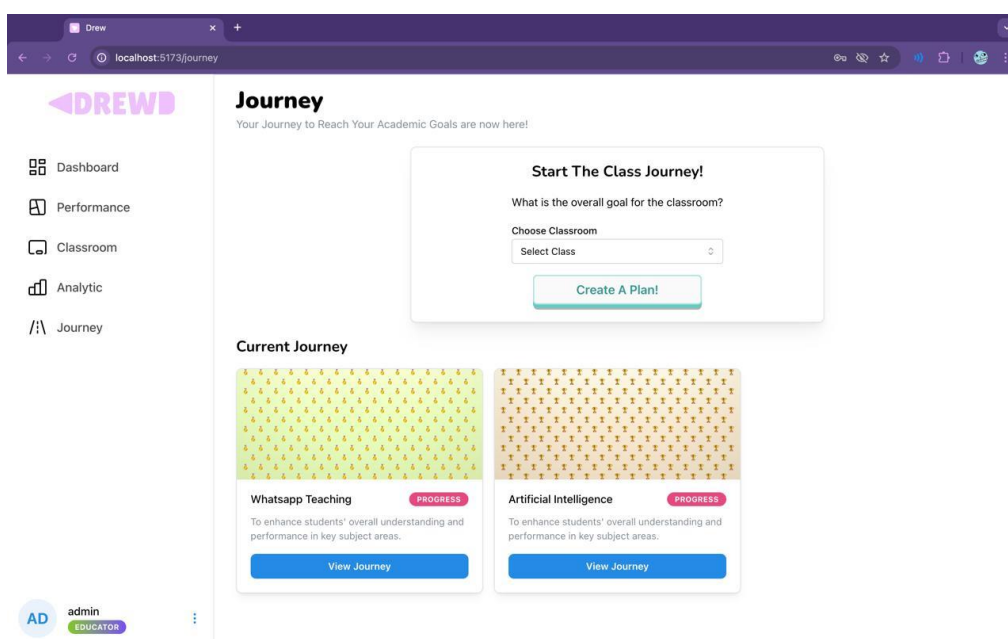


Figure 5.61 Journey Page for Educator

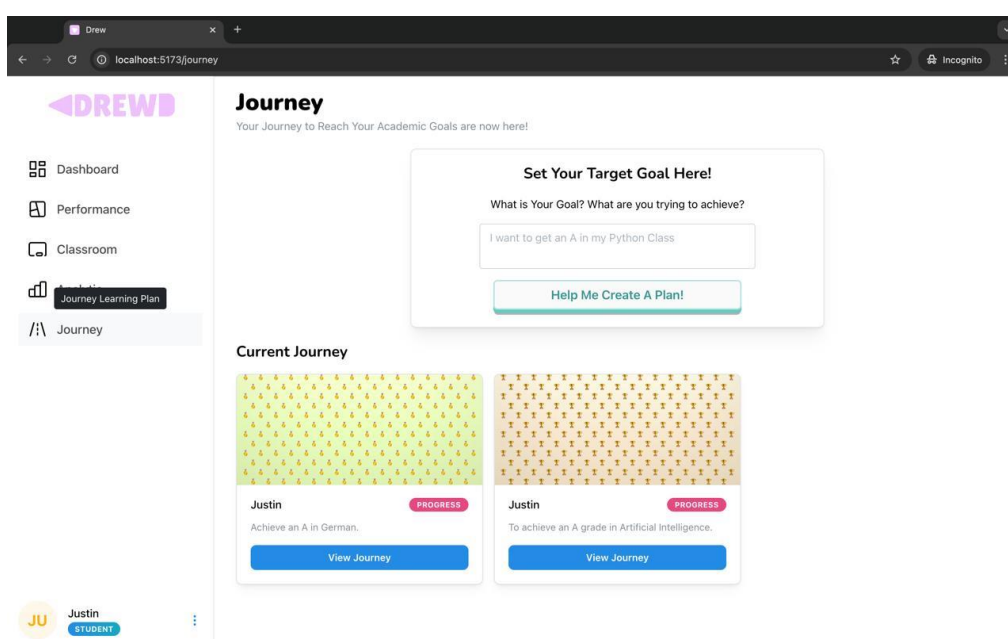


Figure 5.62 Journey Page for Student

The screenshot shows a web browser window with the URL `localhost:5173/class/journey/66b26c65c10af68af573cde0`. The page title is "Your Journey" under the DREW logo. On the left, a sidebar contains navigation links: Dashboard, Performance, Classroom, Analytic, and Journey. The user profile is "admin EDUCATOR".

The main content area displays two journey items:

- Basic Concepts in Mathematics**: Expected Completion Of The Step **2 WEEKS**. Resource: **Khan Academy - Arithmetic**. Description: "This resource provides comprehensive lessons and practice exercises covering basic arithmetic concepts." A "Link For The Resource" is provided. A "Complete" button is visible in the bottom right corner.
- Understanding Scientific Principles**: Expected Completion Of The Step **2 WEEKS**. Resource: **Crash Course Chemistry**. Description: "This YouTube series introduces key chemistry concepts through engaging and informative videos." A video player is shown below the text.

A downward-pointing arrow indicates the flow from the first item to the second.

Figure 5.63 Journey Item Page for Educator

The screenshot shows a web browser window with the URL `localhost:5173/journey/66b236f2badd7425df746f83`. The page title is "Your Journey" under the DREW logo. On the left, a sidebar contains navigation links: Dashboard, Performance, Classroom, Analytic, and Journey. The user profile is "Justin STUDENT".

The main content area displays two journey items:

- Fundamentals of Artificial Intelligence**: Expected Completion Of The Step **1 WEEK**. Resource: **Artificial Intelligence: A Modern Approach**. Description: "A comprehensive introduction to the core concepts and techniques in Artificial Intelligence, written by Stuart Russell and Peter Norvig." A "Link For The Resource" is provided. A "Complete" button is visible in the bottom right corner.
- Machine Learning Techniques**: Expected Completion Of The Step **2 WEEKS**. Resource: **Machine Learning Crash Course by Google**. Description: "An excellent introduction to machine learning concepts and practices with real-world applications." A video player is shown below the text.

A downward-pointing arrow indicates the flow from the first item to the second.

Figure 5.64 Journey Item Page for Student

Figures below show the Specific User Profile viewed by Educator and providing feedback towards the students.

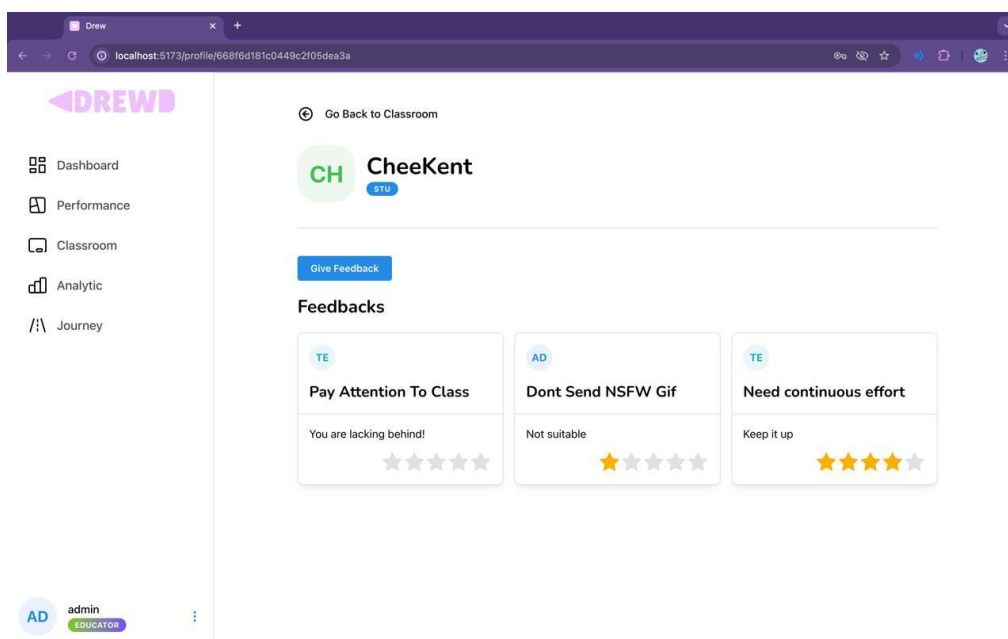


Figure 5.65 User Profile Page for Educator

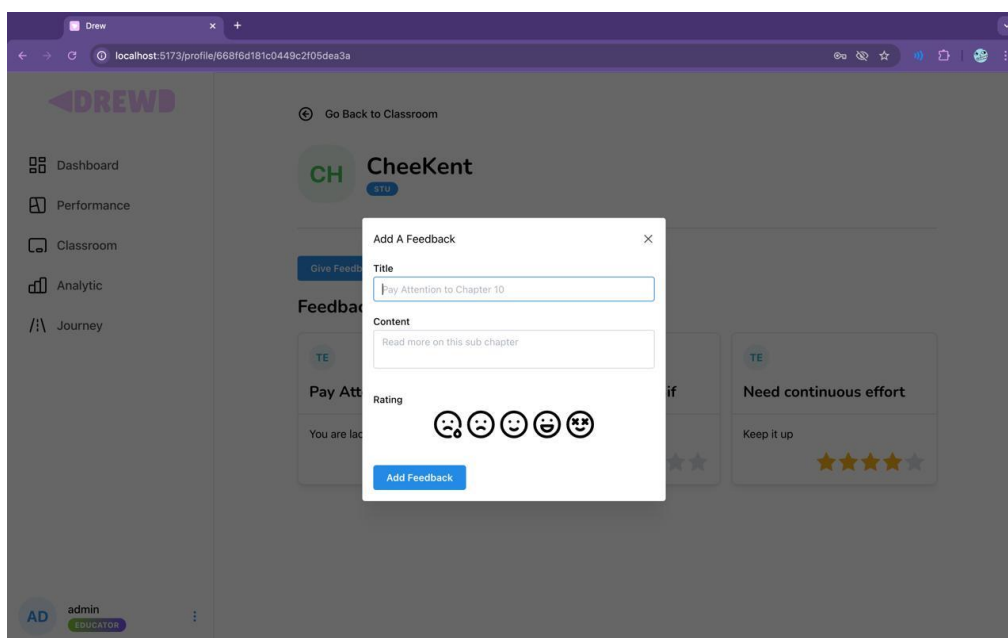


Figure 5.66 Feedback Creation Modal

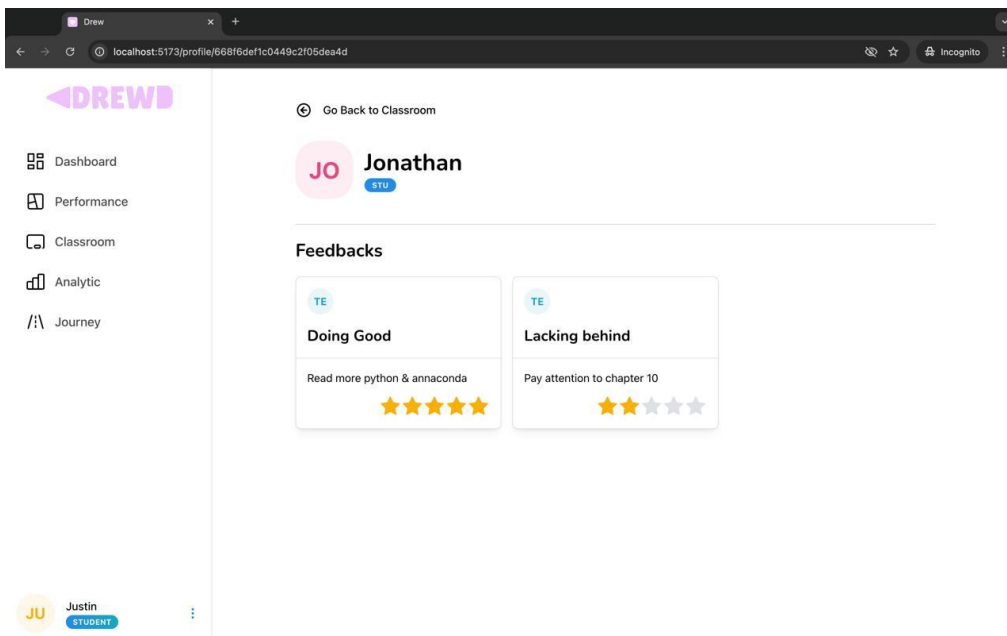


Figure 5.67 User Profile Page for Student

Screenshot of the User Profile to update their details of their account (Functional Requirement 3).

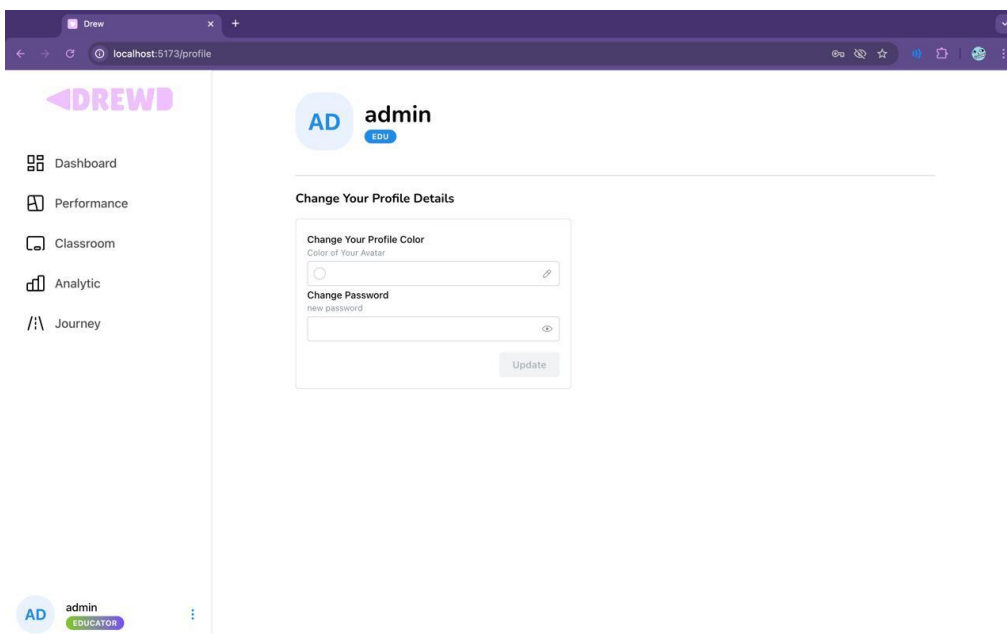


Figure 5.68 User Profile Page

5.4.2 Mobile View

Figures below show the screen of authentication such as login, signup that mentioned in the first 2 use case in a mobile view (FR 1 & 2).

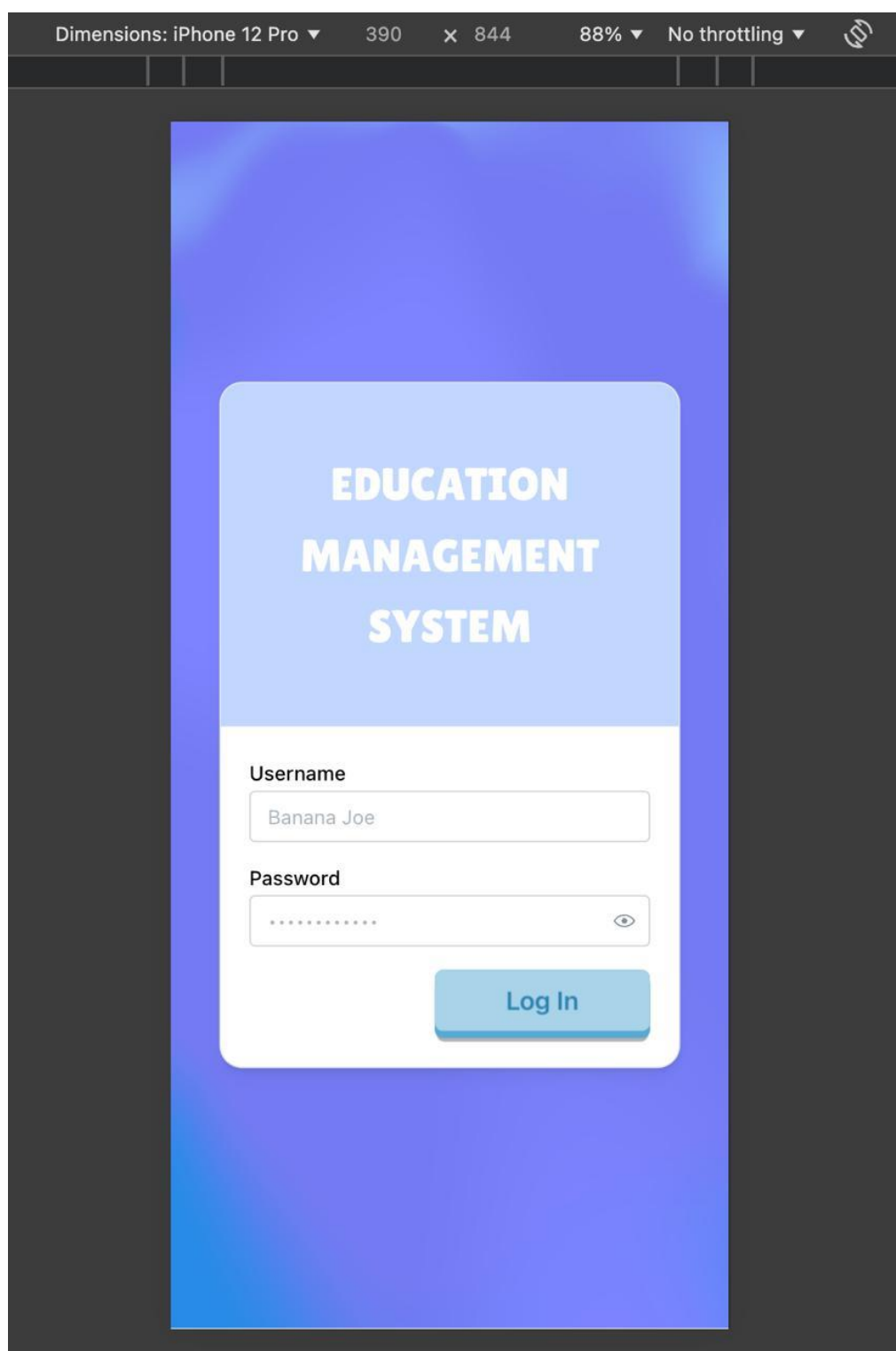


Figure 5.69 Login Page for Educator & Student

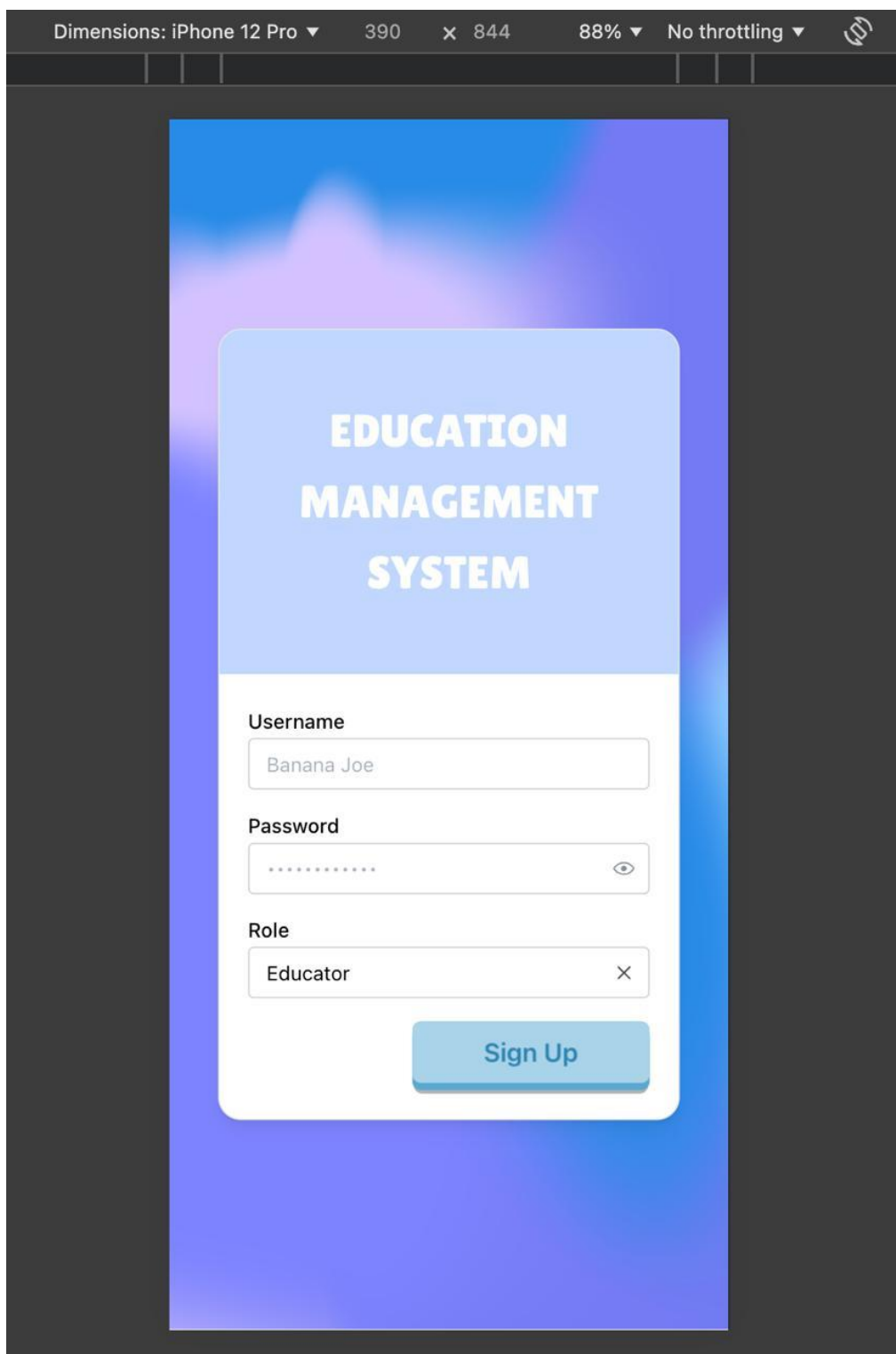


Figure 5.70 SignUp Page for Educator & Student

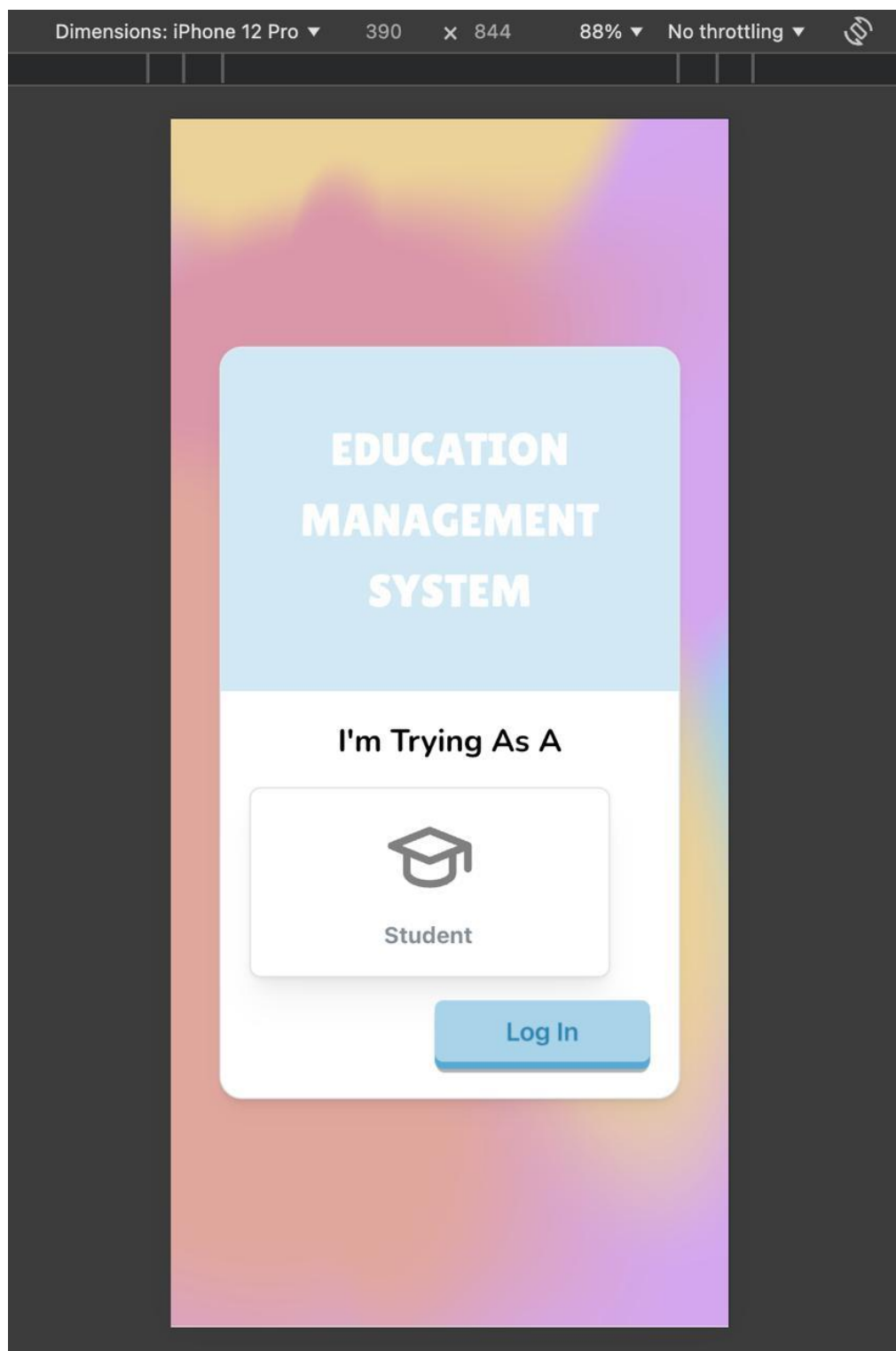


Figure 5.71 Demo Login Page

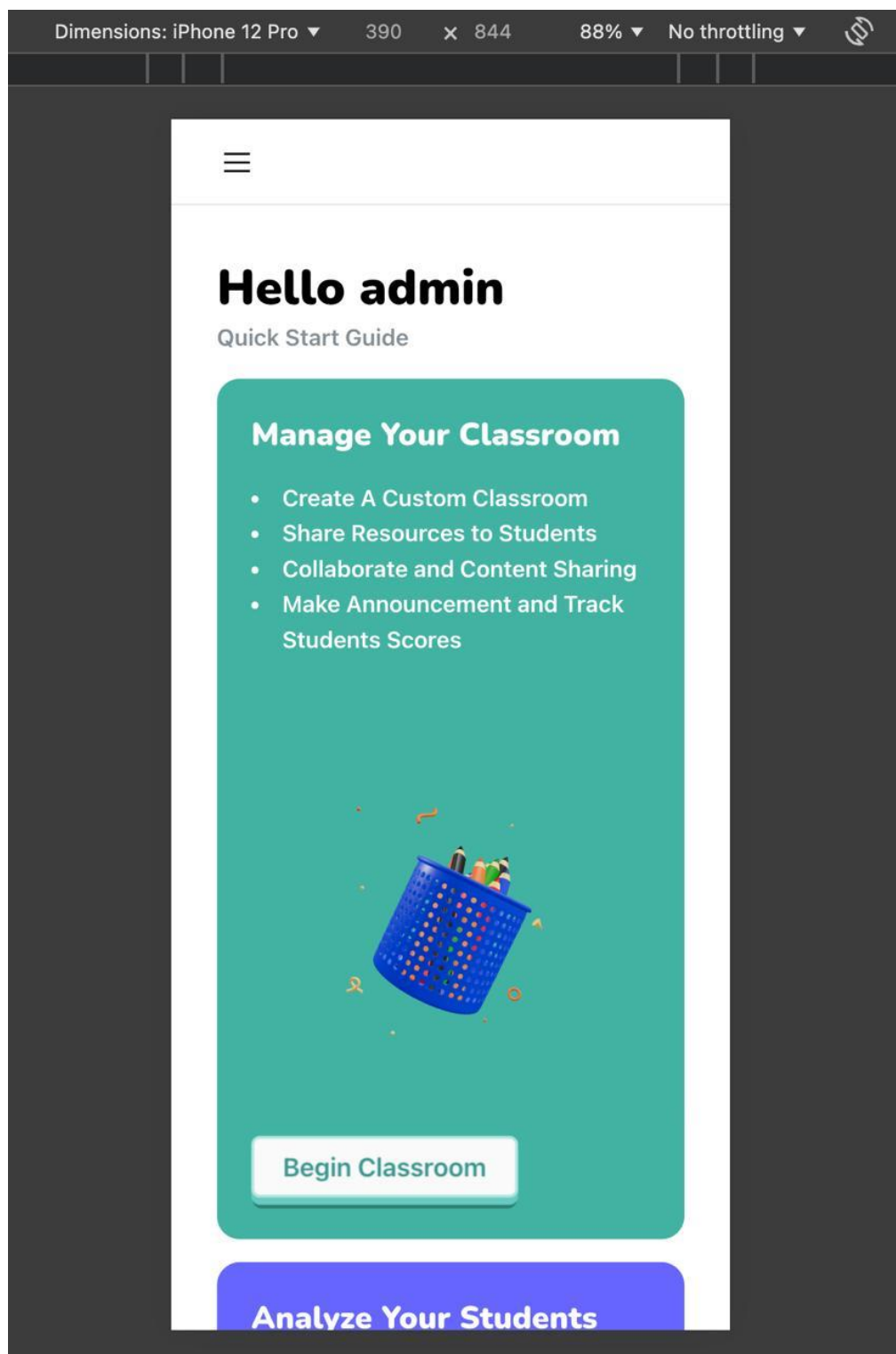


Figure 5.72 Dashboard Page for Educator & Student

Figure above show the landing page which is the page that the user will see after a successful login or signup.

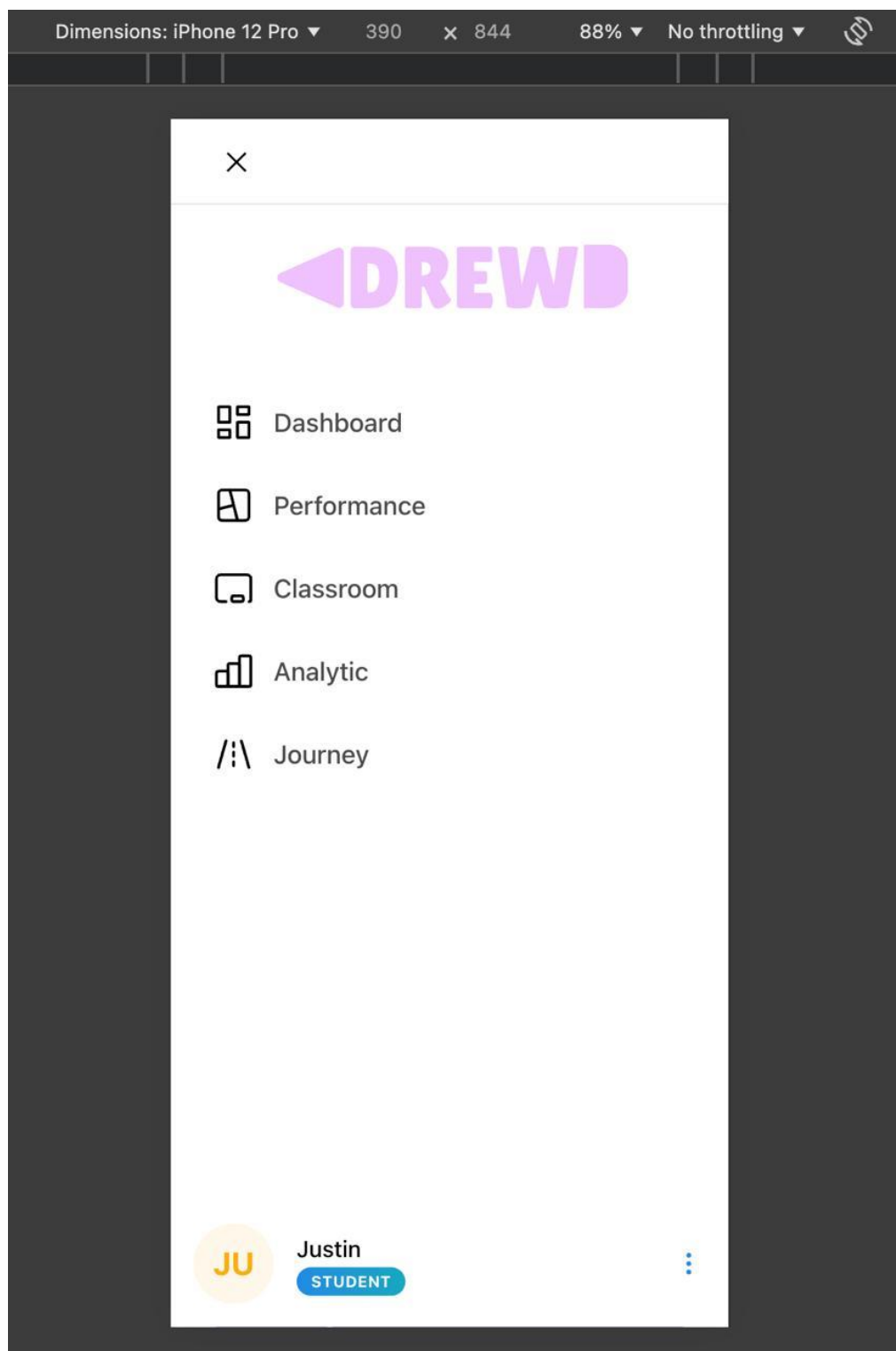


Figure 5.73 Mobile Sidebar Navigation Panel

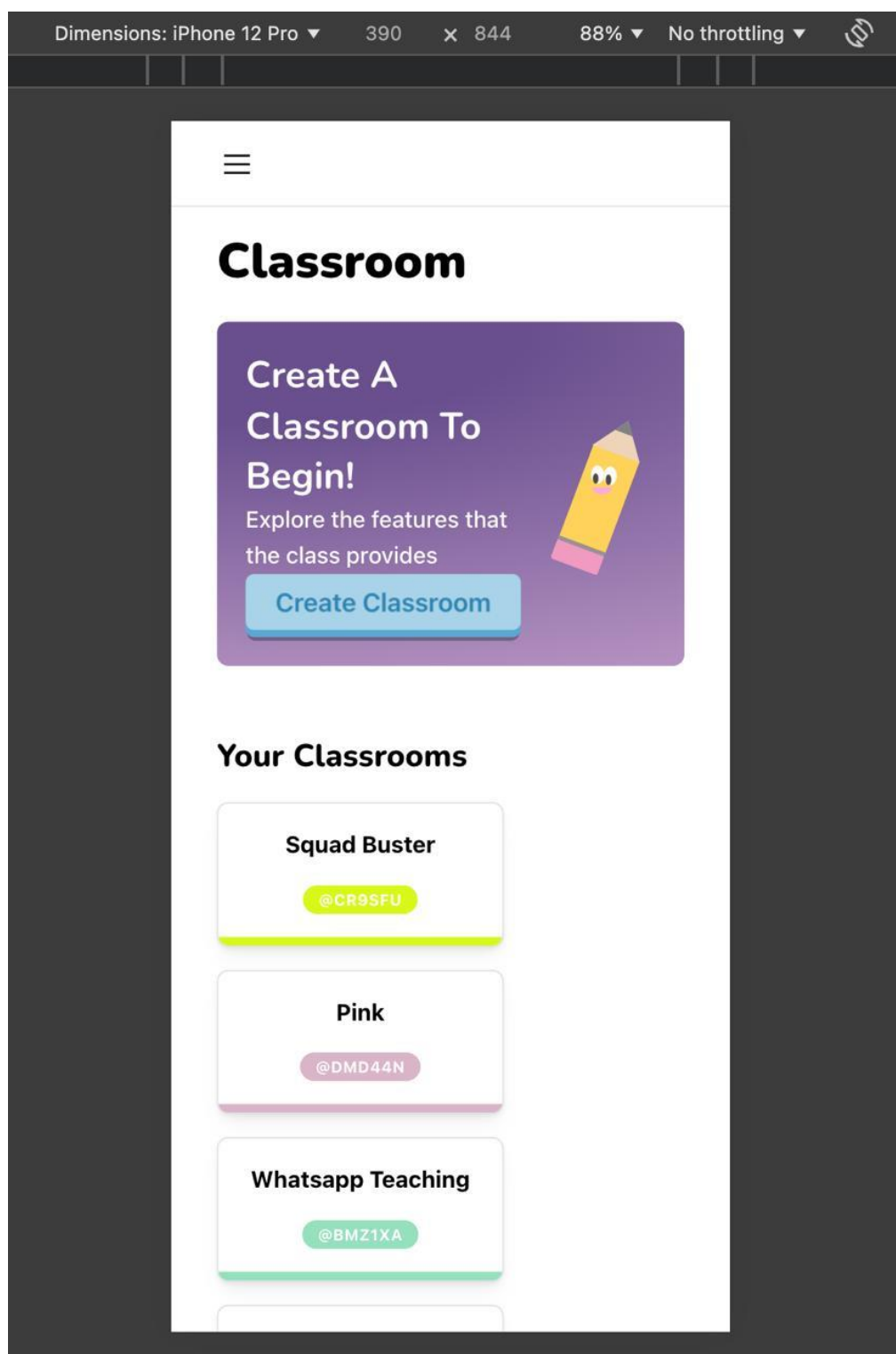


Figure 5.74 Classroom Page for Educator

Following figures show the classroom list that consists of all the classrooms that the user has join. By clicking any classes below, classroom management tools will be shown.

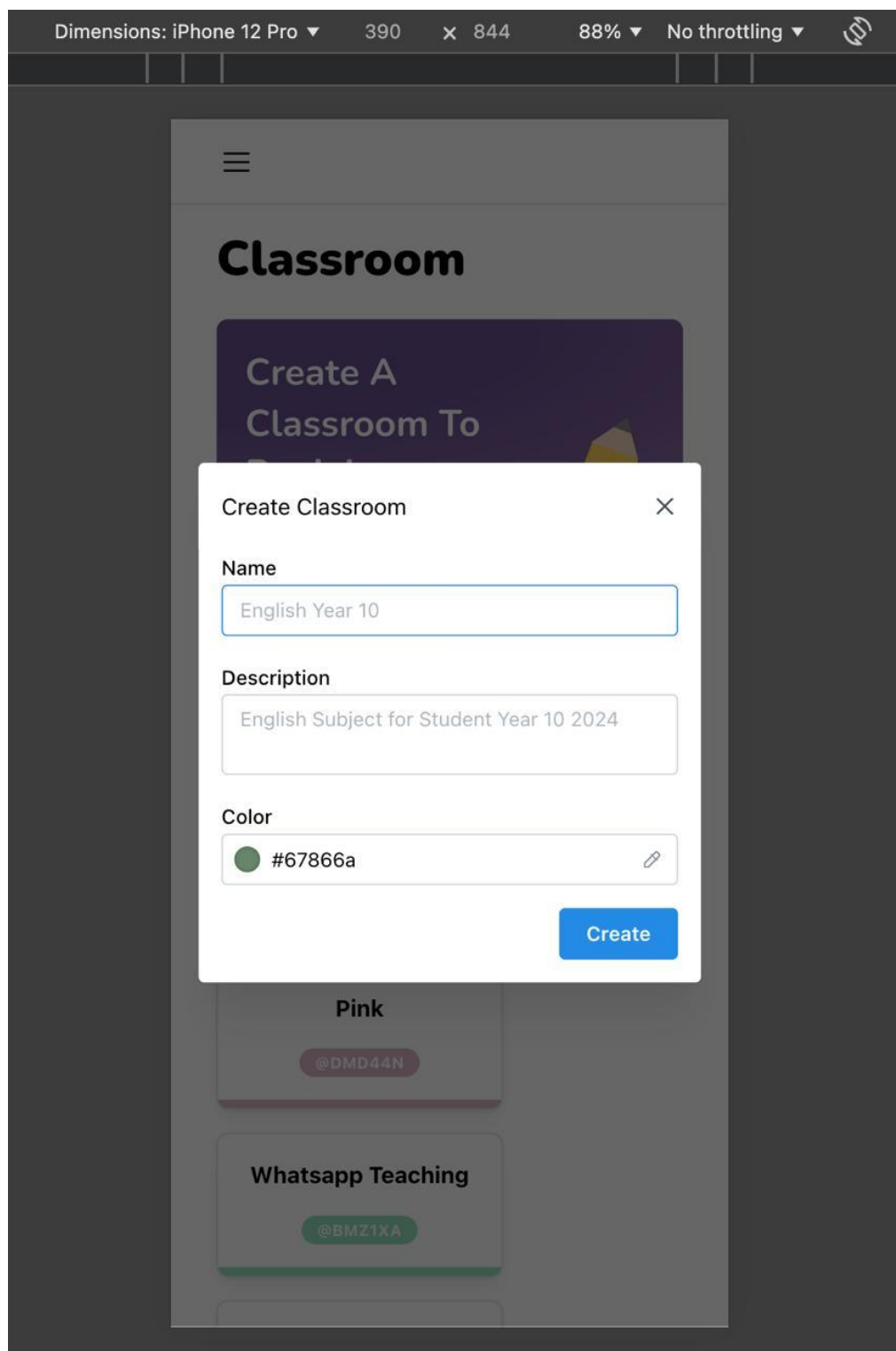


Figure 5.75 Classroom Creation Page

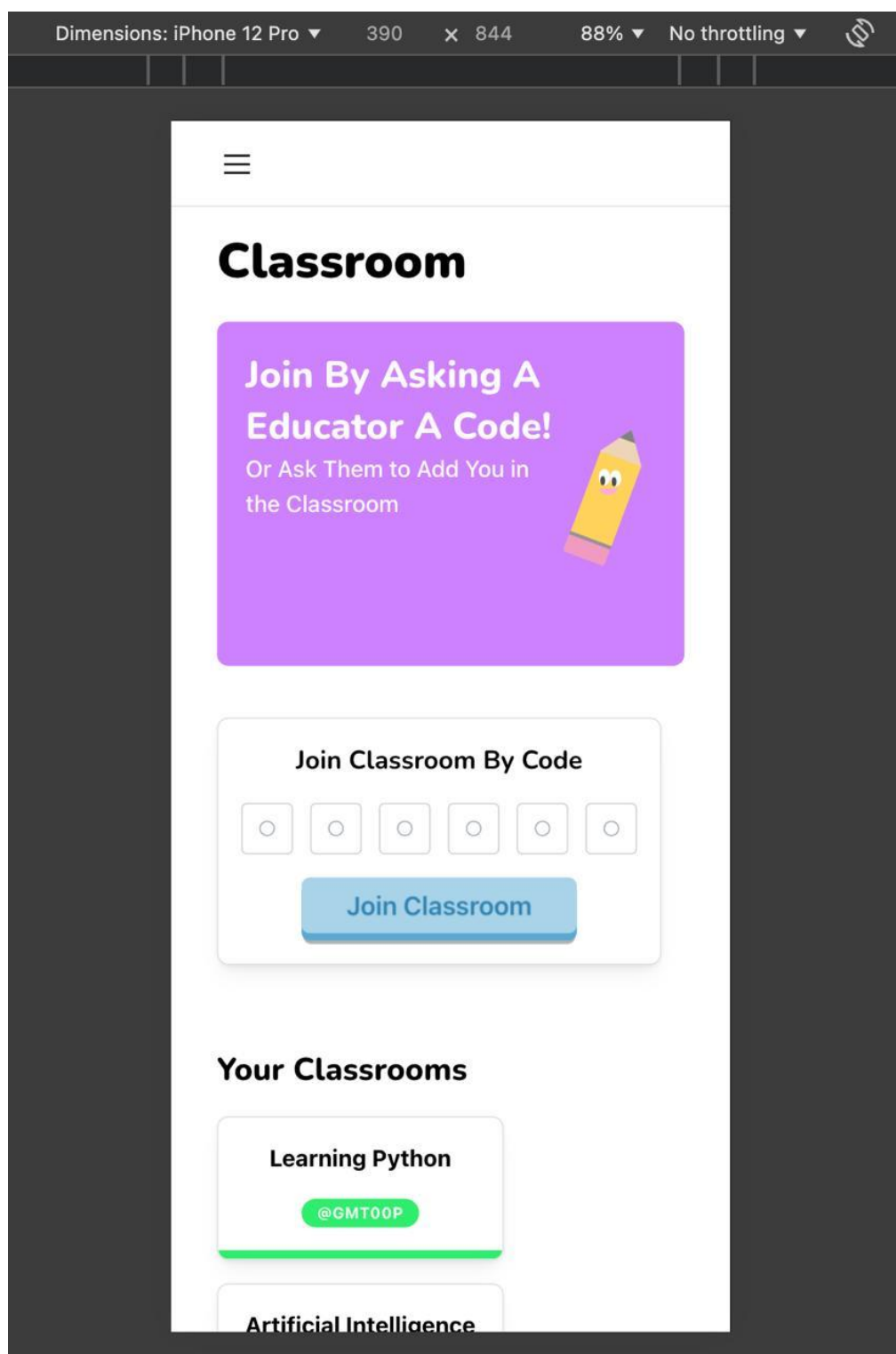


Figure 5.76 Classroom Page for Student

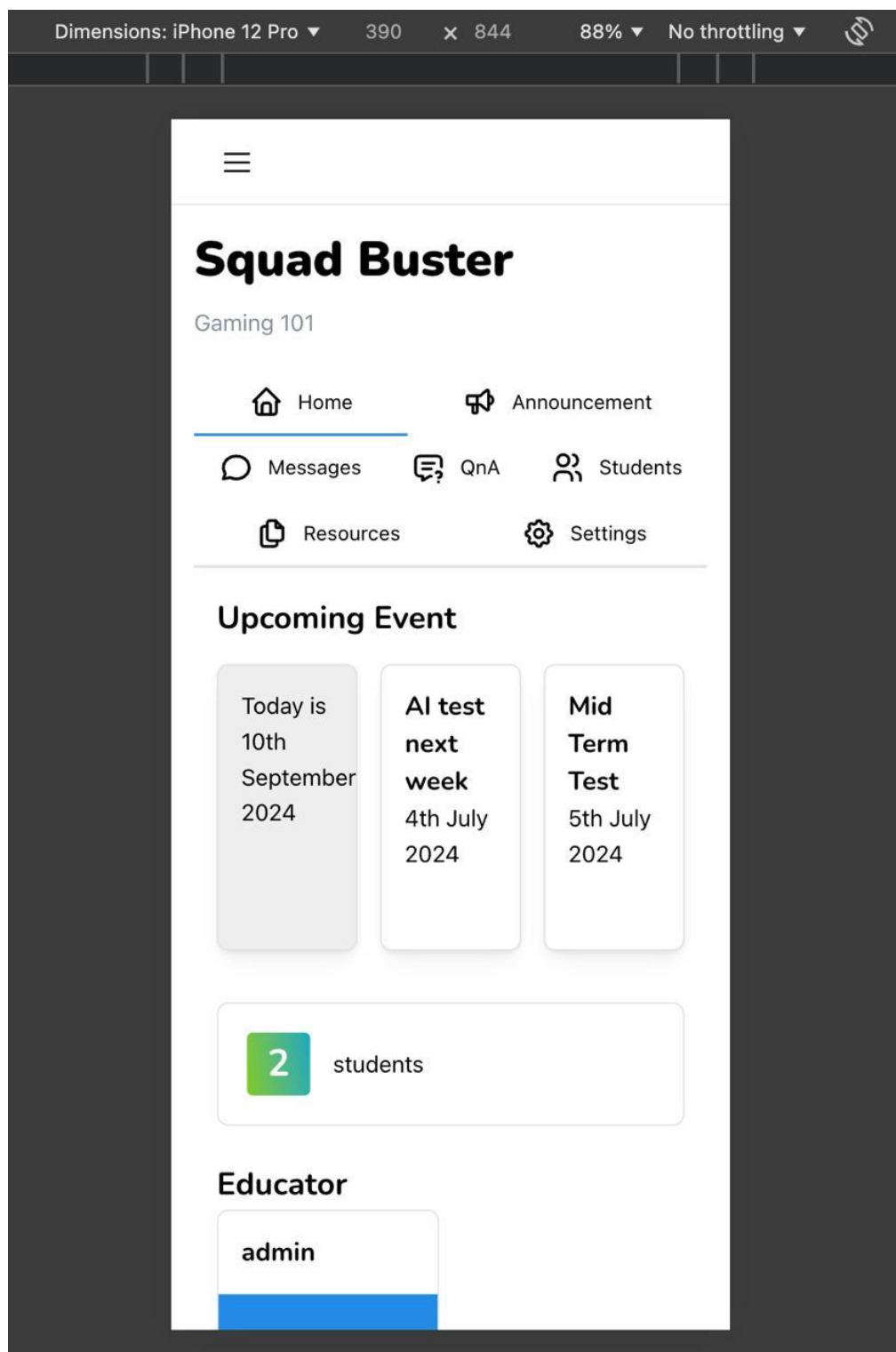


Figure 5.77 Specific Classroom Page for Educator & Student

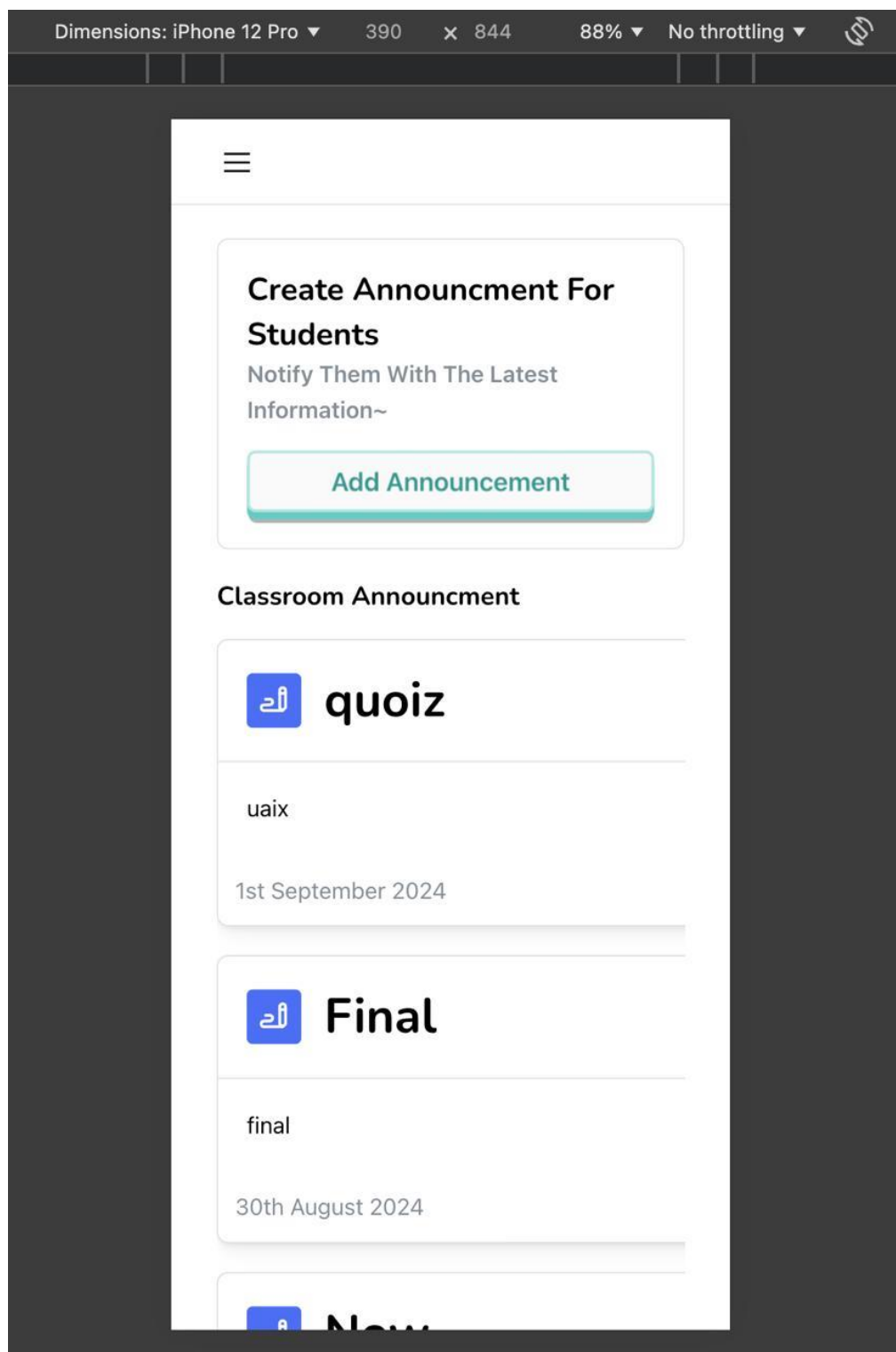


Figure 5.78 Announcement Page for Educator

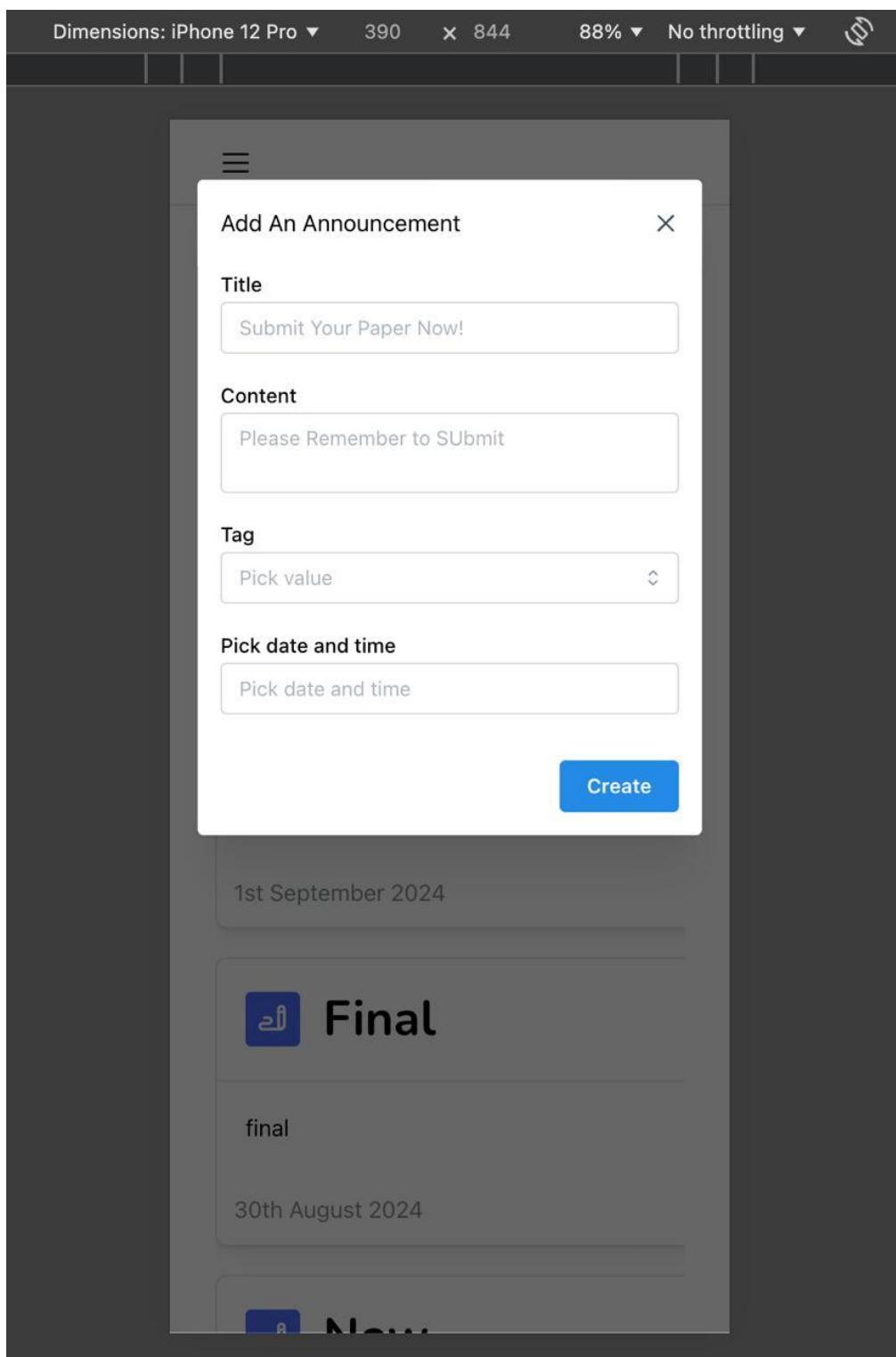


Figure 5.79 Announcement Creation Modal

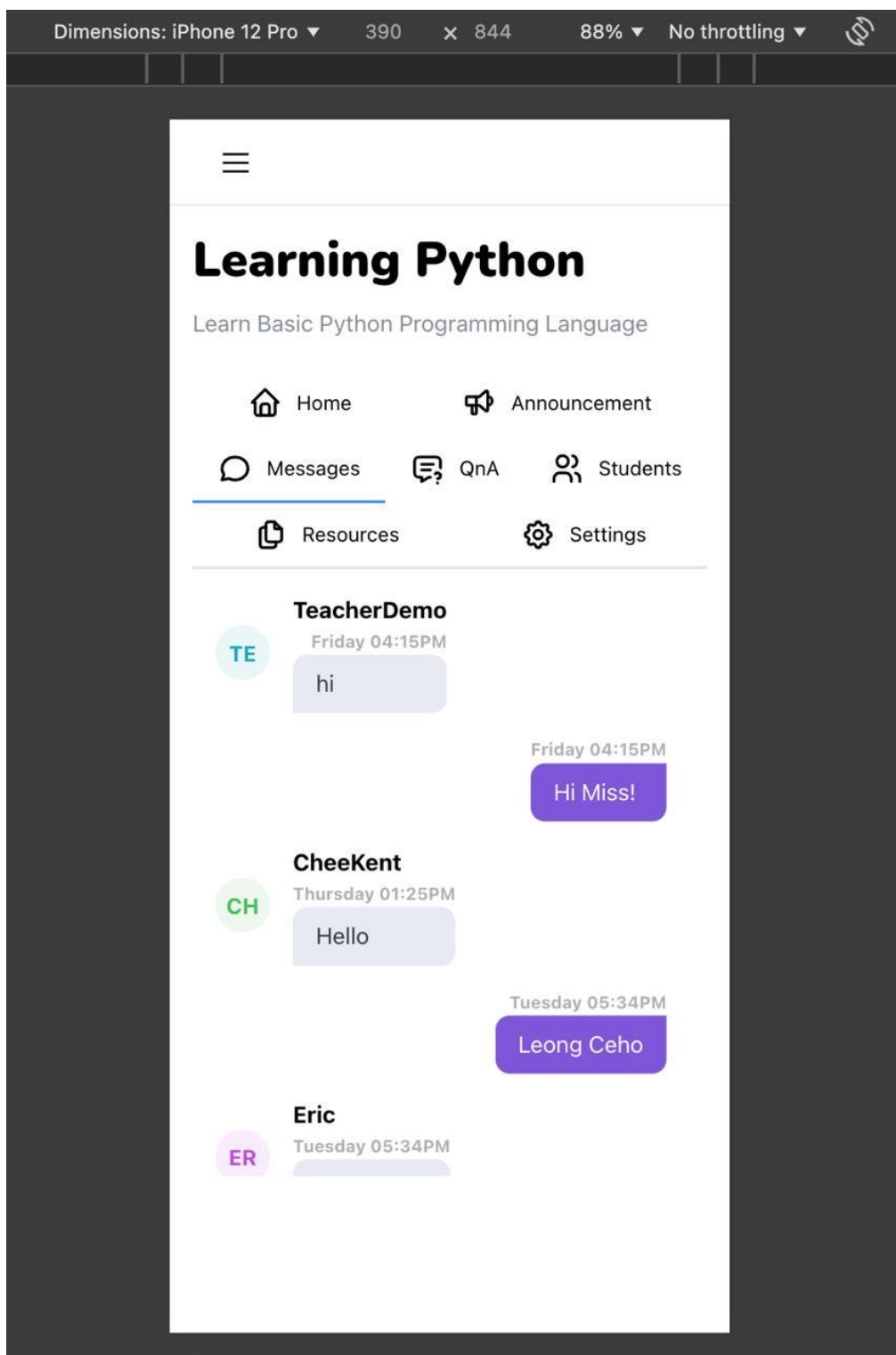


Figure 5.80 Messaging for Educator & Student

Figures above show the messaging between students and educators that is being sent and receive in real time (Functional Requirement 11).

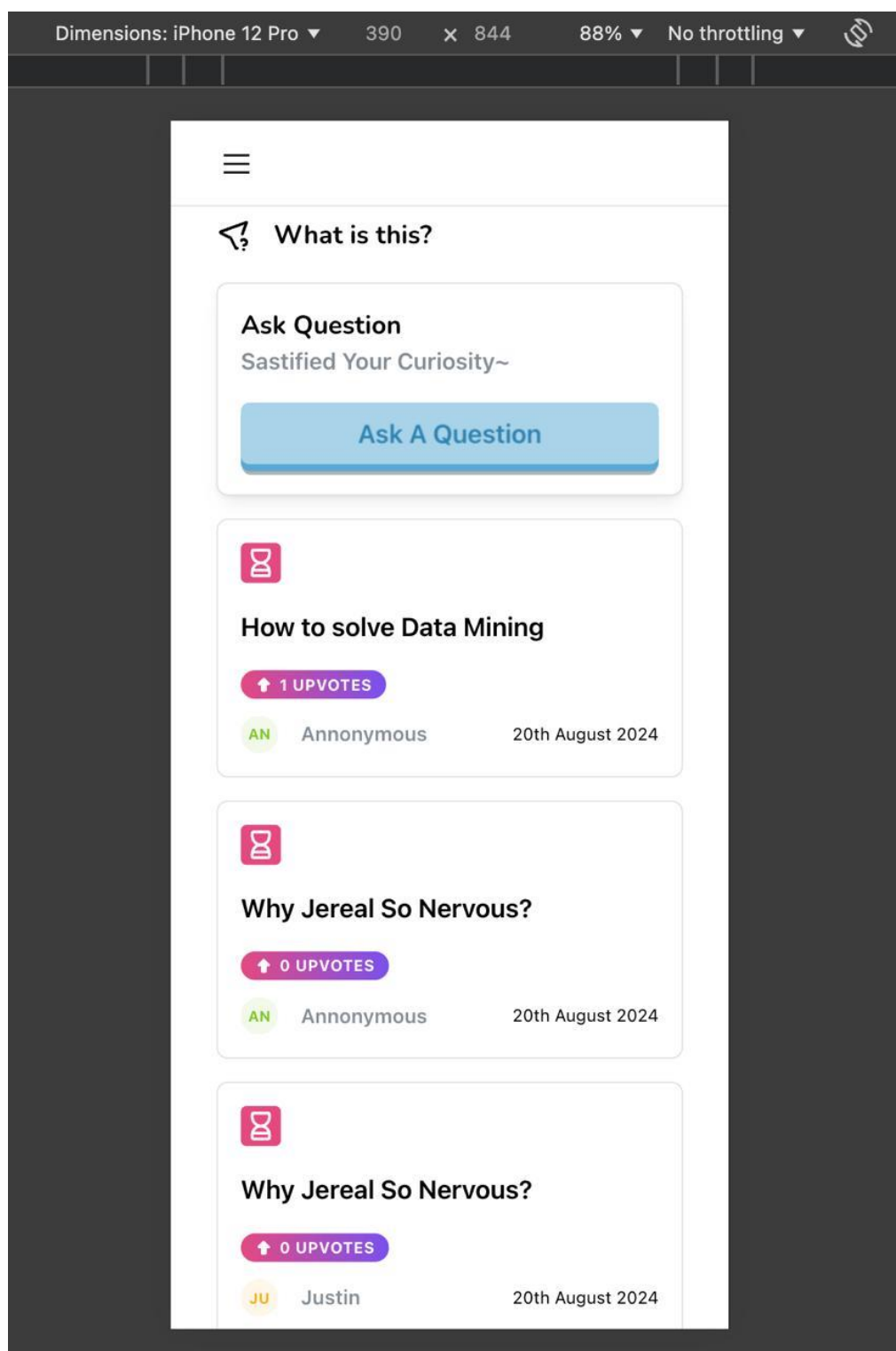


Figure 5.81 QnA Page for Student

These screenshots are the interaction of the question and answer where students is allow to ask questions with the option of anonymous. Educators then can answer these questions. Both users can upvote questions of their liking (FR 12).

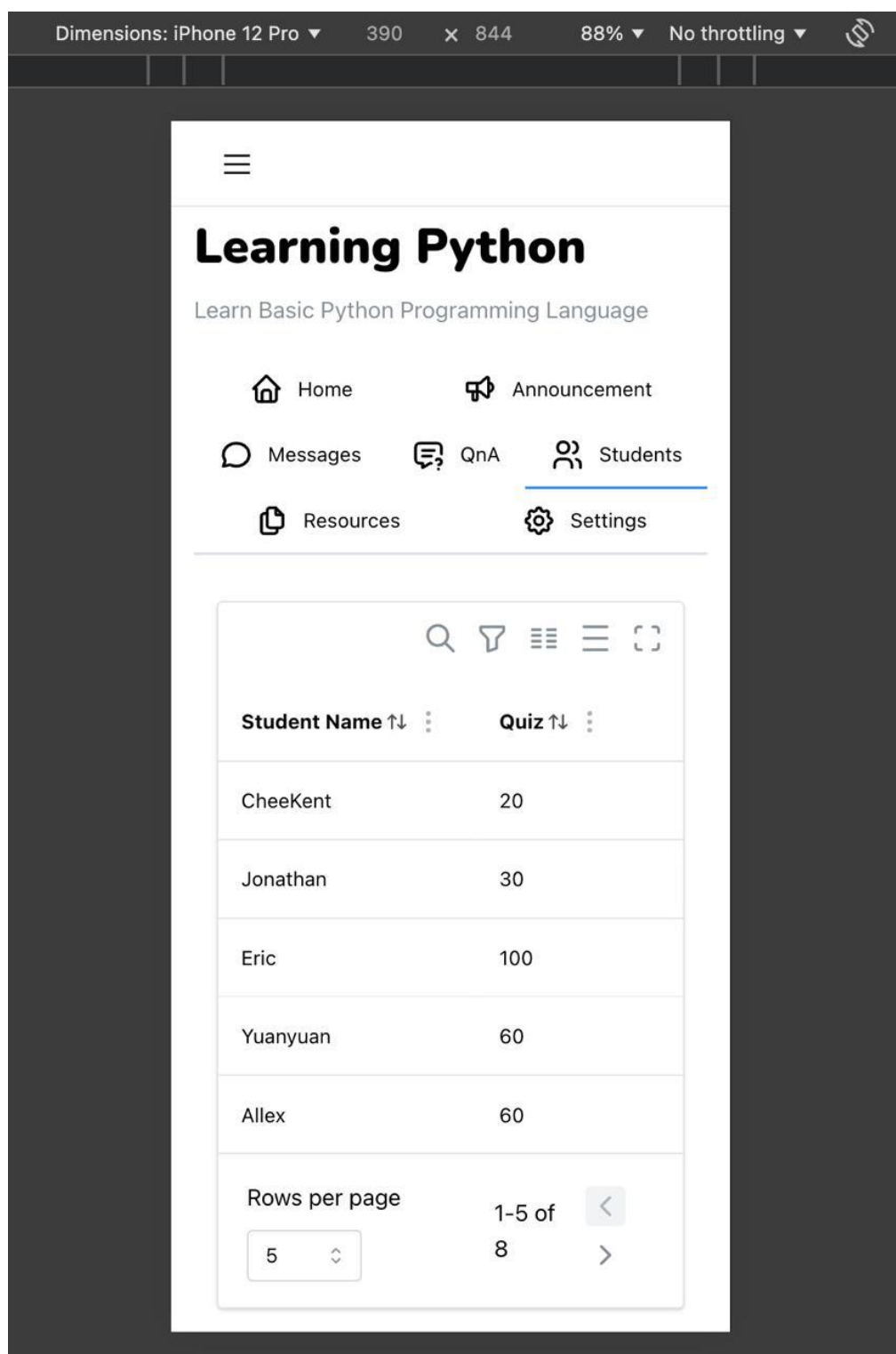


Figure 5.82 Students Test Score Page for Student

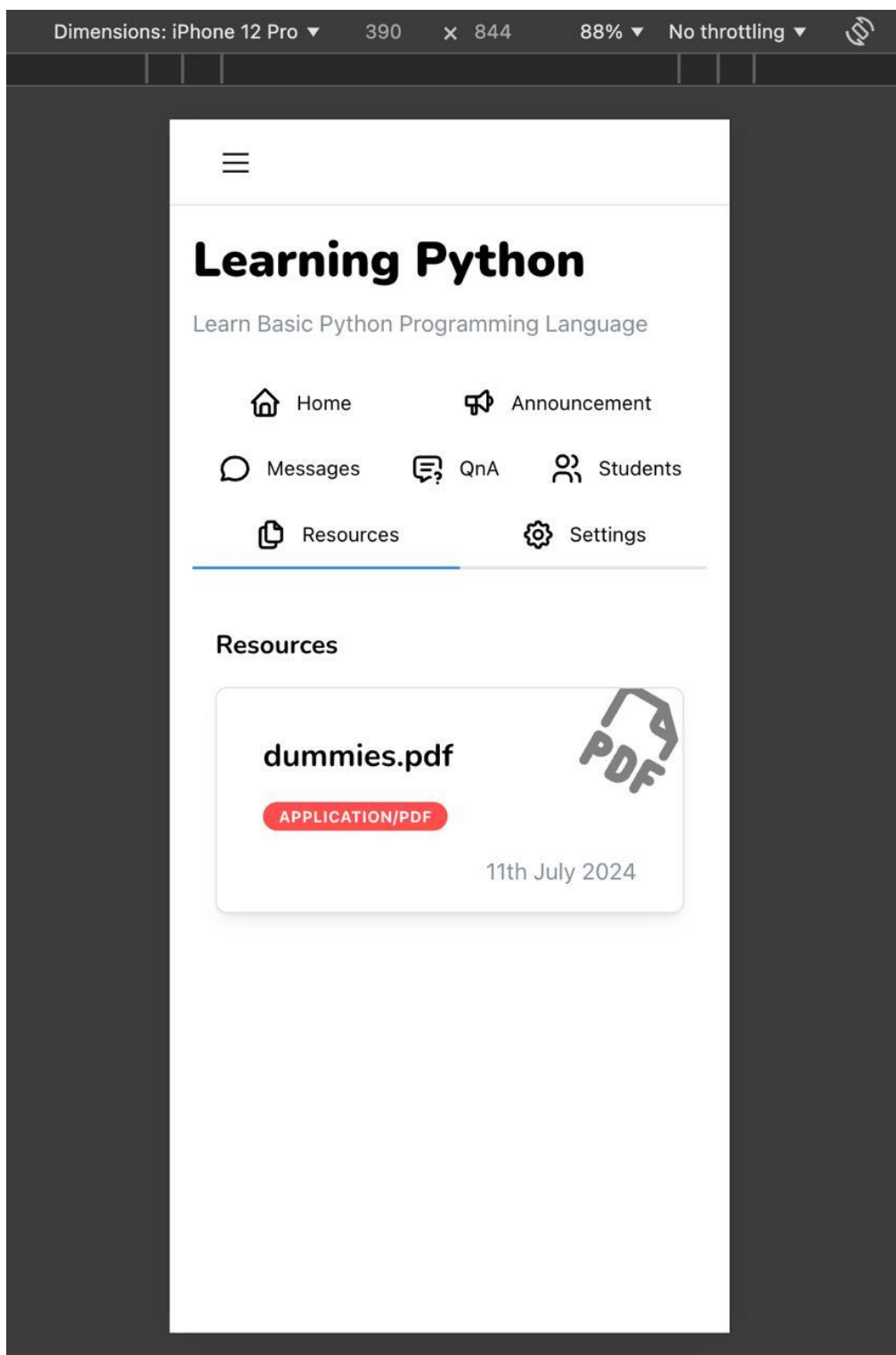


Figure 5.83 Resource Page for Student

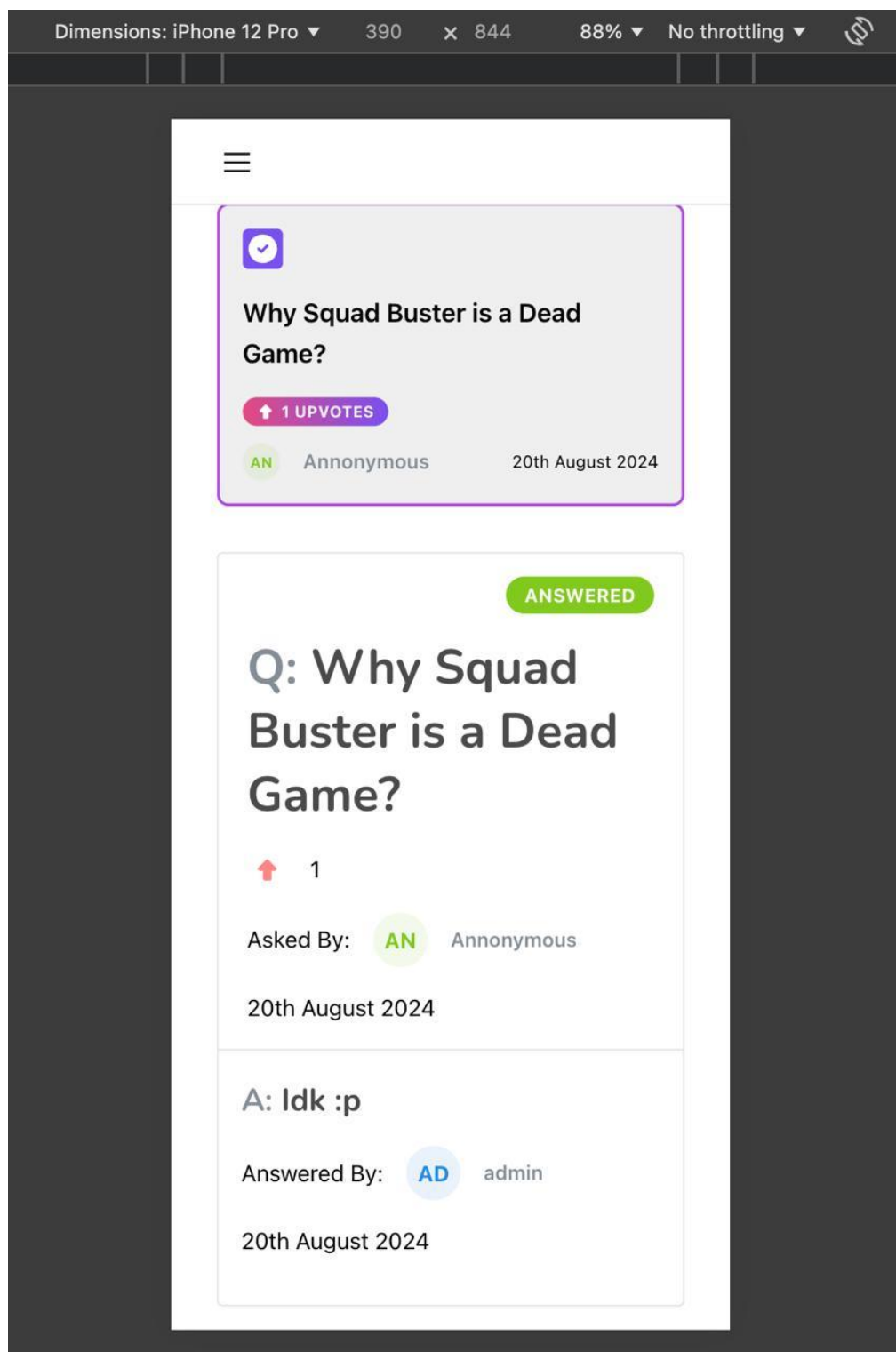


Figure 5.84 QnA Page for Educator

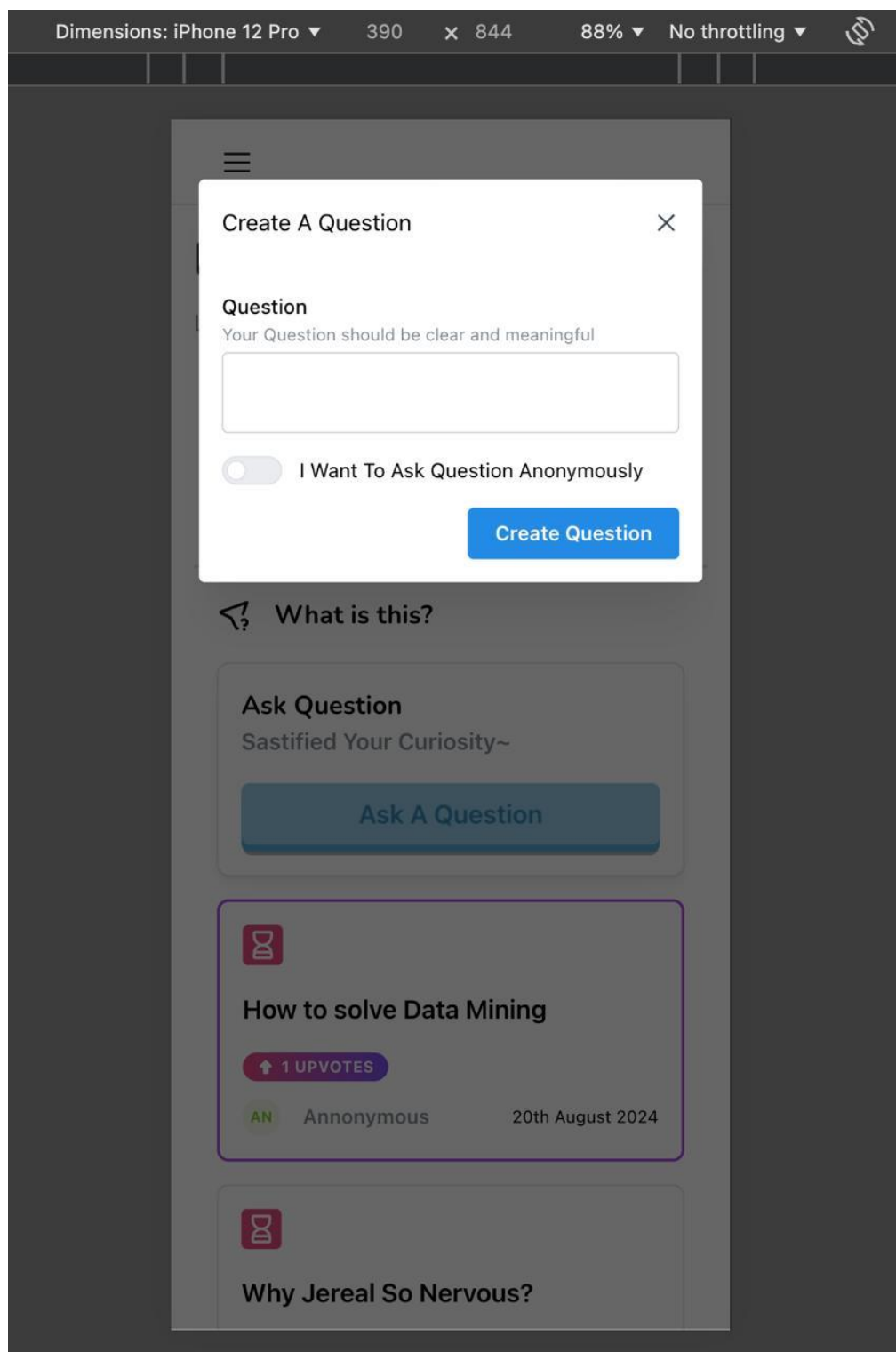


Figure 5.85 Ask a Answer Modal

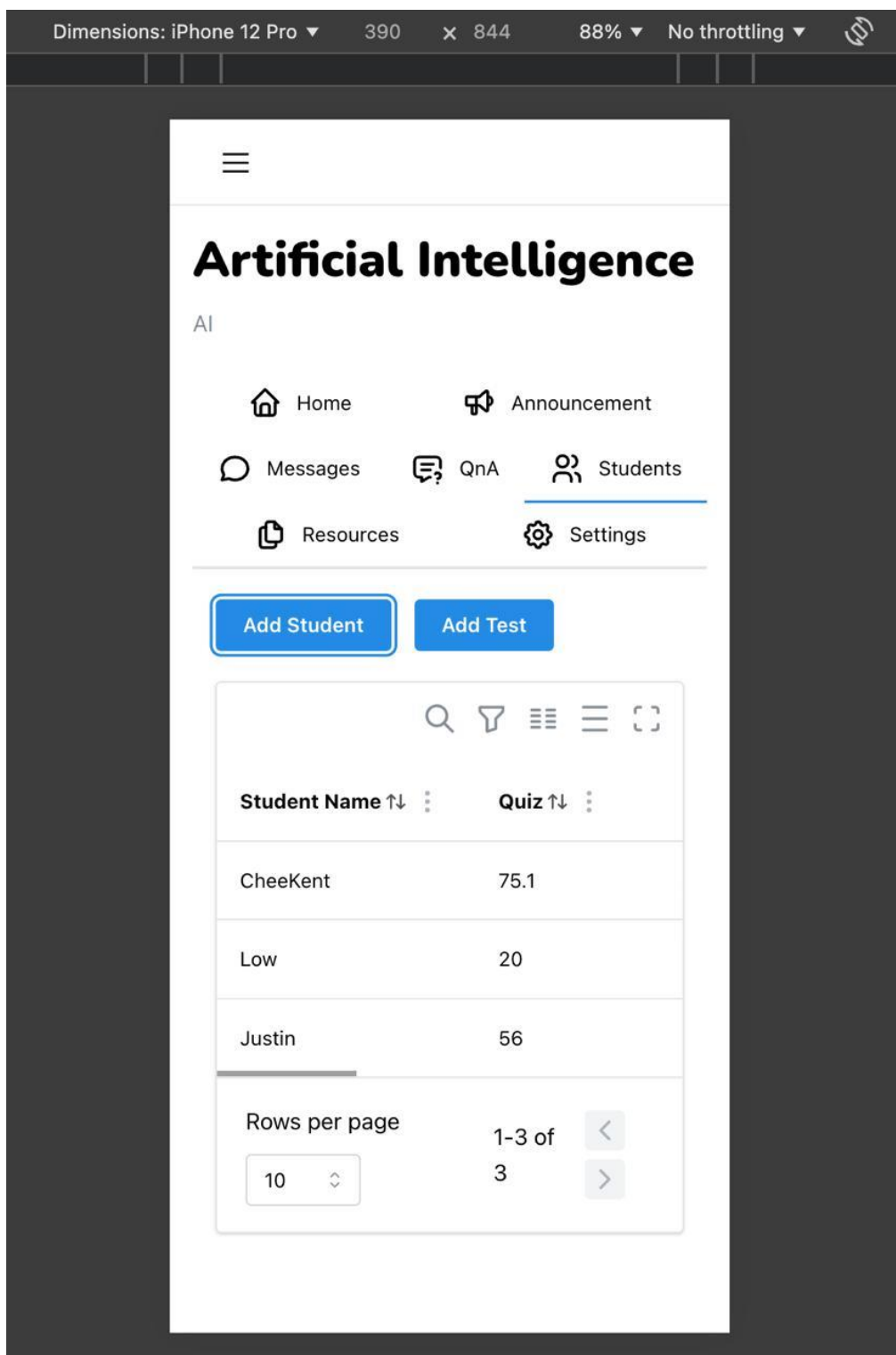


Figure 5.86 Student Test Score Page for Educator

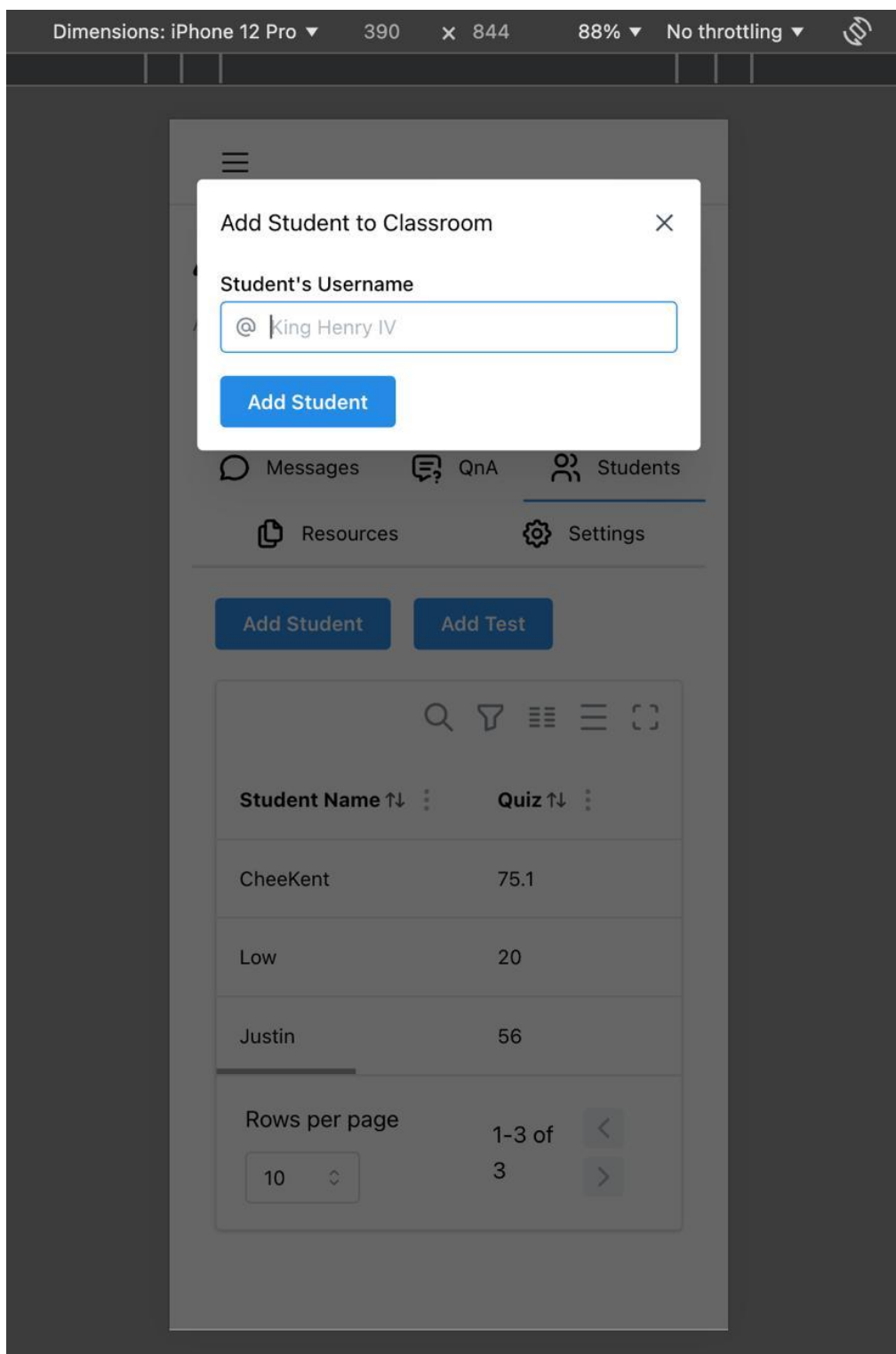


Figure 5.87 Add Student to Classroom Modal

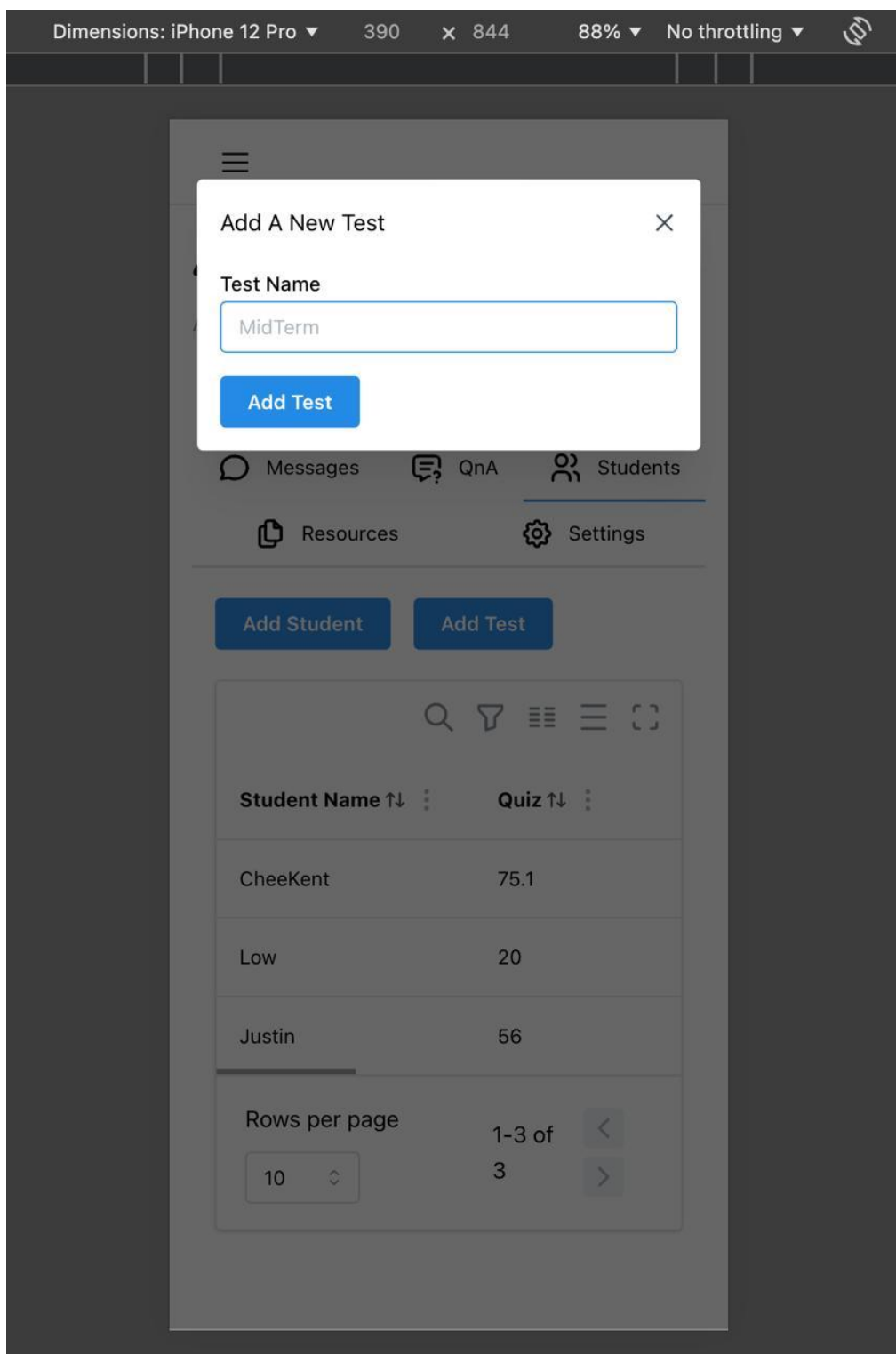


Figure 5.88 Add a New Test Modal

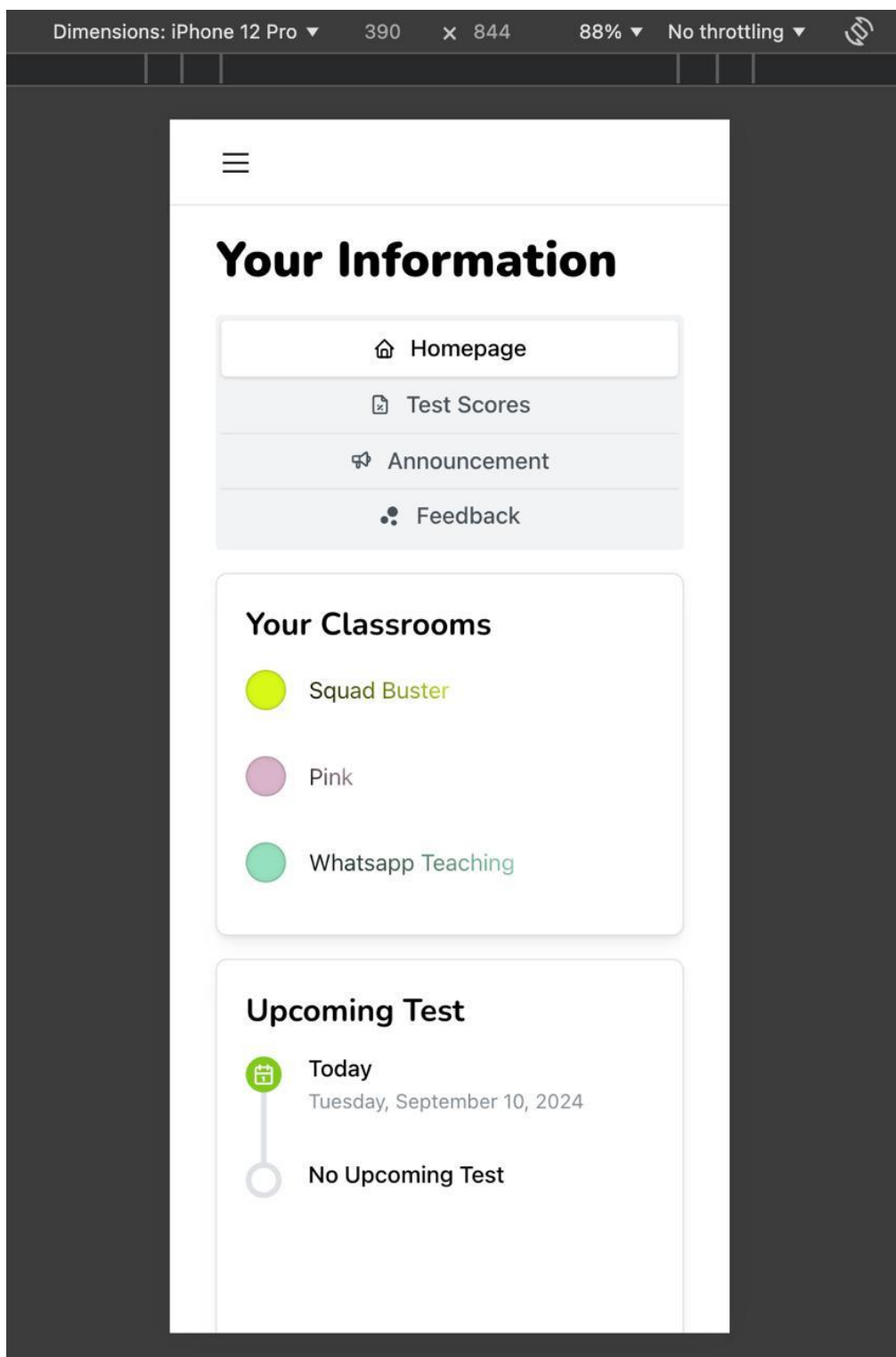


Figure 5.89 Home Page for Educator

Following figures show the Performance page which include all the information of the current user about their latest test score, announcements, feedback etc. User can track their desire information here below (FR 9).

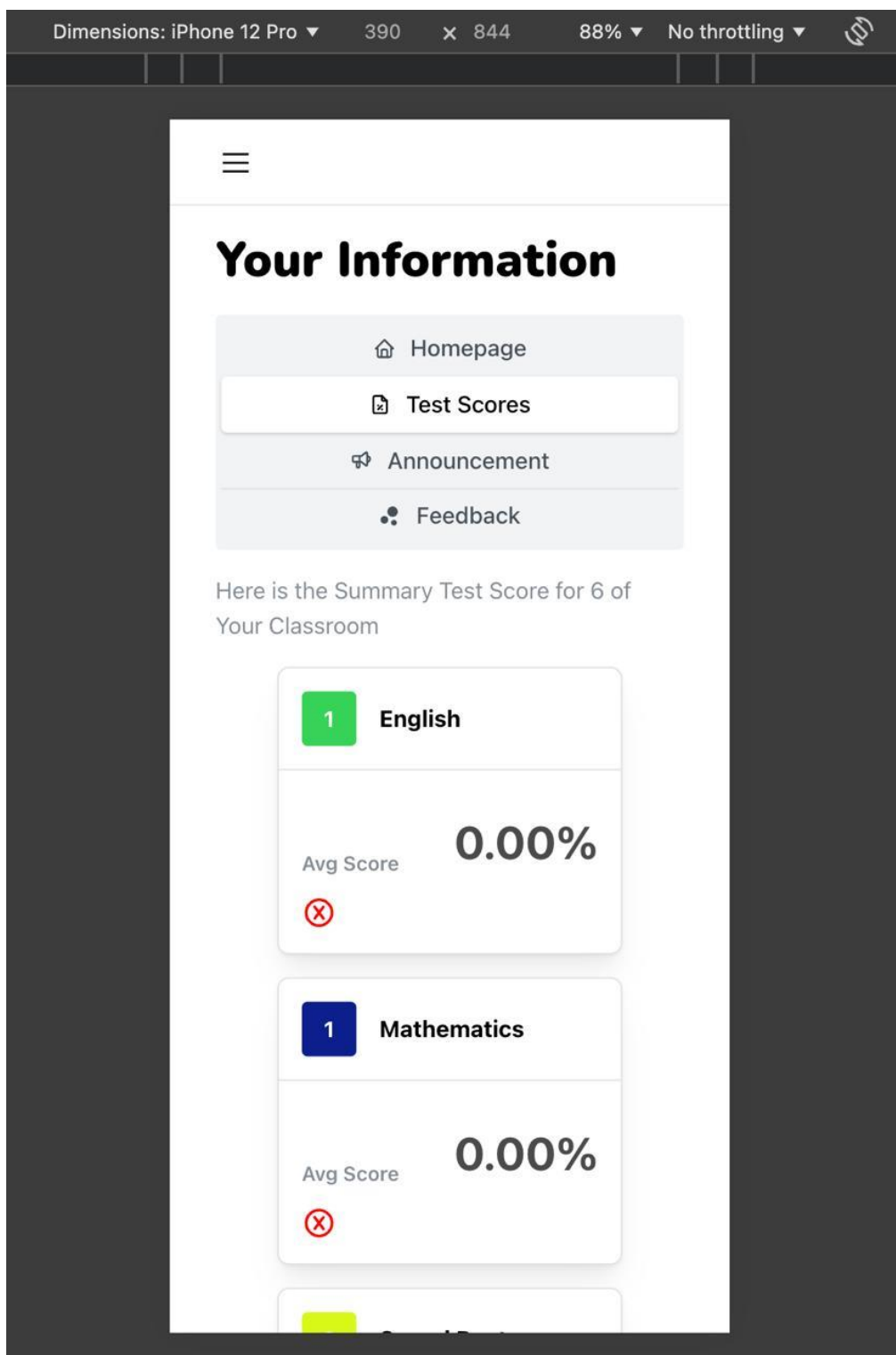


Figure 5.90 Test Score Page for Educator

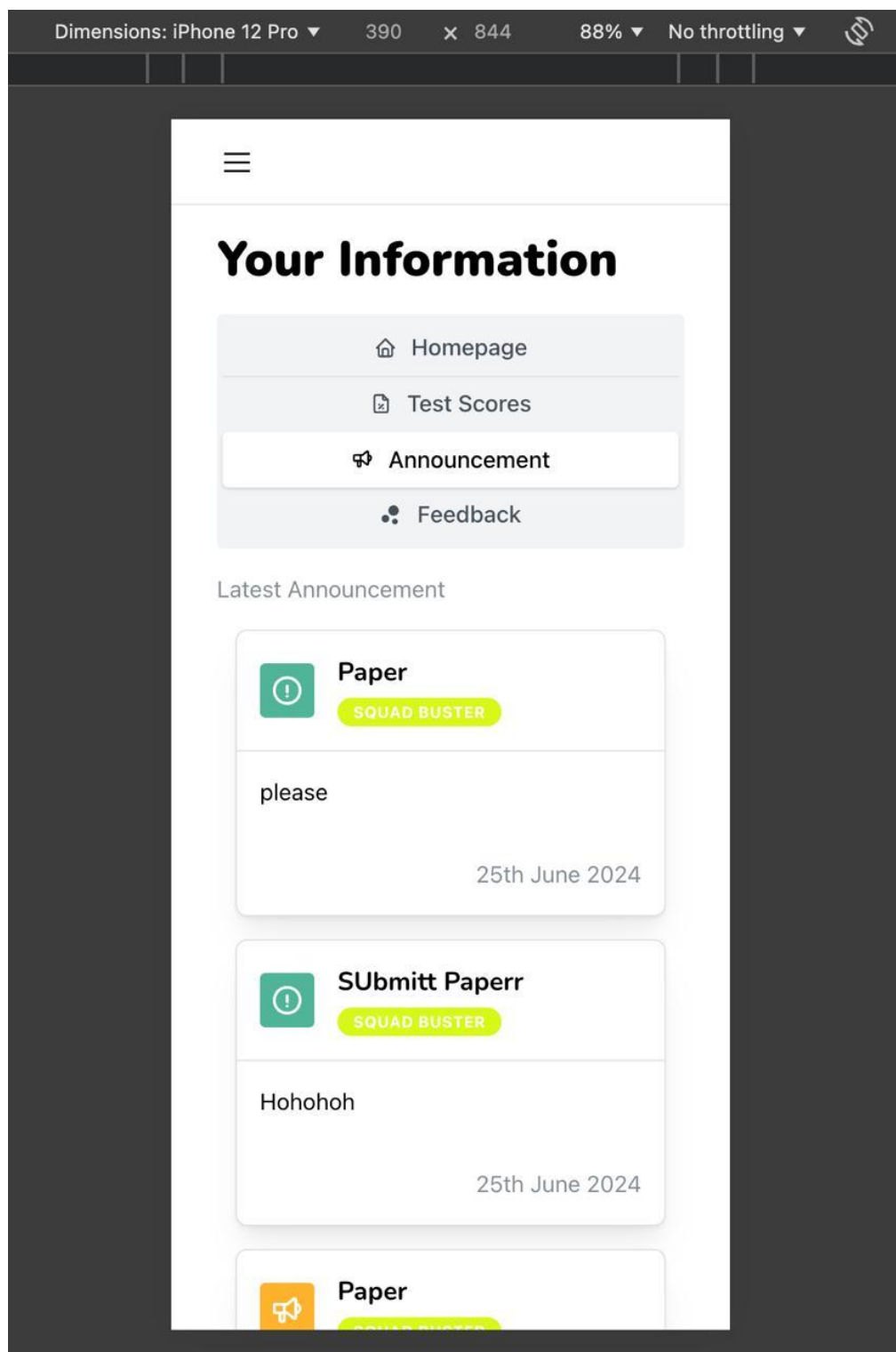


Figure 5.91 Announcement Page for Educator

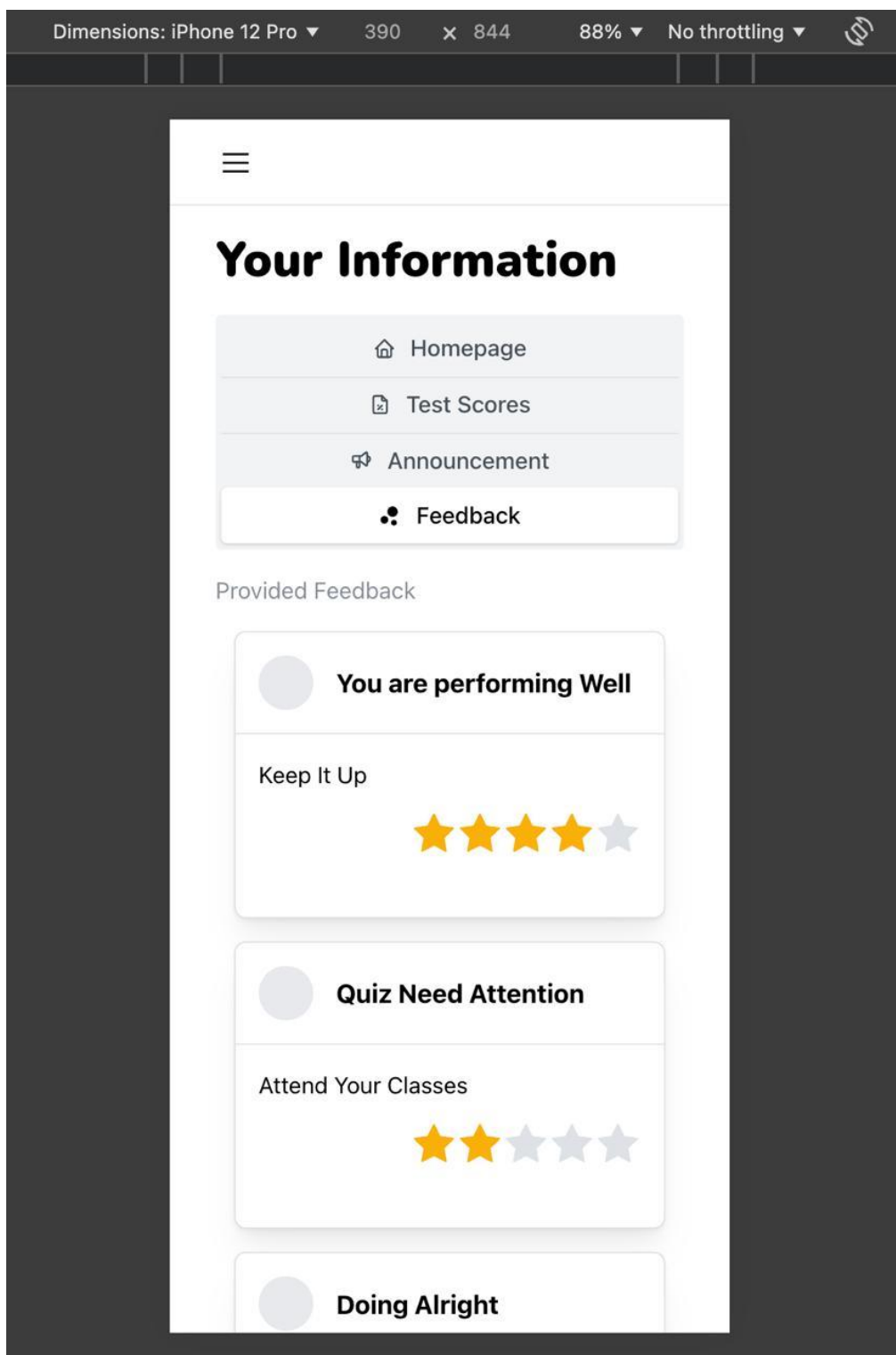


Figure 5.92 Feedback Page for Educator

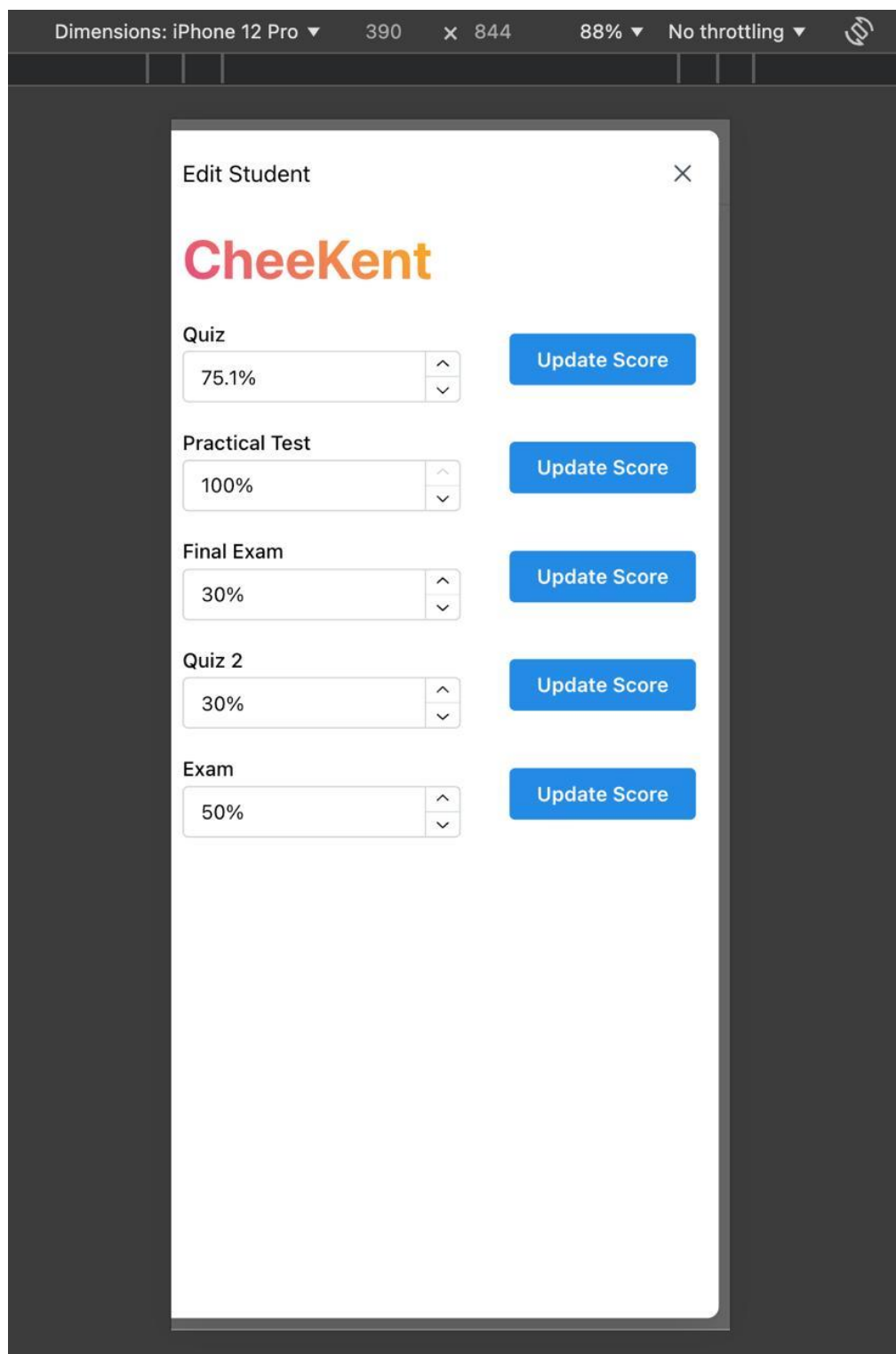


Figure 5.93 Edit Student Test Score Drawer

Figure above show how the educator can manage and update the students test score within a classroom.

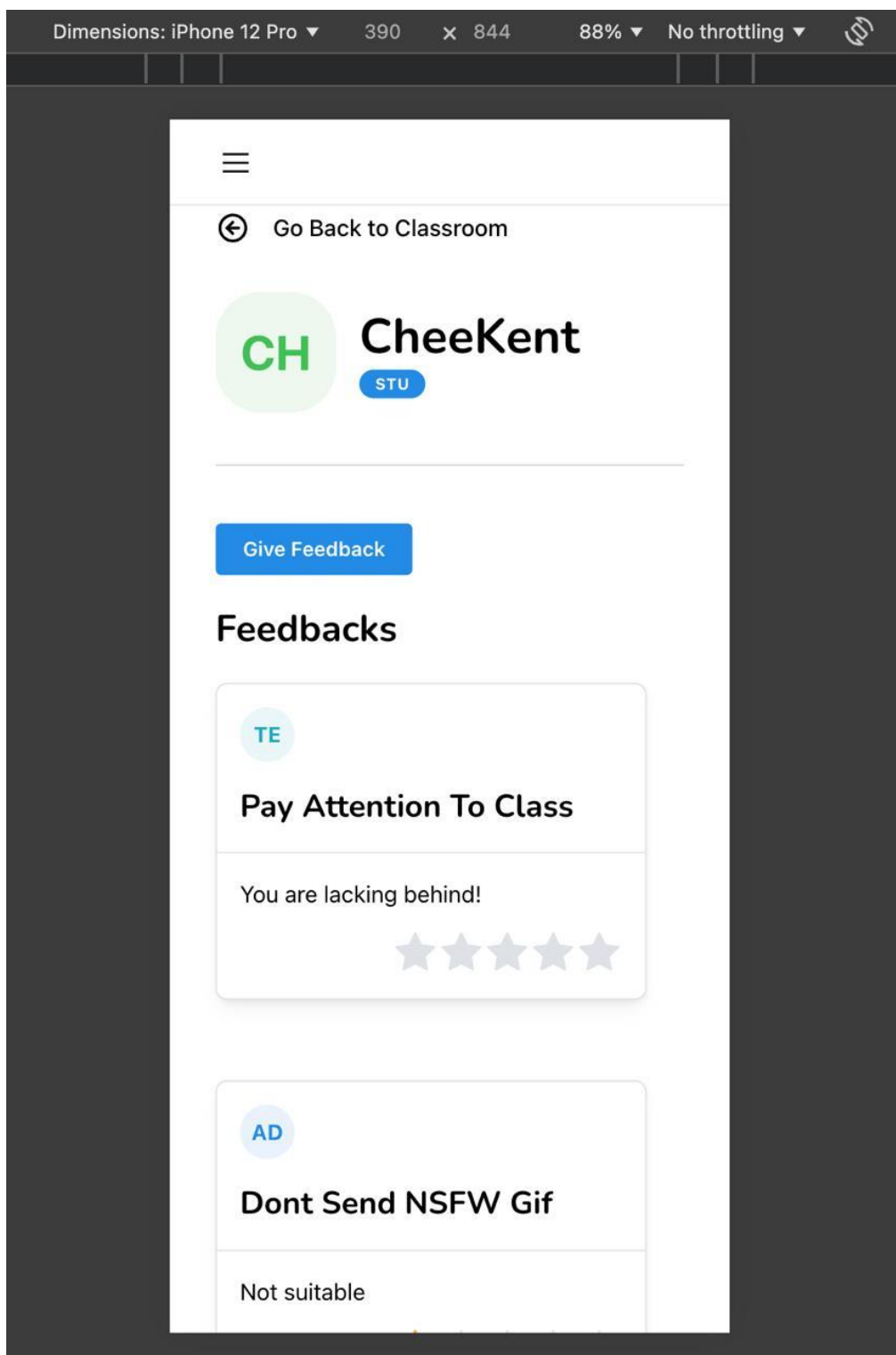


Figure 5.94 User Profile Page for Educator

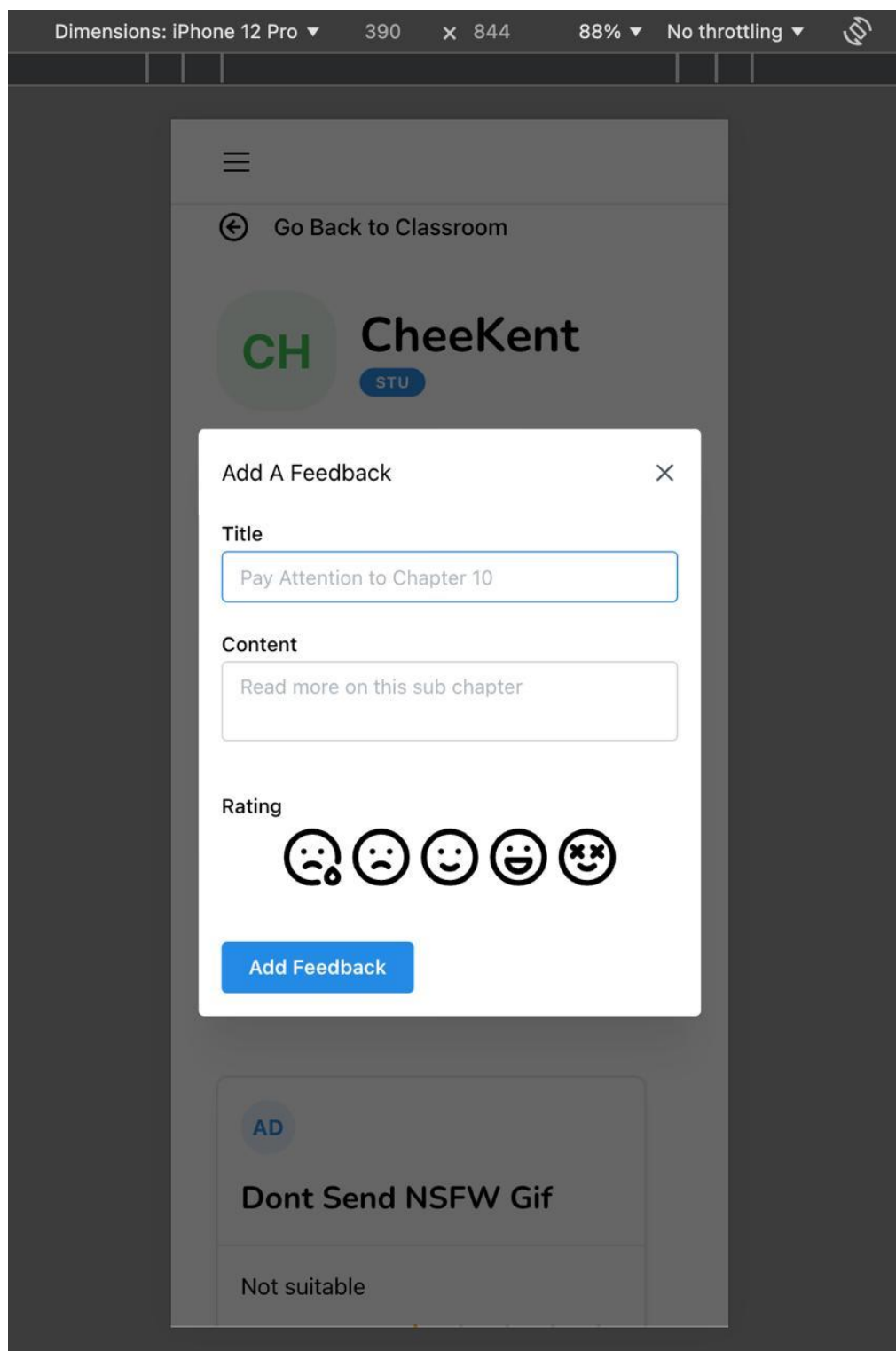


Figure 5.95 Add a Feedback Modal

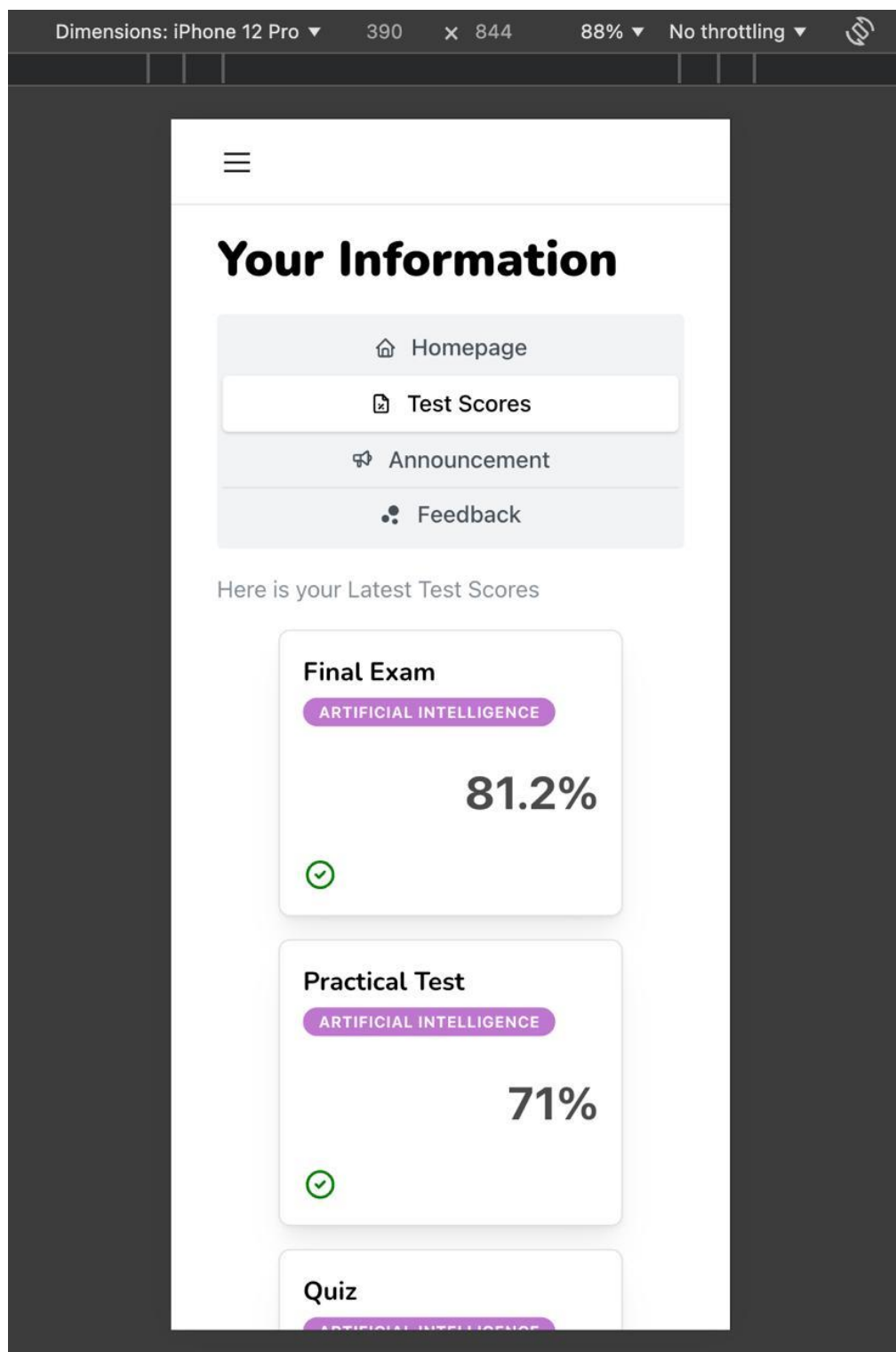


Figure 5.96 Test Score Page for Student

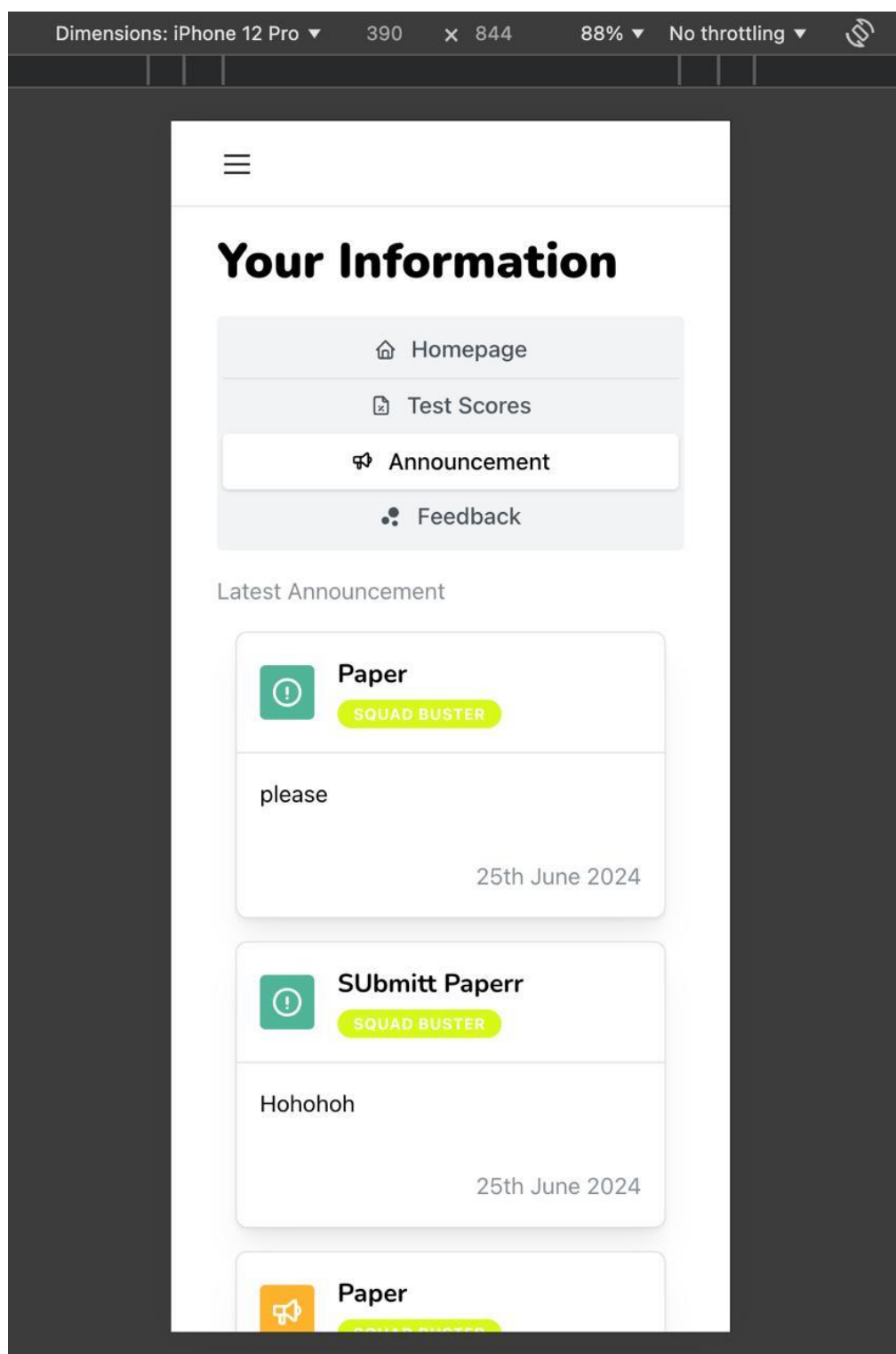


Figure 5.97 Announcement Page for Student

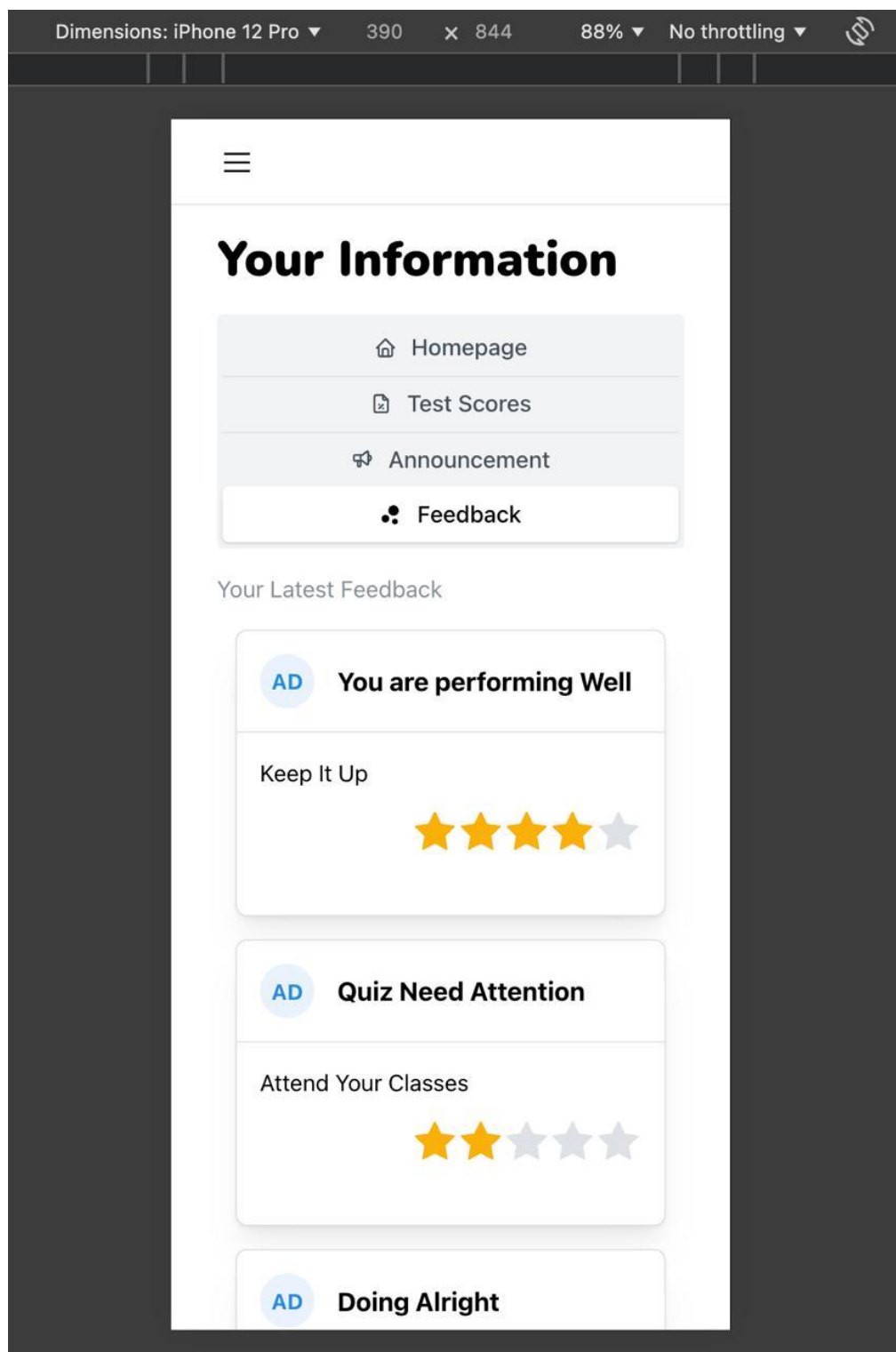


Figure 5.98 Feedback Page for Student

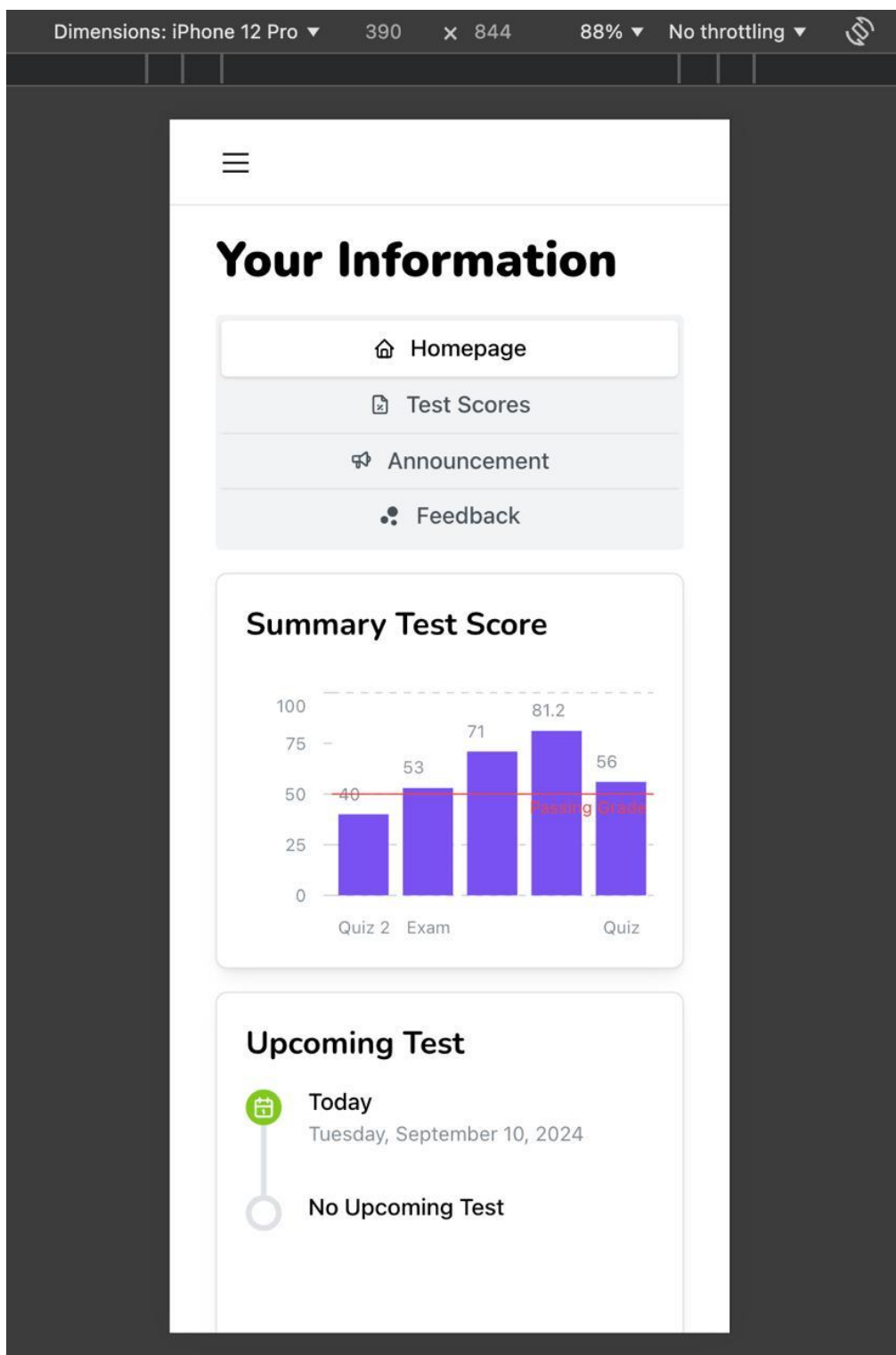


Figure 5.99 Home Page for Student

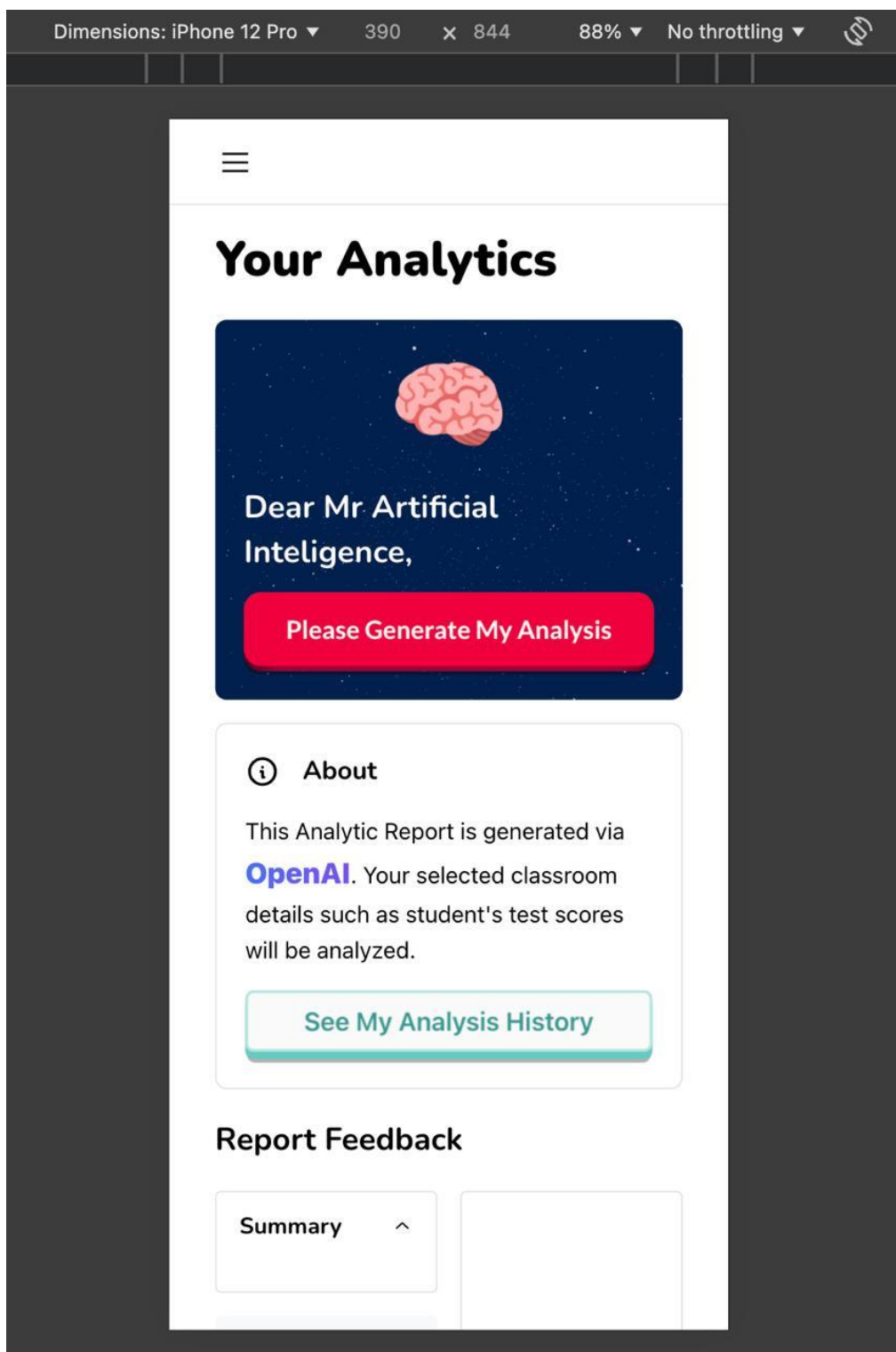


Figure 5.100 Performance Analytic Page for Student

These screenshots shows the analytics module that allow students and educators to generate analytics powered by OpenAI (Functional Requirement 7).

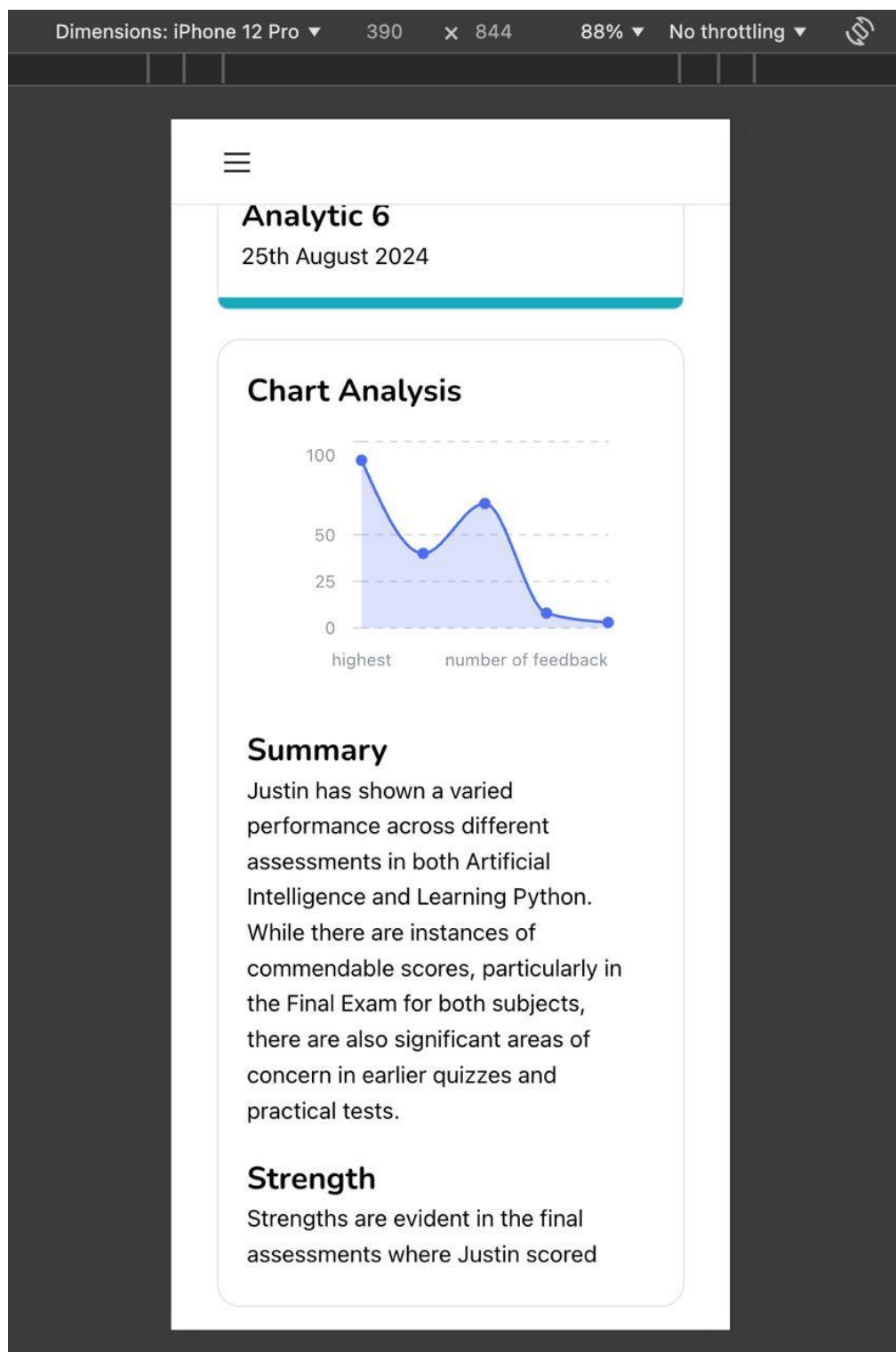


Figure 5.101 Analytic Item for Educator & Student

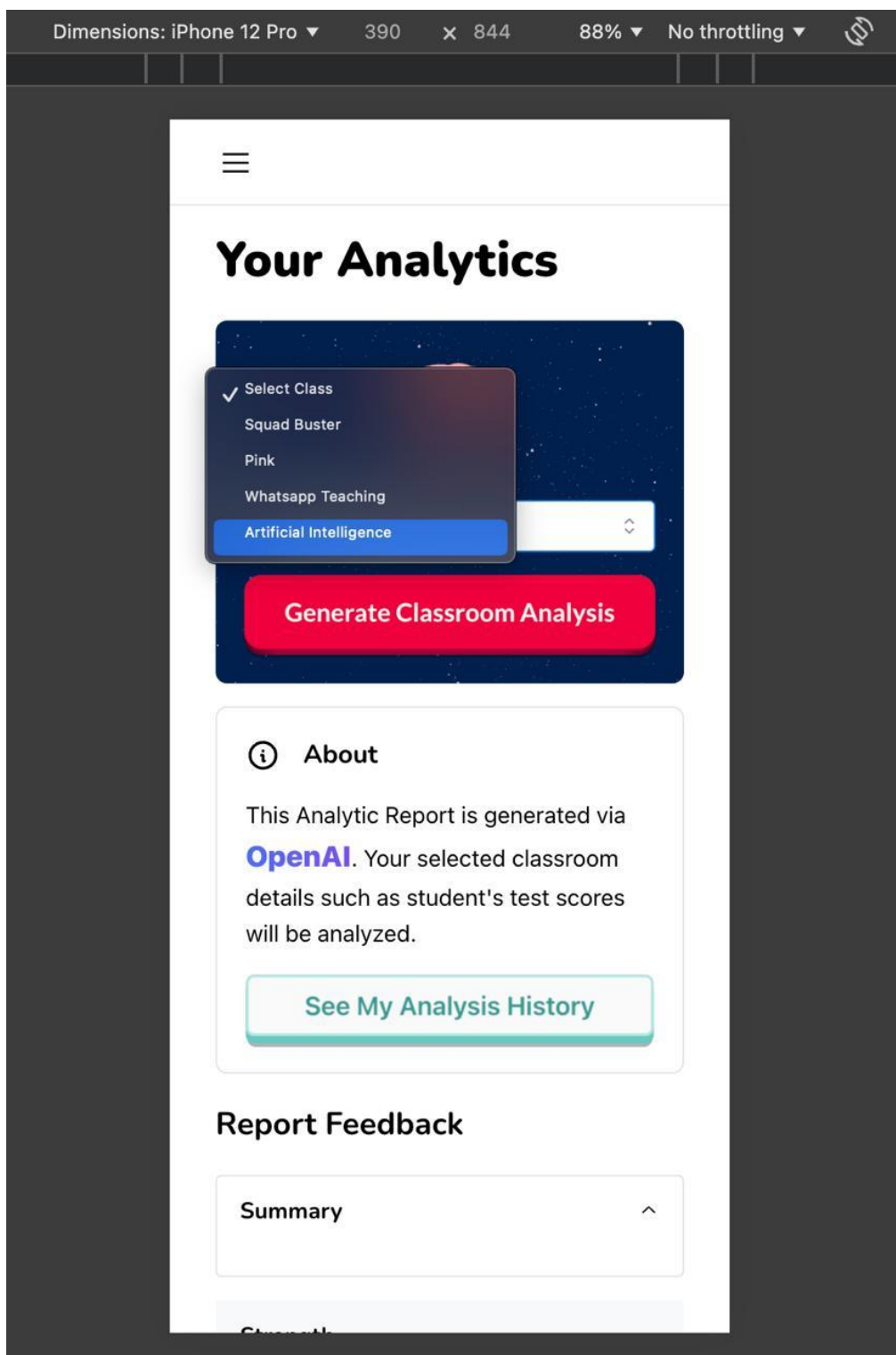


Figure 5.102 Performance Analytic Page for Educator

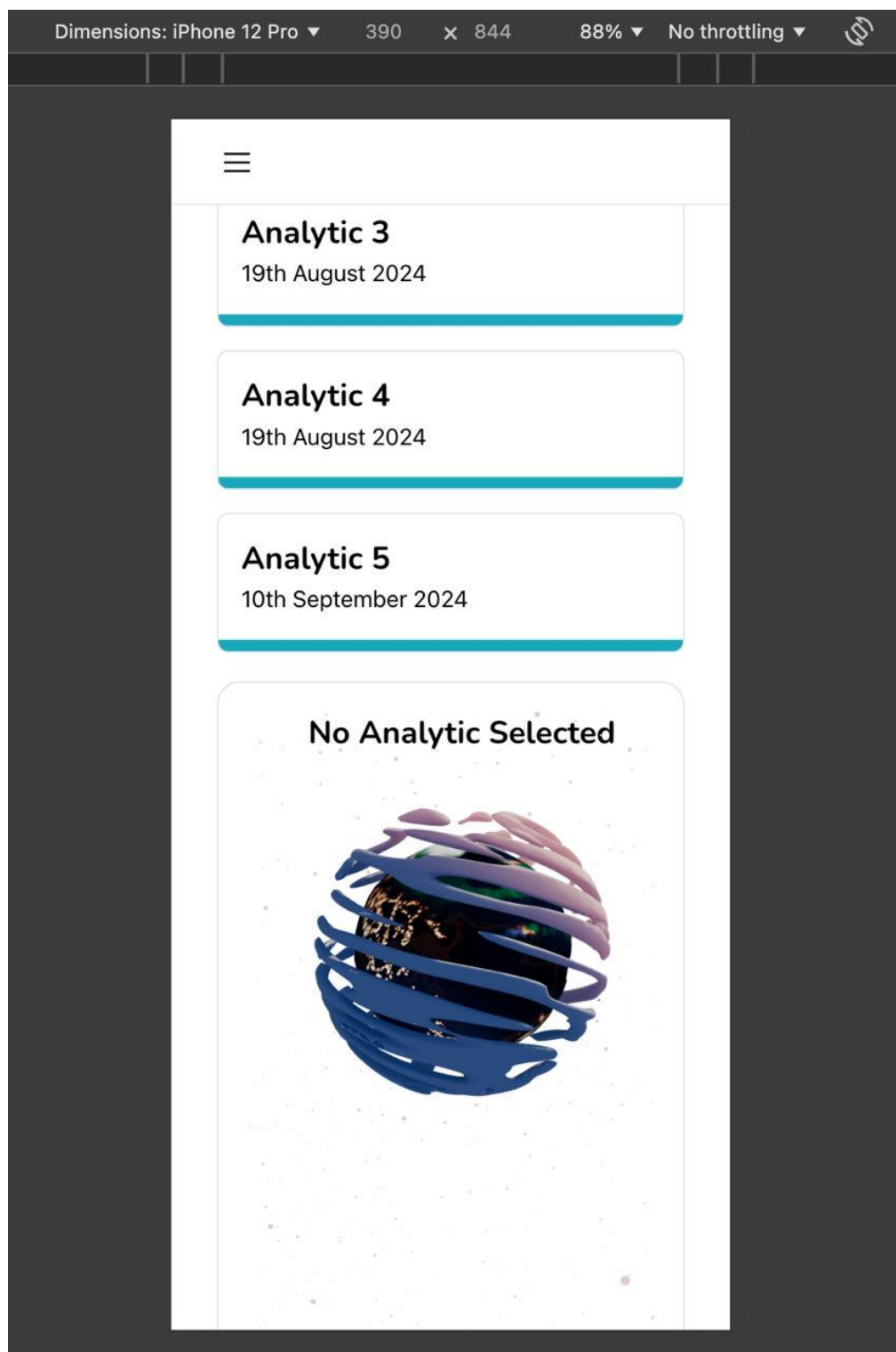


Figure 5.103 Analytic History List Page for Educator & Student

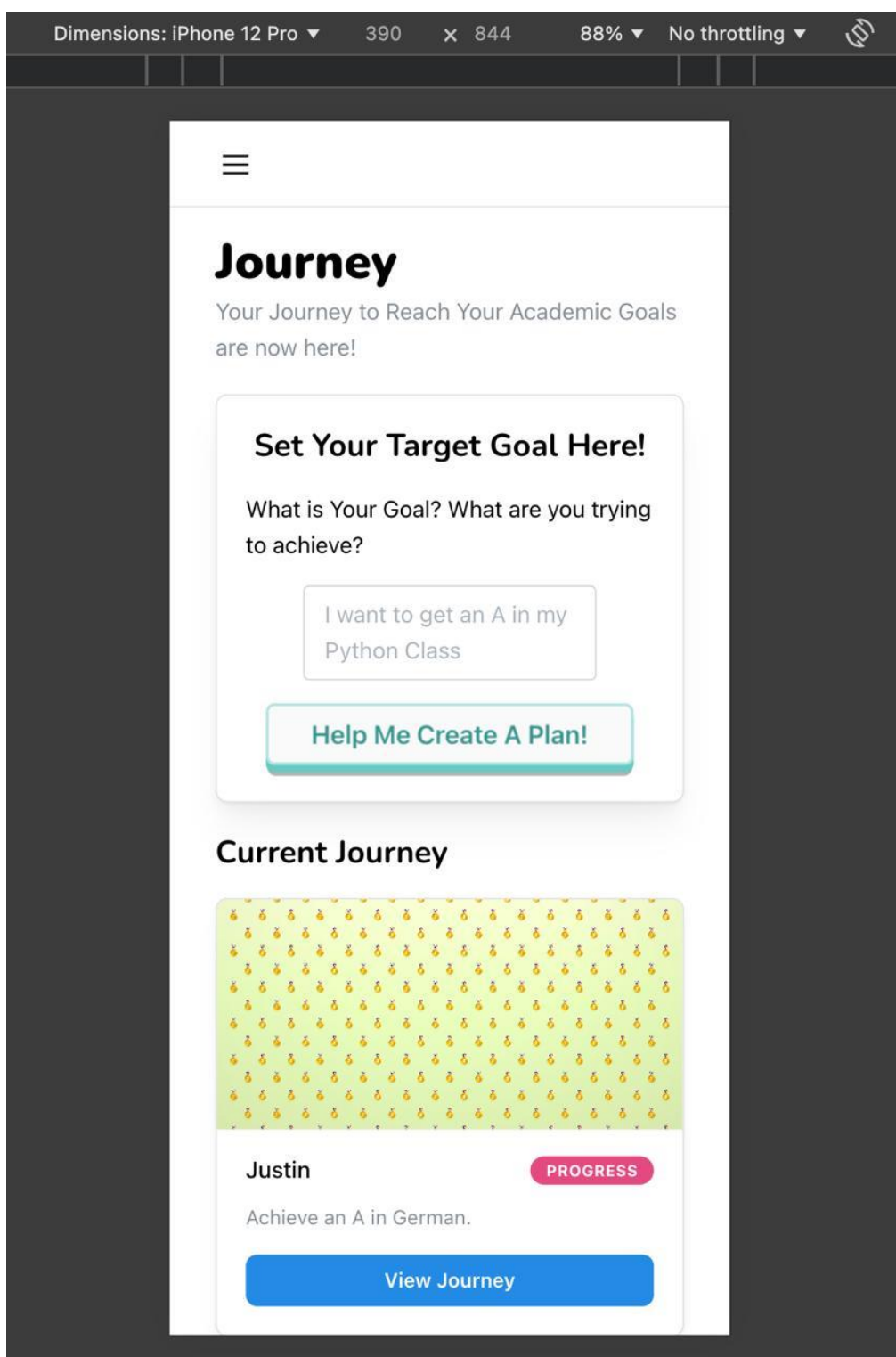


Figure 5.104 Journey Plan Page for Students

These following screenshots shows the analytics module that allow students and educators to generate personalized learning plan powered by OpenAI (Functional Requirement 7).

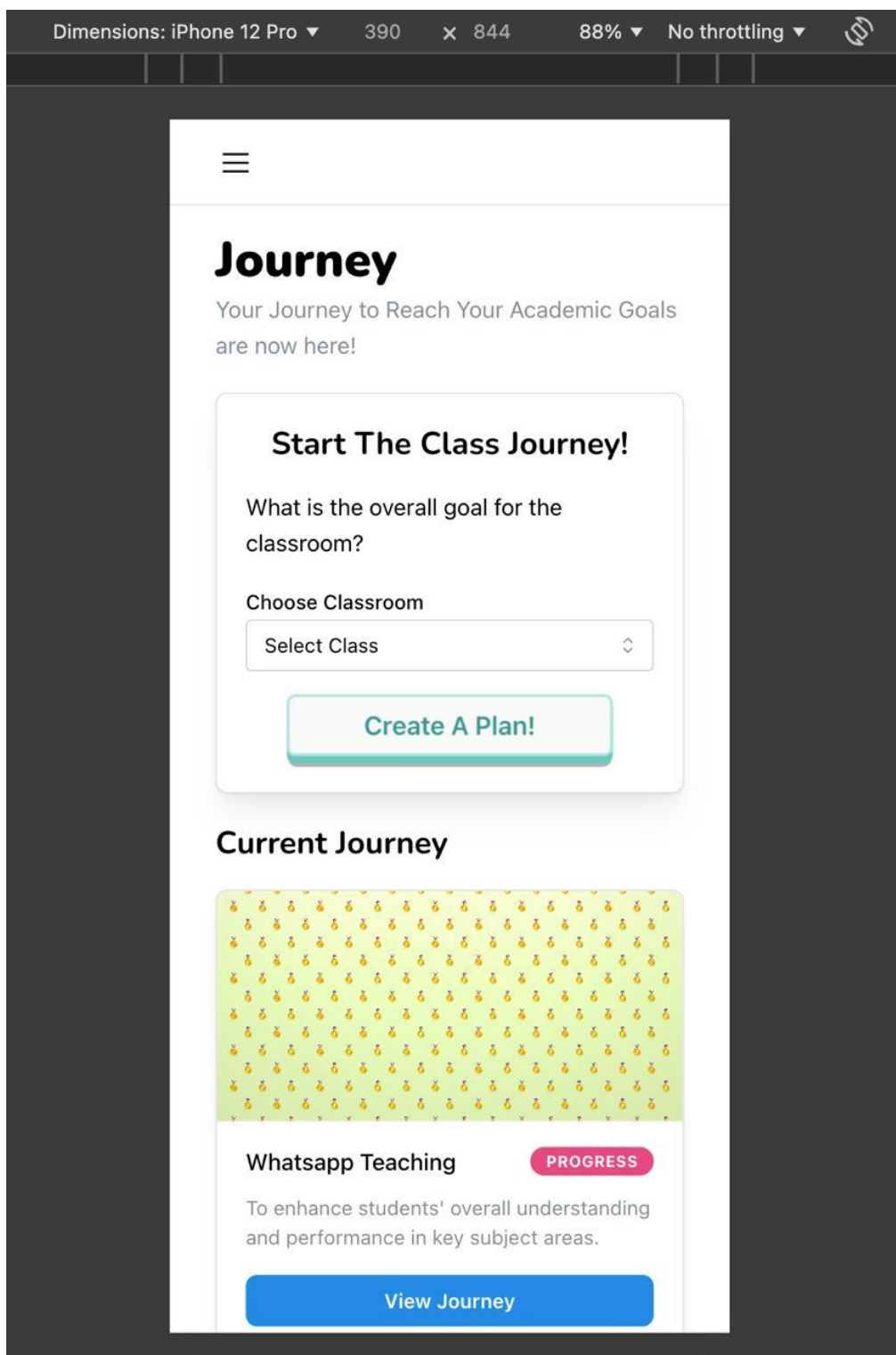


Figure 5.105 Journey Plan Page for Educator

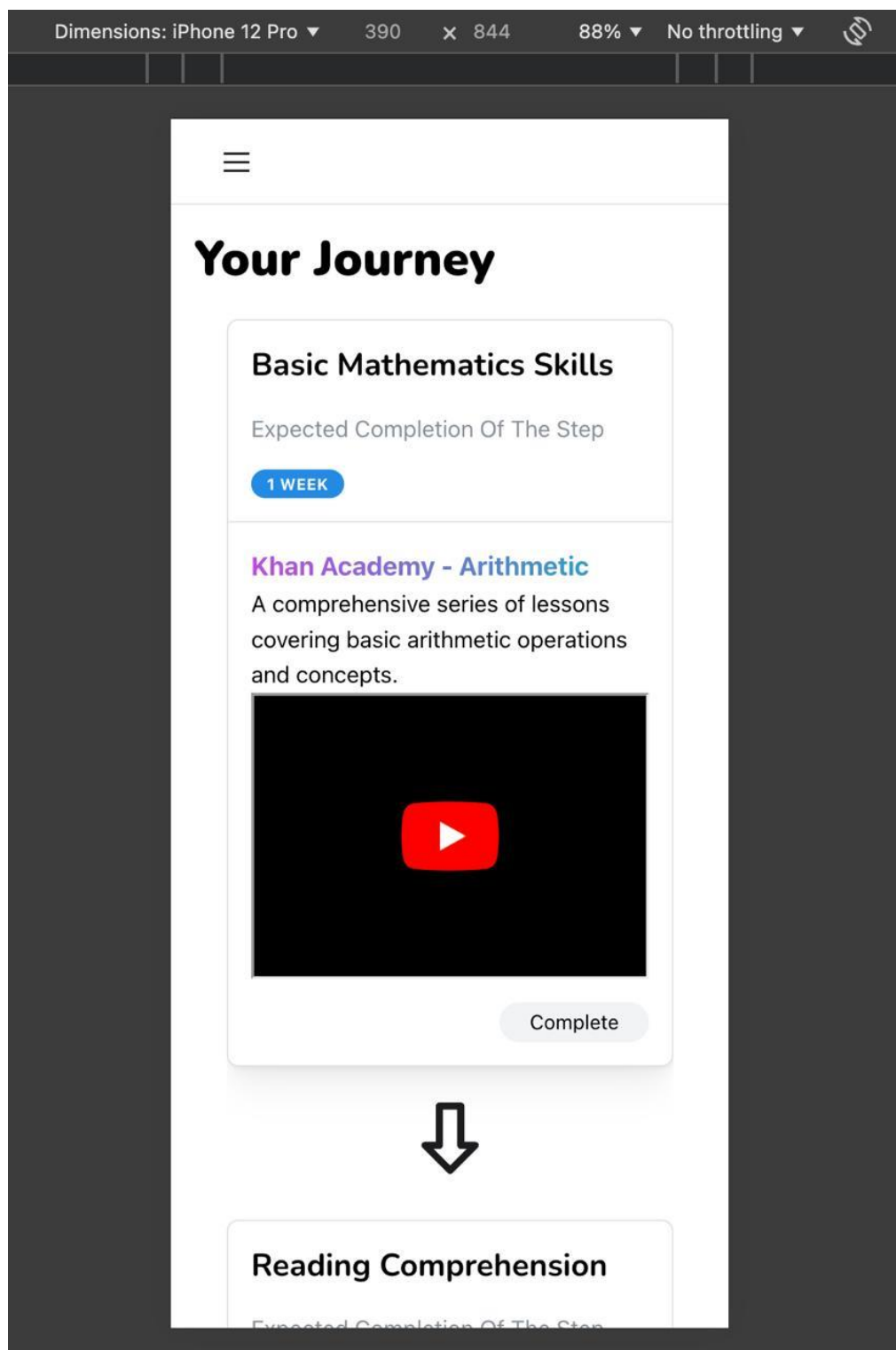


Figure 5.106 Journey Item Page for Educator & Student

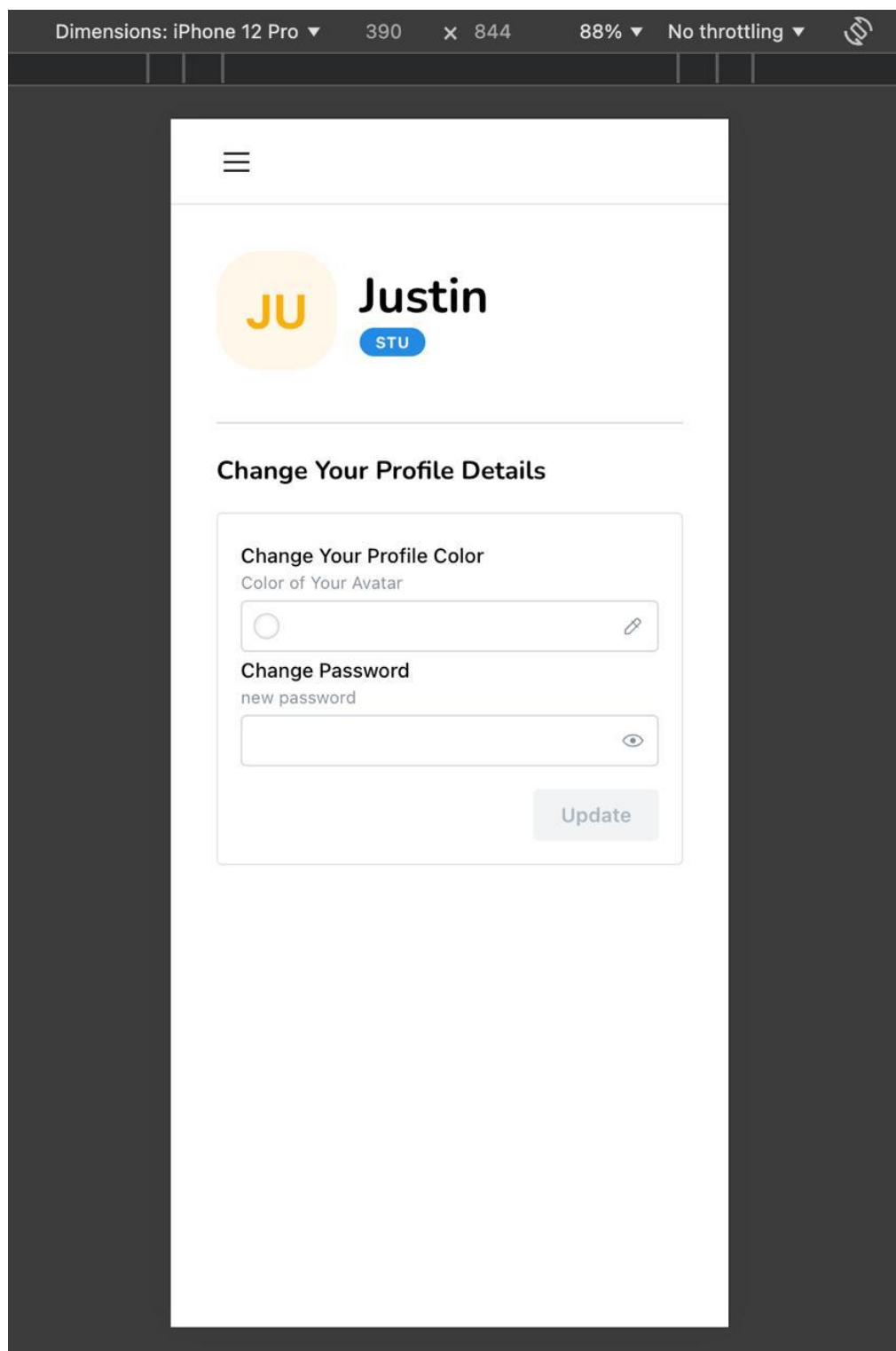


Figure 5.107 User Profile Page for Educator & Student

Screenshot above is the User Profile to update their details of their account (Functional Requirement 3).

CHAPTER 6

SYSTEM IMPLEMENTATION

6.1 Introduction

This chapter focuses on the project's system implementation. It covers some of the core tools that the system had used to implement features such as the authentication and authorization. The frontend, backend libraries used, and deployment are included in this chapter.

6.2 Authentication and Authorization

Web Token (JWT) are used to help the implementation. Bcrypt is used to hash and salt educators and students passwords securely before storing them. The store value will be a hashed version of the password which will ensure that all the password is protected even if the database is attacked. For example, when a user login or register their account, Bcrypt will take the provided password by the users and compare it with the hashed version that is stored in the database. If the compared is validated a true, it means that the user is authenticated. Meanwhile, for authorization, JWT token is generated when a successful login is achieved. Each token contains a payload with user-specific data such as the user role and is signed with a secret key. Every time the user is requesting data from the server, the token will be appended to the request header ensuring that the user has the correct permissions before granting access. This table below shows some of the method that both Bcrypt and Json Web Token contains and its usage.

Table 6.1: Bcrypt and JWT methods

Method	Library	Usage
hash	bcrypt	Encrypts a plain text password into a hashed version for secure storage in a database.
compare	bcrypt	Compares a plain text password with a hashed password to check if they match.
sign	jsonwebtoken	Creates a JSON Web Token (JWT) with a payload and secret key, used for authentication.
verify	jsonwebtoken	Checks the validity of a JWT using the secret key to ensure its authentic and hasn't been tampered with.

6.3 Socket.IO

The implementation of real-time communication in this Education Management system is achieved using the library Socket.IO and its client counterpart socket.io-client. With the help of Socket.IO, the system enables both educators and students to message each other in real time. This is because Socket.IO provide a bi-directional communication between the server and clients. Firstly, the server will initialize Socket.IO and sets up various event listeners to handle incoming connections and specific events from the clients. For instance, when a student sends a message in the classroom, the server will listen to these events and broadcasts them to the relevant connected clients in real-time. Additionally, in the front-end side, using socket.io-client, it will emit events without the page to manually reloads. This communication between client and server allows the users receive instantaneous updates and can interact with the system in a highly responsive manner. The method that allows the system to listen and emit the events are listed in the table below.

Table 6.2: Socket.IO methods

Method	Description
on	Listens for a specific event or message from the server or client. It takes an event name and a callback function to handle the event.
emit	Sends a specific event or message to the server or client. It includes an event name and optional data to be sent.
off	Removes a specific event listener or handler. It is used to stop listening for an event.
leave	Used to make a client leave a specific room or channel. It is used for managing rooms or channels in Socket.IO.
join	Used to make a client join a specific room or channel. It allows the client to receive messages broadcasted to that room.

6.4 OpenAI

The implementation of OpenAI's GPT-4.0 mini in this Education Management System is one of the core libraries used as it is responsible for generating the performance analysis and personalized learning plans called journey plan. The OpenAI library is integrated in the server of the system. Whenever a user request to generate a report, the server will start to gather the information of the desired target and arrange them in an order for analysis. The data and details will be sent to the OpenAI server where GPT-4.0 mini is chosen as its offer the most performance while being the cheapest option and is recommended by OpenAI developers too. The model uses this data to generate a comprehensive performance analysis, identifying key areas of strength, weaknesses, and suggested improvements. After the generation by OpenAI, the server will parse the result and an object which includes detailed feedback that helps educators and students is produced and stored in the database.

Meanwhile for the creation of custom learning plans, the system uses OpenAI's capabilities to craft individualized study paths that align with the

specific goals and identified needs of each student. The contents of the journey plan will include steps, recommended learning materials, timelines, and additional tips that will help the students to go for that little extra mile in their studies. The generation process is similar to the analysis report, but this journey plan allows the students or educators to enter their own target to achieve such as getting a better score in certain subjects. The integration with GPT-4.0 mini provides the flexibility to continuously refine and update these learning plans based on new performance data, making it a powerful tool for enhancing personalized education within the application. Table below showcase some of the method that the openai library provides.

Table 6.3: OpenAI methods

Method	Description
model	Specifies the model to be used for generating completions, in this case, "gpt-4o-mini".
messages	An array of message objects that define the conversation context. Each message has a role (e.g., "system" or "user") and content.
max_tokens	The maximum amounts of tokens to generate in the response or the words and parts of words generated.

6.5 Cloudinary

Cloudinary allows the implementation of media uploads in this Education Management System. Besides that, multer and body-parser are used to handle and process media files in the server. Cloudinary is integrated as the primary cloud storage service for images, videos, and other media assets, providing a scalable and secure environment for media management. The process of the media upload begins as the user chosen a desired media to upload. When a file is uploaded, Multer, a middleware for handling multipart/form-data, parses the incoming request containing the media file. Multer is configured to handle the storage settings, validate file types, and manage file size limits to ensure that

only appropriate files are processed by the system. Once Multer processes and temporarily stores the file, the file data is then sent to Cloudinary using the Cloudinary API. If the upload is successful, Cloudinary API will return a `public_url` which is then stored in the database. This `public_url` is the url to access the media.

Additionally, another middleware called `body-parser` is used together to parse incoming request bodies. When the media is uploads, there are metadata associated with the media such as titles, descriptions, or tags. . `Body-parser` converts these request bodies into a usable format (e.g., JSON), allowing seamless integration between media data and other application components. This combination setup ensures a streamlined process for handling media uploads, providing a smooth media upload & retrieval process. This table below showcase some of the methods of the libraries mentioned.

Table 6.4: Cloudinary, Multer, body-parser methods

Method/Feature	Library	Description
<code>diskStorage</code>	<code>multer</code>	Configures how uploaded files are stored on the server's disk, including specifying the destination and filename.
<code>urlencoded</code>	<code>body-parser</code>	Parses URL-encoded data (like form submissions) from the request body, making it available in <code>req.body</code> .
<code>uploader</code>	<code>cloudinary</code>	Handles file uploads to Cloudinary's cloud storage, allowing for image processing and storage on the Cloudinary service.

6.6 React Router

The navigation of the client side of the Education Management System is handled by React Router DOM. React router is used to navigation between different components and pages seamlessly. It provides a simple way to define routes allowing the react app to render the specific components based on the current URL path. These below is some method or components used to navigate effortlessly within the application.

Table 6.5: React Router Methods

Method	Description
BrowserRouter	wraps the entire application, enabling the use of routing functionalities
Route	used to define paths and the corresponding components to render when a user visits those paths
Link, NavLink	act like HTML anchor tags but without refreshing the entire page, maintaining the Single Page Application (SPA) behavior
useNavigate	used for programmatic navigation, allowing components to redirect users to other routes based on certain conditions, such as after a successful logi

6.7 Deployment

6.7.1 Front-End Deployment with Netlify

For deploying the front end of the Education Management System, Netlify is used. Netlify is a static site hosting service where it helps to simplifies continuous deployment and hosting. To configure the deployment, the Git repository of the client side is connected to Netlify. The branch named “prod” for production is selected for the source of deployment. This ensures that any commits or merges to the prod branch will trigger automatic deployments to

Netlify. After that, environment variables must be configured at Netlify as the client has used some API keys that are confidential. Netlify uses these environment variables during the build process to configure your application correctly. Additionally, build commands and directory settings within Netlify, ensuring that the production-ready build is deployed from the `prod` branch. After the deployment, a public domain is given free by Netlify.

6.7.2 Back-End Deployment with Render

For deploying the backend server of the Education Management System, render.com is used. Render is configured to use the main branch of the Git repository that contains the server code for deployments. This setup is able to manage and detect any backend code updates. This ensures that changes pushed to the main branch are reflected in the live application. Besides that, environment variables for OpenAI and Cloudinary APIs are added to the environment. Render also offers a comprehensive dashboard that contains a console to display any logs or error logs that can help the debugging process easier. Not only that, after Render hosts the server, it will give a public URL that can be accessed as the server API endpoint which allows the Netlify-hosted application to connect and enable the communication. Lastly, it also provides options for configuring build and start commands specific to the server, ensuring that your server is built and runs correctly upon deployment.

6.8 Summary

This chapter provides an overall concept of the front end and back-end implementation of this project. This implementation includes the implementation of OpenAI, SocketIO, Cloudinary, React Router, and authentication and authorization of the project, and the deployment process.

CHAPTER 7

SYSTEM TESTING

7.1 Introduction

This chapter will showcase the testing results for the Education Management System. The system testing involves a unit testing, usability testing, and user acceptance testing to ensure the functionality and reliability of the application. Additionally, a traceability matrix are produced which it will link the use cases, functional requirements, and test cases.

7.2 Traceability between Use Cases, Functional Requirements and Test Cases

Testing is a critical part of the software development lifecycle as it determines the system has meet the expectations of the end users to ensure a well-rounded application. Thus, a traceability between use cases, functional requirements, and test cases will be created to better understand all system functionality are properly tested and validated. This mapping provides a clear link between what the system is intended to do (use cases), how it should perform those tasks (functional requirements), and how these functions are tested (test cases). Most importantly, with the traceability matrix, it can help better maintaining quality and consistency throughout the testing process.

7.2.1 Use Case Table

Table below displays the use cases table that includes the use case ID and use case name.

Table 7.1: Use Case Table

Use Case ID	Use Case Name
UC001	Login Account
UC002	Register Account
UC003	Update Account
UC004	Messaging
UC005	Interact QnA
UC006	Create Classroom
UC007	Upload Learning Materials
UC008	Post Announcement
UC009	Manage & Track Student
UC010	Generate Analytic Report
UC011	Join Classroom
UC012	View Learning Material
UC013	View Announcement
UC014	Generate Personalized Feedback

7.2.2 Functional Requirements Table

Table below displays the functional requirements table that includes the functional requirement ID and the functional requirement statement.

Table 7.2: Functional Requirements Table

Functional Requirement ID	Description
FR-1	The system shall allow educators and students to register and create user accounts.
FR-2	The system shall allow educators and students log in securely.

FR-3	The system shall allow educators and students to manage their profiles, including updating basic information.
FR-4	The system shall allow educators to upload learning materials.
FR-5	The system shall allow students to access and view uploaded learning materials.
FR-6	The system shall allow educators to create classroom.
FR-7	The system shall offer performance analytics for educators to track student progress.
FR-8	The system shall provide features for generating personalized learning plan based on student performance data processed by AI
FR-9	The system shall allow students track their own learning progress.
FR-10	The system shall allow educators to post announcements in classroom.
FR-11	The system shall allow send and receive messages between educators and students within classroom.
FR-12	The system shall allow educators and students to interact with each other through questions and answers.

7.2.3 Test Cases Table for Unit Testing

Table below displays the test cases table that includes the test case name, test case description and its corresponding functional requirement id. The details of each test cases are appended to the Appendix of this report.

Table 7.3: Unit Test Cases Table

Test Case ID	Test Case Name	Test Case Description	Related FR ID	Result
TC001	Test User Registration	Verify that educators and students can register and create accounts with valid credentials.	FR-1	Pass
TC002	Test Duplicate Registration	Ensure that the system prevents registration with already existing username.	FR-1	Pass
TC003	Test Secure Login	Test secure login with correct credentials for both educators and students.	FR-2	Pass
TC004	Test Incorrect Login Credentials	Test the login functionality with incorrect credentials and ensure proper error messages are shown.	FR-2	Pass
TC005	Test Profile Update	Verify that educators and students can update their profiles with new information.	FR-3	Pass
TC006	Test Upload Learning Materials	Check if educators can successfully upload learning materials.	FR-4	Pass
TC007	Test Access Learning Materials	Verify that students can access and view the learning materials uploaded by educators.	FR-5	Pass

TC008	Test Create Classroom	Test the ability of educators to create a new classroom.	FR-6	Pass
TC009	Test View Performance Analytics	Ensure educators can view performance analytics of student progress in the classroom.	FR-7	Pass
TC010	Test Personalized Learning Generations	Verify that the system can generate personalized learning plan based on performance data.	FR-8	Pass
TC011	Test Learning Progress Completion	Ensure students can mark their own learning progress complete.	FR-9	Pass
TC012	Test Post Announcements	Test that educators can post announcements in the classroom.	FR-10	Pass
TC013	Test Send Messages in Classroom	Check that educators and students can send and receive messages within the classroom.	FR-11	Pass
TC014	Test Q&A Interaction	Verify that students can ask questions anonymously and educators can respond in the classroom.	FR-12	Pass
TC015	Test Upvote Questions	Test that educators & students can upvote questions in the Q&A feature.	FR-12	Pass
TC016	Test Validate User Permissions	Test to ensure only authorized users can access or perform specific	FR-3, FR-4, FR-6	Pass

		actions (e.g., upload materials).		
TC017	Test Received Message	Ensure message are received in real time within a classroom	FR-11	Pass
TC018	Display Upcoming Tests and Assignments	Test the dashboard for students to show upcoming tests and assignments.	FR-9	Pass

7.2.4 Traceability Matrix

For better visualize the relationship between the unit testing done, functional requirements and the use case, a traceability matrix is produced where all the test conducted are paired with tis corresponding functional requirements and use cases. The traceability matrix table can be found below.

Table 7.4: Traceability Matrix Table

Test Case ID	Functional Requirement ID	Use Case ID
TC001	FR-1	UC002
TC002	FR-1	UC002
TC003	FR-2	UC001
TC004	FR-2	UC001
TC005	FR-3	UC003
TC006	FR-4	UC007
TC007	FR-5	UC012
TC008	FR-6	UC006
TC009	FR-7	UC009
TC010	FR-8	UC014
TC011	FR-9	UC009

TC012	FR-10	UC008
TC013	FR-11	UC004
TC014	FR-12	UC005
TC015	FR-12	UC005
TC016	FR-3, FR-4, FR-6	UC003,UC007, UC006
TC017	FR-11	UC004
TC018	FR-9	UC009

7.3 Usability Testing

Usability Testing is conducted for this project as it is one of the crucial phases of testing. This ensures the target users can perform basic operations within the system with ease and minimal confusion. The main outcome of the usability testing is to gather direct feedback from users about the system and calculate the overall usability score which is the System Usability Scale (SUS). The usability testing was conducted online, and it follows a structured approach to ensure a consistent and reliable results is produced. This usability test consists of 2 main users' group that can be divided into educators and students. Each participant was required to complete predefined tasks that represented typical actions within the system. These scenarios are designed to simulate real-world interactions with the system and help identify any challenges users might face. Following the test scenarios, the users provided feedback by completing a user satisfaction survey. The results of this survey can be found in the appendix of this report. The results are then analyzed to calculate the average SUS score which can measure the system's overall usability and user satisfaction.

7.4 Test Scenarios of Usability Testing

Table below displays the test scenarios table for usability testing that includes a list of 10 item questions with 2 open ended questions in order to calculate the SUS score.

Table 7.5: Usability Testing Table Cases

No	Test Name	Test Description
1	Consistent Color Scheme	Test the ease of navigation within the system to ensure that users can find and access different functionalities without confusion.
2	Clear Instructions	Verify that all critical actions (e.g., submit, update, delete) are clearly visible and accessible to users.
3	Intuitive Navigation	Test the ease of navigation within the system to ensure that users can find and access different functionalities without confusion.
4	Visibility of Actions	Verify that all critical actions (e.g., submit, update, delete) are clearly visible and accessible to users
5	Feedback Mechanism	Confirm that the system provides timely and appropriate feedback after user actions (e.g., successful submission, error messages).
6	Readability of Text	Verify that all text, including prompts, labels, and error messages, is readable, appropriately sized, and easily understandable.
7	Error Message Clarity	Check if error messages are clear, concise, and provide guidance on how to resolve issues.
8	Consistency in Icon Usage	Verify that icons used throughout the system are consistent in design and represent their intended actions clearly.
9	Prompt and Instruction Clarity	Ensure that all prompts and instructions are clear, concise, and guide the user effectively through the functionalities.
10	Ease of Task Completion	Observe if users can complete a typical task (e.g., registration, sending a message) without extensive guidance or confusion.
11	User Satisfaction	Assess user satisfaction with the overall interface design, including aesthetics, readability, and layout.

	with Interface Design	
12	Ease of Understanding Functionalities	Evaluate how easily users can understand and use the system's functionalities without extensive training.

7.4.1 Results of Usability Testing

The System Usability Scale is able to measure the usability of the system in a quick and easy way. Each of the ten usability questions was scored from 1 which means strongly disagree to the highest score 5 that is Strongly Agree. Below are the SUS scores for each participant based on the feedback received.

Table 7.6: SUS Calculation Table

Participant	Q 1	Q 2	Q 3	Q 4	Q 5	Q 6	Q 7	Q 8	Q 9	Q10	Total Score	SUS Score
Participant 1	4	4	2	5	3	4	3	4	5	3	37	72.5
Participant 2	5	3	3	5	3	5	2	4	3	4	37	72.5
Participant 3	3	4	4	3	4	4	4	5	4	3	38	75.0
Participant 4	5	5	4	5	5	3	2	4	5	3	41	82.5
Participant 5	3	3	4	4	4	3	3	4	5	3	36	70.0
Average SUS score											74.5	

The average SUS score across all participants is approximately 74.5, which suggests that the system is fairly usable but has room for improvement.

Although the average SUS score is at the higher end of the scale, it is good to bear in mind that the sample size of five participants is relatively small, providing only a rough estimation of the system's usability. A larger group of participants would yield more reliable and representative results. Thus, from after the usability testing it is much recommended to increase the number of participants in future usability testing to gain a wider understanding of user experiences and identify any usability issues that may not have been covered with a smaller sample. Besides that, some of the participants have made some good comments and feedback on the open ended question and these information is reviewed and noted for future work.

7.4.2 Summary of Usability Test

This summary reflects general sentiments and specific areas of feedback from participants, providing insights into areas of improvement and well-received aspects of the system.

Table 7.7: Summary Usability Test

Reviews & Suggestions	Liked Features / Disliked Features
The color scheme is mostly consistent, but some text elements are too bright.	Consistent color scheme, clean and easy-to-use interface.
Instructions are generally clear, but some users found certain elements confusing.	Clear prompts and instructions guide effectively. Analytic page readability could be improved.
Instructions are generally clear, but some users found certain elements confusing.	Clear prompts and instructions guide effectively.
Error messages are clear but could provide more detailed guidance on resolving issues.	Clear success and error messages provide feedback after actions.

	Error messages need better guidance.
Navigation is mostly straightforward; however, some participants found it challenging to locate specific functionalities.	Important actions like "Submit" and "Update" are easy to access.

7.5 User Acceptance Test

User Acceptance Testing (UAT) is also another critical phase project where the system is evaluated by its actual end-users to ensure it meets their needs and expectations. For the Education Management System, UAT was conducted with 2 user group including educators and students who interacted with the web application. This testing phase involved hands-on sessions where users were asked to perform tasks in real-time. These interactions are very valuable and is an opportunity to observe what their reaction and thoughts towards the system from ease of user to any errors encountered. Besides that, participants were encouraged to verbalize their thoughts as they navigated the system. This is called think-aloud method, which allow the test to capture what the user thoughts as they navigated the system allowing a deeper understanding of the user experience. Since the whole system is deploy on Netlify with a public domain, the testing environment can be performed remotely and used by participants own devices.

To conduct the User Acceptance Testing (UAT) for the Education Management System remotely, a structured approach is applied and followed. First, the UAT form is prepared and passed to the participants, which can be found at the appendix of this report. The form includes basic information and the test cases. Participants will be given access to the system with a demo account based on their role where they can interact with various features such as classroom management, test score updates, and analytics generation. During the UAT session, participants will follow the outlined test cases, noting whether each test case passed or failed and providing their feedback on their interaction. On top of that, screen sharing, and video call is used for real-time support and

to observe participant interactions. Once the testing completed, the UAT form is collected and analyzed. Any issues are identified in order to meet the system user requirements. Finally, participant will sign off on their participation, confirming that the UAT has been completed thoroughly. After analyzing the result, actions are taken, and necessary adjustments are made based on feedback. Here below is a summary of the action taken based on the UAT results.

7.5.1 User Acceptance Test Result

Here below is some of the highlight issue and encounter from the UAT test conducted. This below is a table that summarizes the issue encounter and action taken upon it.

Table 7.8: Summary UAT Table and Action Taken

Test Case	Feedback Given	Action Taken
UAT009	“I feel like the system's student management necessary tools are provided but it lacks extra features that would allow me to better track student progress and manage their profiles more effectively.”	Added A section to show to better clearly show the results and score for students and educators
UAT006	“An Anonymous Option for me would be good in QnA section”	Added an option to ask question anonymously
UAT002	“The software on mobile view is not too optimize, recommend to improve Mobile UI”	Update the some components that have issue diplaying properly in the mobile view.

According to summary and action take table, it has shown that some minor tweaks and adaptations solutions were implemented to solve the issues faced by the participants during the UAT. These minor tweaks are made to solve these issue that have bigger impact on the user experience than others and can

be solve in within the time frame. Nevertheless, there are still a lot of feedback provided in the UAT that can greatly help the system experience, but due to time constraint, these feedback cannot be implemented in this short period. Overall, the UAT was deemed successful because there was not any major issue encounter that may destroy the whole purpose of the system and majority of the test cases are passed confidently.

7.6 Summary

This chapter have discussed the testing activities conducted which include unit testing, usability testing and user acceptance testing. These testing ensure that the education management system have achieve the functional and non-functional requirements mentioned in the report. As a result, unit testing is able validated each module individually. Secondly, usability testing highlighted a positive user experience, with high satisfaction scores and valuable feedback on potential enhancements. Lastly, UAT confirmed the system's alignment with user expectations, revealing minor issues that were promptly resolved, ultimately demonstrating the system's effectiveness and readiness for real-world use.

CHAPTER 8

CONCLUSION AND RECOMMENDATIONS

8.1 Introduction

This Education Management System with OpenAI project has been in development for close to 12 months from the planning to deployment. This application has successfully developed and implemented OpenAI API to better enhance educational environment through AI generated analytics, learning plan and interactive features. This project has begun with detailed planning, including defining the project scope, gathering requirements, and reviewing existing systems to set a clear roadmap. This was followed by a thorough analysis and design phase, where interface flow diagrams and high-fidelity prototypes were created to guide the development process. The development phase involved iterative process that consist of design, development, and testing. Before any iterative cycle, the project first setup includes the configuration of the GitHub repository and database. After that, it followed by the development of core modules such as Login and Authentication, Classroom Management, Student Management, and Performance Analytics and so on. Each module was tested to ensure functionality and integration before proceeding to the next. In the final phase, unit testing, usability testing and user accept testing were performed. The system demonstrated a strong overall performance, with a positive reception from users. However, some limitations were present in the system. These limitations will be discussed later in the report.

The project has laid a solid foundation for improving educational management with AI powered analytics and learning plan. Moving forward, the recommendations for future work include addressing the identified limitations. These improvements will help develop a more powerful and user-centric education management system. The project documentation has been completed where this report has captured all activities and developments for future reference. Overall, the project has met its objectives and has delivered a functional system that aligns with user needs and expectations.

8.2 Objective Examination

The project objectives outlined at the start of the Education Management System development have been thoroughly examined and met as follows.

The first objective is to examine collaborative learning approaches and review similar applications. This objective was achieved through comprehensive research during the initial planning phase. A review of existing education management systems and collaborative learning platforms is reviewed including Google Classroom, MyCampus and Moodle. This review has helped the initial planning by identifying key features and best practices in similar applications. Although the chosen review application may not be similar to the goals and objectives this project trying to achieve, it is still very beneficial to review these and learn from their successful application. This project is entirely different from these and have its own unique proposed purposes.

The second objective is to develop an education management system which serves as a centralized communication hub and integrates with AI powered analytics. The development of the Education Management System was completed successfully, providing a centralized platform for communication powered OpenAI analytics and learning recommendation. The system includes modules for class management, student management, performance analytics, and test score tracking.

The third objective is to implement AI-powered analytics for personalized learning. The project integrated AI-powered analytics to enhance personalized learning. This feature allows educators to generate detailed performance reports and analytics, providing insights into individual student performance and overall class trends. The implementation of OpenAI's analytics capabilities aligns with the objective to personalize learning and provide actionable insights for educators.

The last objective is to conduct evaluation on the developed system using usability testing, user acceptance test (UAT), and unit testing. The result from these testing has shows that the system has meets user expectations which has a majority positive feedback on its functionality and performance. Although

some limitations were identified and addressed, the evaluations confirmed that the system is functional and aligns well with user needs.

8.3 Limitations

Although the Education Management System project successfully met its primary objectives, several limitations were identified during the testing phases. Here Below are the limitations.

Table 8.1: Limitations Table

No	Limitation	Description
1	Analytic Module Is Too General, Lacks Details Capabilities	A more detailed insights, such as specific metrics related to each student's achievements and areas for improvement can be display more clearly and easy to access.
2	Lacks powerful collaboration tools	The system does not support collaborative features like video and voice calling. The absence of these tools limits the potential for real-time interaction and deeper engagement among educators and students where educators can see the emotion and behavior of the students.
3	Theres is no native mobile application	Students and Educators access the system through a web browser on mobile devices. This approach has led to suboptimal user interface and user experience (UI/UX) on mobile platforms compared to native applications. A mobile app could provide a more tailored and responsive design, enhancing usability and overall user satisfaction.

8.4 Recommendations for Future Work

To address the limitations identified in the Education Management System project and enhance its overall functionality, several recommendations for future work are proposed.

Table 8.2: Future Work Recommendations

No	Recommendation	Description
1	Detailed Student Analysis	The system should be enhanced to provide a more comprehensive view of individual student performance. This includes detailed progress reports, specific metrics, and insights that can offer personalized feedback. Implementing advanced data analytics and visualization tools will help educators gain better insights into each student's achievements and areas needing improvement.
2	Enhanced Collaboration Tools	Future iterations of the system should incorporate advanced collaborative features, such as video and voice calling. This would facilitate more dynamic and interactive communication between educators and students, enhancing engagement and collaboration. Integrating these tools would align the system with modern educational practices and improve the overall user experience.
3	Development of a Mobile App	To address the limitations of using a web browser on mobile devices, a dedicated mobile application should be developed. A native

		mobile app would offer a more responsive and optimized user interface, improving usability and accessibility for users on mobile platforms. This development will ensure a better UI/UX experience compared to the current web-based approach.
4	Adoption of Test-Driven Development (TDD)	Implementing a Test-Driven Development (TDD) approach for future development phases will enhance the system's reliability and maintainability. By writing tests before developing features, developers can ensure that new code is robust and meets the defined requirements. This approach will help in catching issues early in the development cycle and improving the overall quality of the system.

These recommendations aim to make the Education Management System a better platform for the educators and students to enjoy their learning needs. Continuous improvements and updates will be essential for providing a better user experience and ensuring the system meets evolving user needs.

REFERENCES

Bailey, J., 2023. *Ai in Education, Education Next*, [online] Available at: <<https://www.educationnext.org/a-i-in-education-leap-into-new-era-machine-intelligence-carries-risks-challenges-promises/>> [Accessed: 14 April 2024].

Bhandari, P., 2023. *What is quantitative research? Definition, uses & methods*, Scribbr, [online] Available at: <<https://www.scribbr.com/methodology/quantitative-research/>> [Accessed: 14 March 2024].

Bradley, J., 2023. *The role of education in personal growth and transformation*, Medium, [online] Available at: <<https://medium.com/lampshade-of-illumination/the-role-of-education-in-personal-growth-and-transformation-b83ded37c6b0>> [Accessed: 15 March 2024].

CIO Applications, 2024. *Integrating AI for education success*, [online] Available at: <<https://www.cioapplications.com/news/integrating-ai-for-education-success-nid-11093.html>> [Accessed 10 March 2024].

Evaluating Efficacy of Survey Research as a Quantitative Research Method, 2022. *Evaluating Efficacy of Survey Research as a Quantitative Research Method*, Statistics Consultation, [online] Available at: <<https://www.statisticsconsultation.com/evaluating-efficacy-of-survey-research-as-a-quantitative-research-method/#:~:text=The%20Survey%20Method%20has%20several,measure%20multiple%20variables%20at%20once>> [Accessed: 14 March 2024].

Hutchins, H., & Biswas, G., Conlin, L., Emara, M., Grover, S., Basu, S. and Mcelhaney, K., 2018. *Studying Synergistic Learning of Physics and Computational Thinking in a Learning by Modeling Environment*.

Liñán, L.C. and Pérez, Á.A.J., 2015. *Educational Data Mining and Learning Analytics: Differences, similarities, and Time Evolution*, [online] Available at:

<<https://rusc.uoc.edu/rusc/ca/index.php/rusc/article/view/v12n3-calvet-juan/2746.html>> [Accessed: 31 March 2024].

Martin, M., 2023. *Incremental model in SDLC: Use, advantage & disadvantage*, [online] Available at: <<https://www.guru99.com/what-is-incremental-model-in-sdlc-advantages-disadvantages.html>> [Accessed: 14 March 2024].

May, M., 2023. *The benefits of multimodal learning strategies*, *SolidProfessor*, [online] Available at: <<https://www.solidprofessor.com/blog/multimodal-approach-learning/#:~:text=By%20combining%20the%20various%20ways,using%20just%20one%20learning%20style>> [Accessed: 15 March 2024].

Melo, N., 2023. *Incorporating artificial intelligence into the classroom: An examination of benefits, challenges, and best practices*, *eLearning Industry*, [online] Available at: <<https://elearningindustry.com/incorporating-artificial-intelligence-into-classroom-examination-benefits-challenges-and-best-practices>> [Accessed: 18 March 2024].

Montoya, S., 2018. *Why we need effective education management information systems*, *UNESCO UIS*, [online] Available at: <<https://uis.unesco.org/en/blog/why-we-need-effective-education-management-information-systems>> [Accessed: 15 March 2024].

Möller, O., 2015. *Traditional education = fail?*, *Medium*, [online] Available at: <<https://medium.com/@olamoller/traditional-education-fail-b0418e98af67>> [Accessed: 10 April 2024].

Pappas, C., 2024. *Greater than the sum of its parts: 8 essential elements of a synergistic elearning strategy*, *eLearning Industry*, [online] Available at: <<https://elearningindustry.com/essential-elements-of-synergistic-elearning-strategy>> [Accessed: 31 March 2024].

Parsons, L, 2024. *Ethical concerns mount as AI takes bigger decision-making role*, *Harvard Gazette*, [online] Available at: <<https://news.harvard.edu/gazette/story/2020/10/ethical-concerns-mount-as-ai-takes-bigger-decision-making-role/>> [Accessed: 14 April 2024].

Shah, D., 2021. *The barriers of traditional learning and development and how hybrid learning can solve them - blogs*, *Sproutlogix*, [online] Available at: <<https://www.sproutlogix.com/blogs/barriers-of-traditional-learning/>> [Accessed: 10 April 2024].

Singh, A.K., 2023. *Blended learning vs. traditional learning: A detailed overview of the two approaches*, *eLearning Industry*, [online] Available at: <<https://elearningindustry.com/blended-learning-vs-traditional-learning-a-detailed-overview-of-the-two-approaches>> [Accessed: 10 April 2024].

Streamline organizational learning using enterprise LMS, 2020. *Streamline organizational learning using enterprise LMS*, [online] Available at: <<https://www.websynergies.com/en/discover-more/blogs/2020/January/changing-how-organizations-learn-grow-and-innovate-streamline-organizational-learning/>> [Accessed: 20 March 2024].

Zaky, H. , 2023. *Feedback effectiveness in higher education: Utilizing students' feedback to foster teaching and learning*, 5(1), p.2.

21K School, 2023. *Challenges of traditional schooling: World schools, World Schools - Find the Best International Schools Worldwide*, [online] Available at: <<https://world-schools.com/challenges-of-traditional-schooling/>> [Accessed 13 March 2024].

APPENDICES

Appendix A: Review of Similar Applications

Table A-1: Summary Table of Similar Applications

Feature	Moodle	Google Classroom	My Campus	Duolingo
Target Audience	Higher Education, K-12	K-12	Higher Education, K-12	Language Learning Individuals
Strengths	Highly customizable, Open-source, Extensive plugins	User-friendly, Integrates with Google Workspace, Easy to set up	Virtual Classrooms with whiteboard that promote collaboration	Adaptive learning, Gamification, Effective for language acquisition
Limitations	Steep learning curve, Requires technical expertise, Potentially overwhelming for some users	Limited customization options, Primarily focused on content delivery, Lacks advanced analytics	Less User Friendly Interface Require recurring payment	Primarily focused on individual learning, Limited collaboration features

Appendix B: Survey Questions

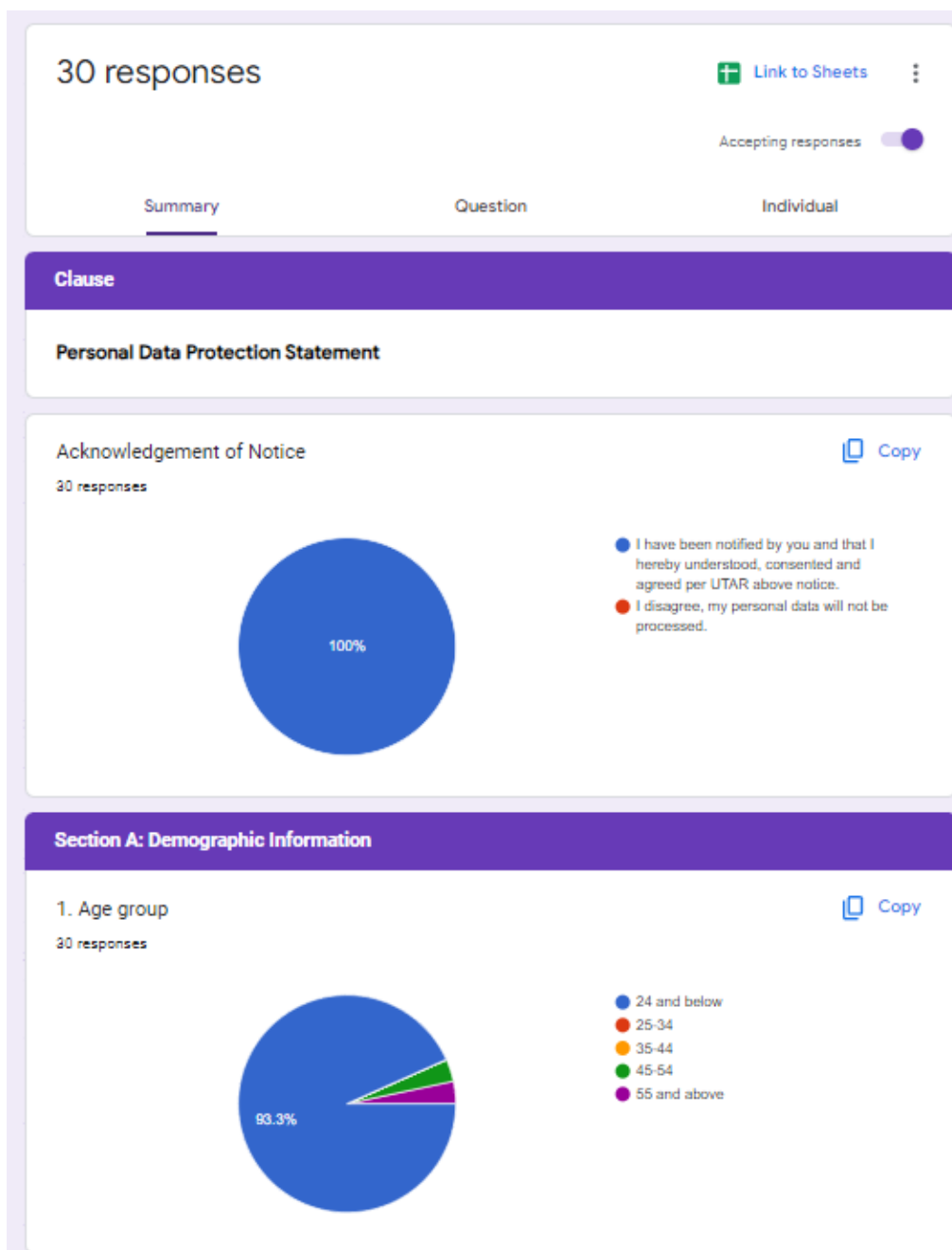


Figure B-1: Question 1.

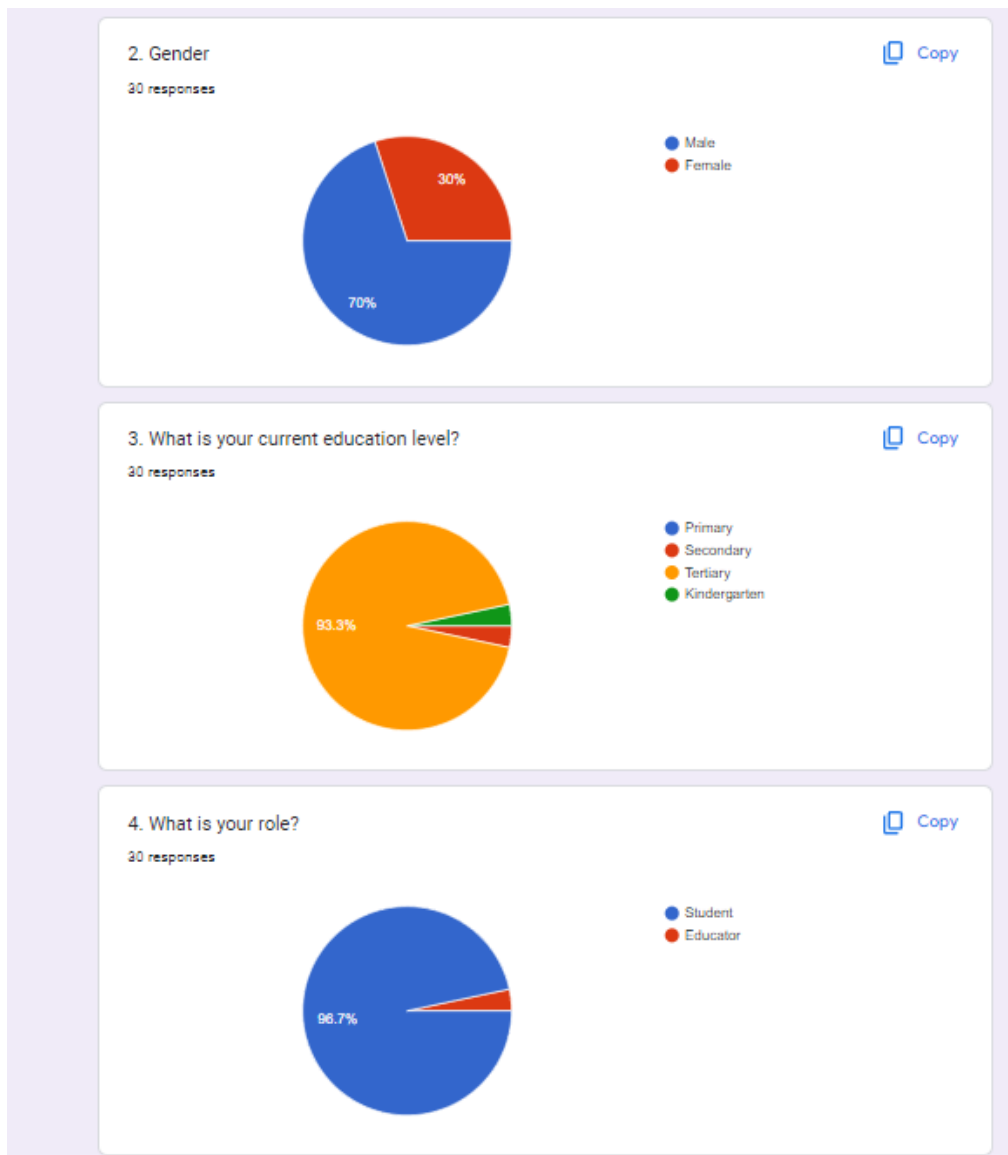


Figure B-2: Question 2 to 4.

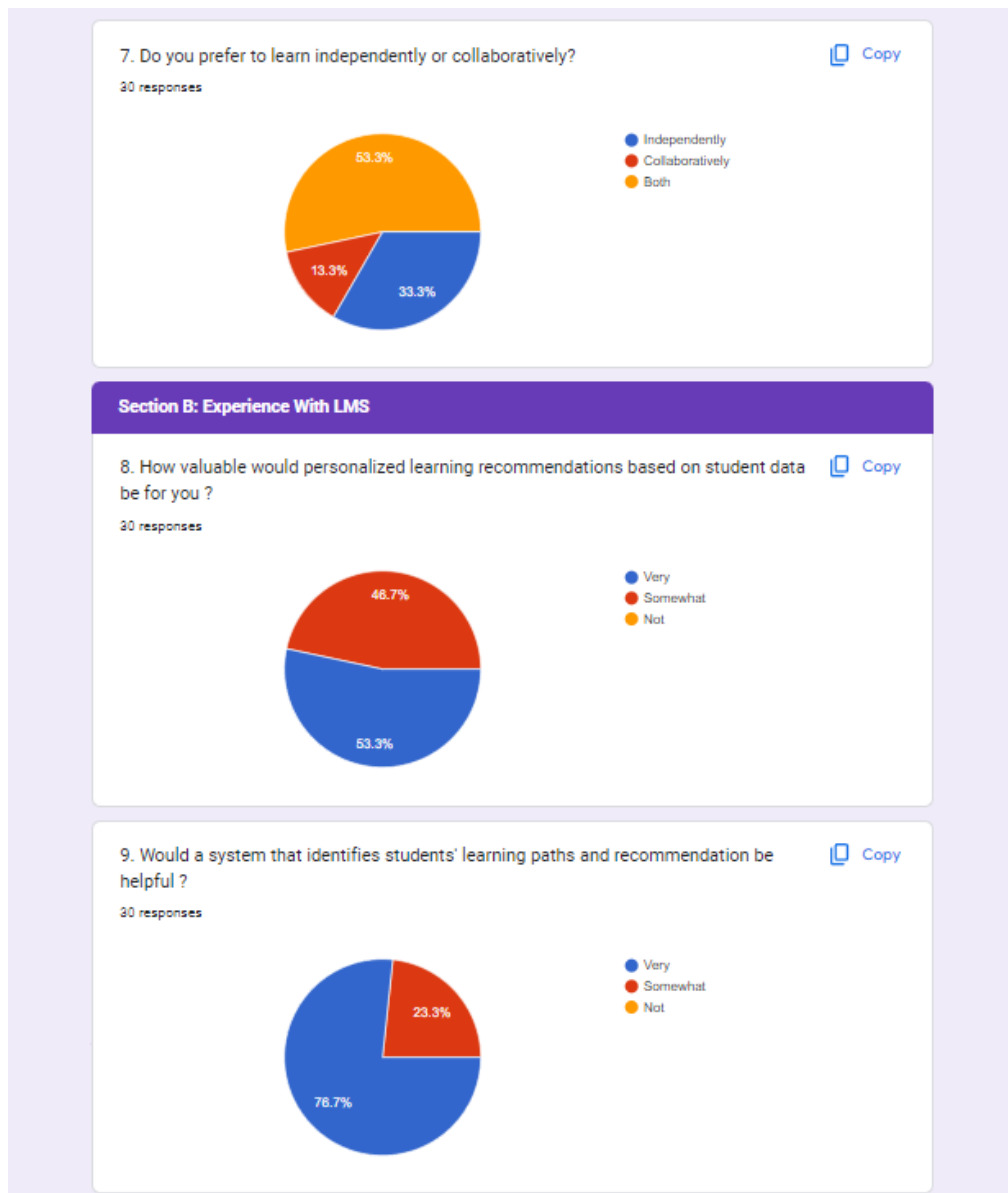


Figure B-3: Question 4 to 6.

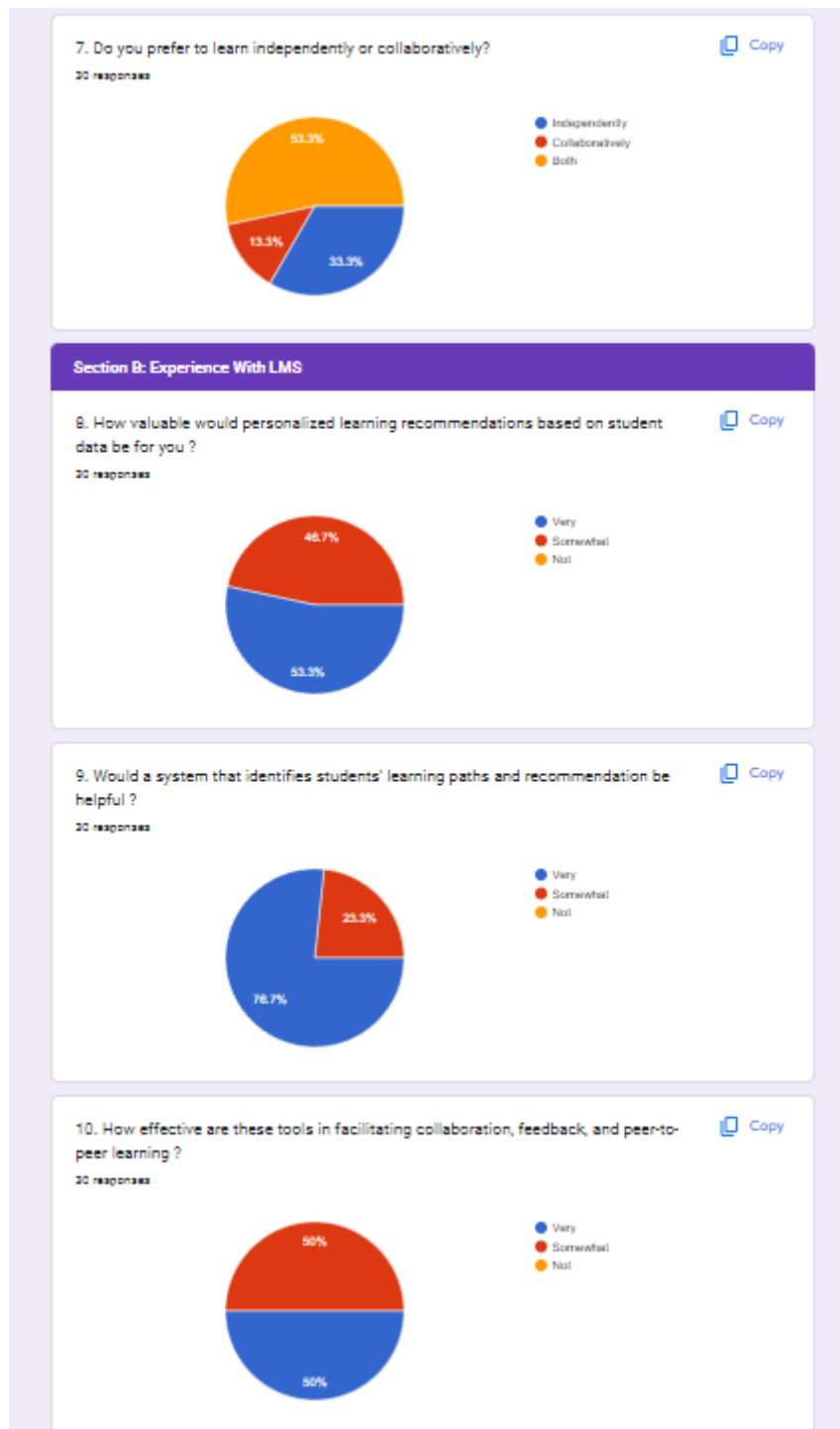


Figure B-4: Question 7 to 10.

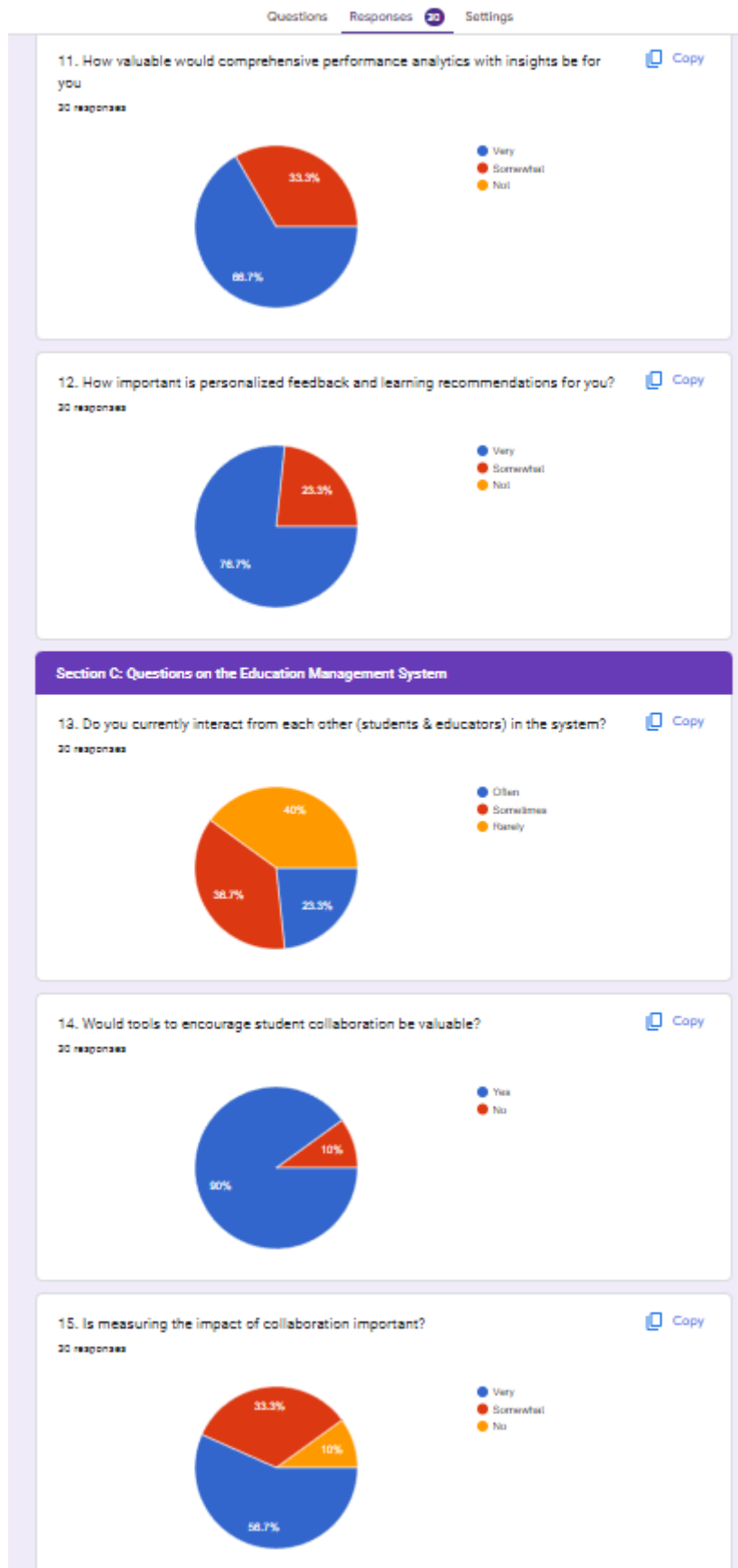


Figure B-5: Question 11 to 15.

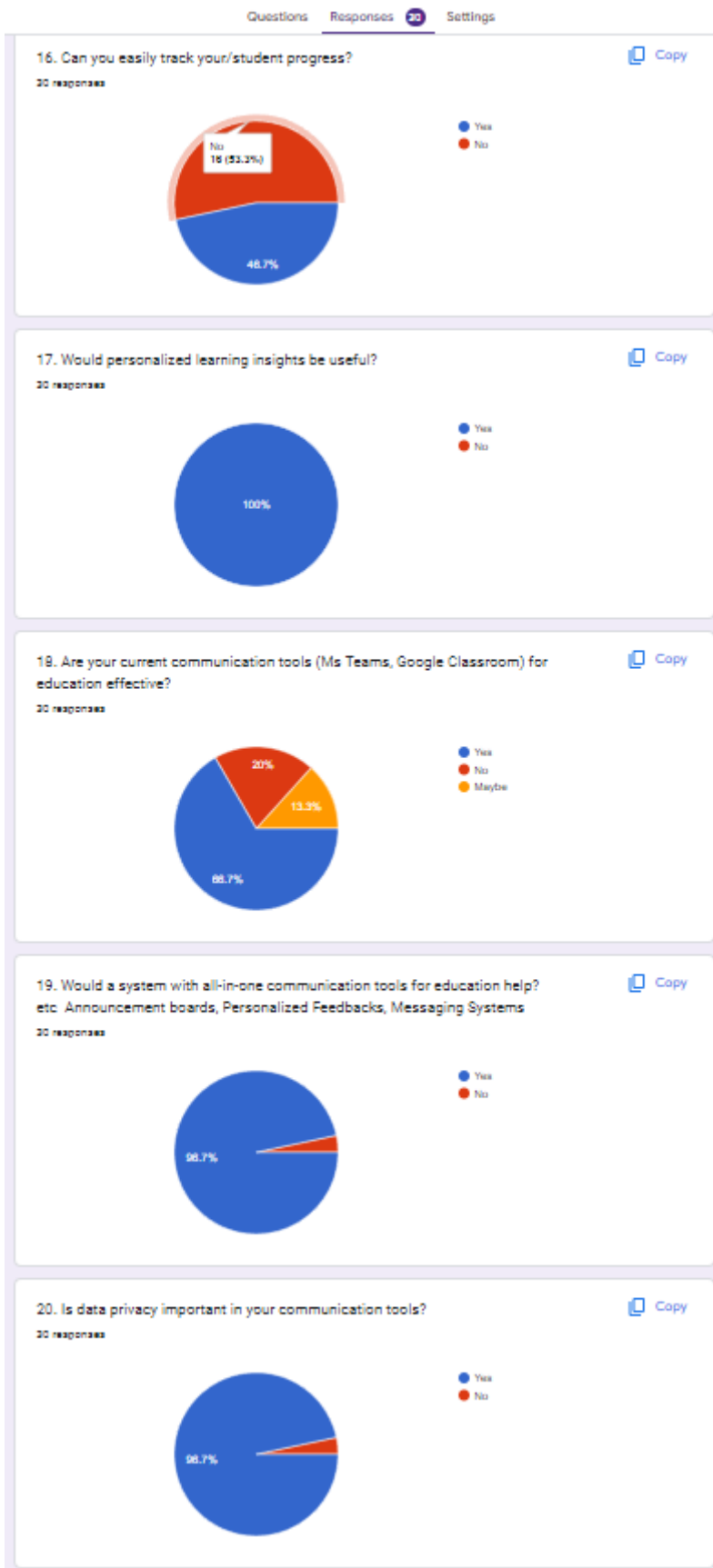


Figure B-6: Question 16 to 20.

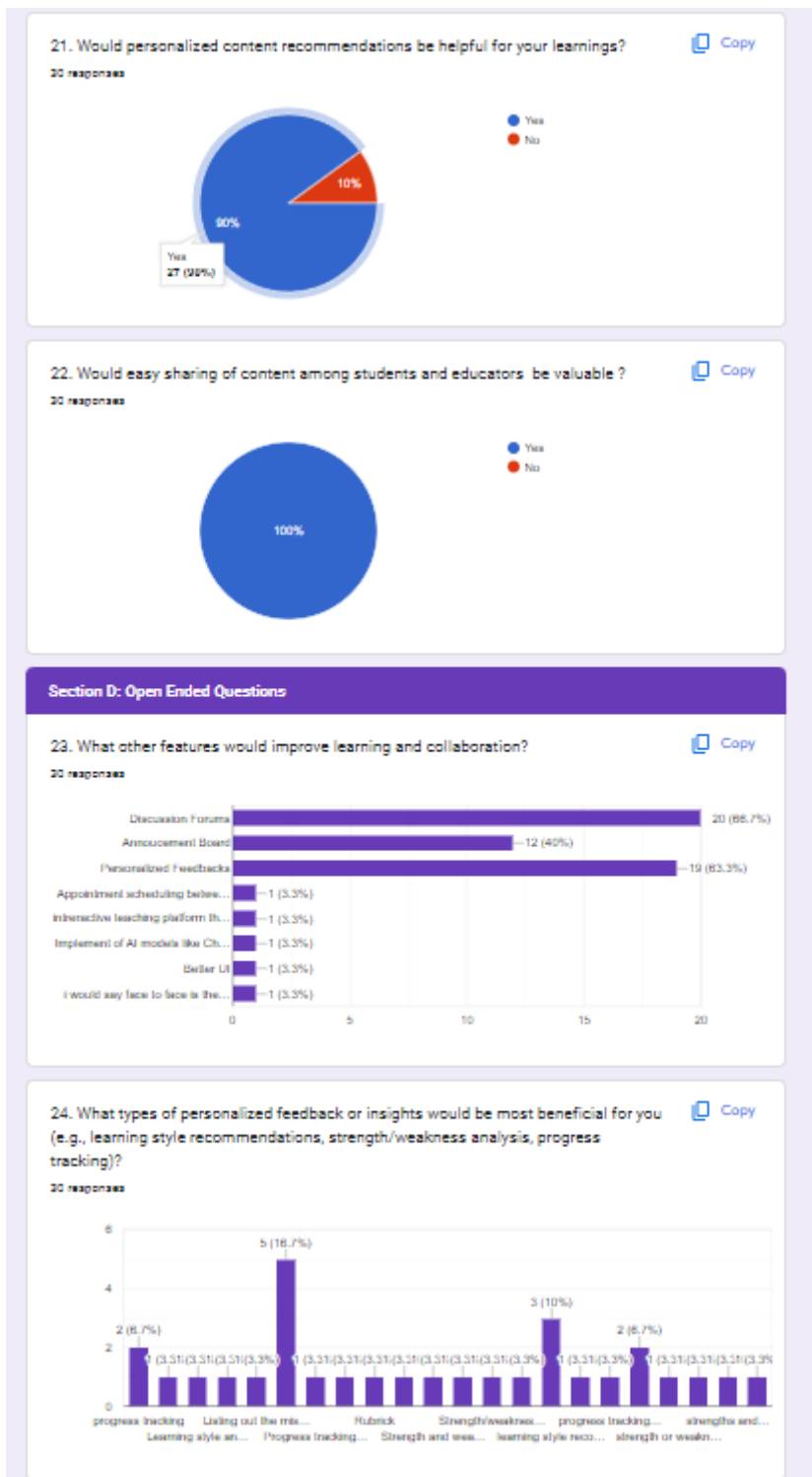


Figure B-5: Question 21 to 24.

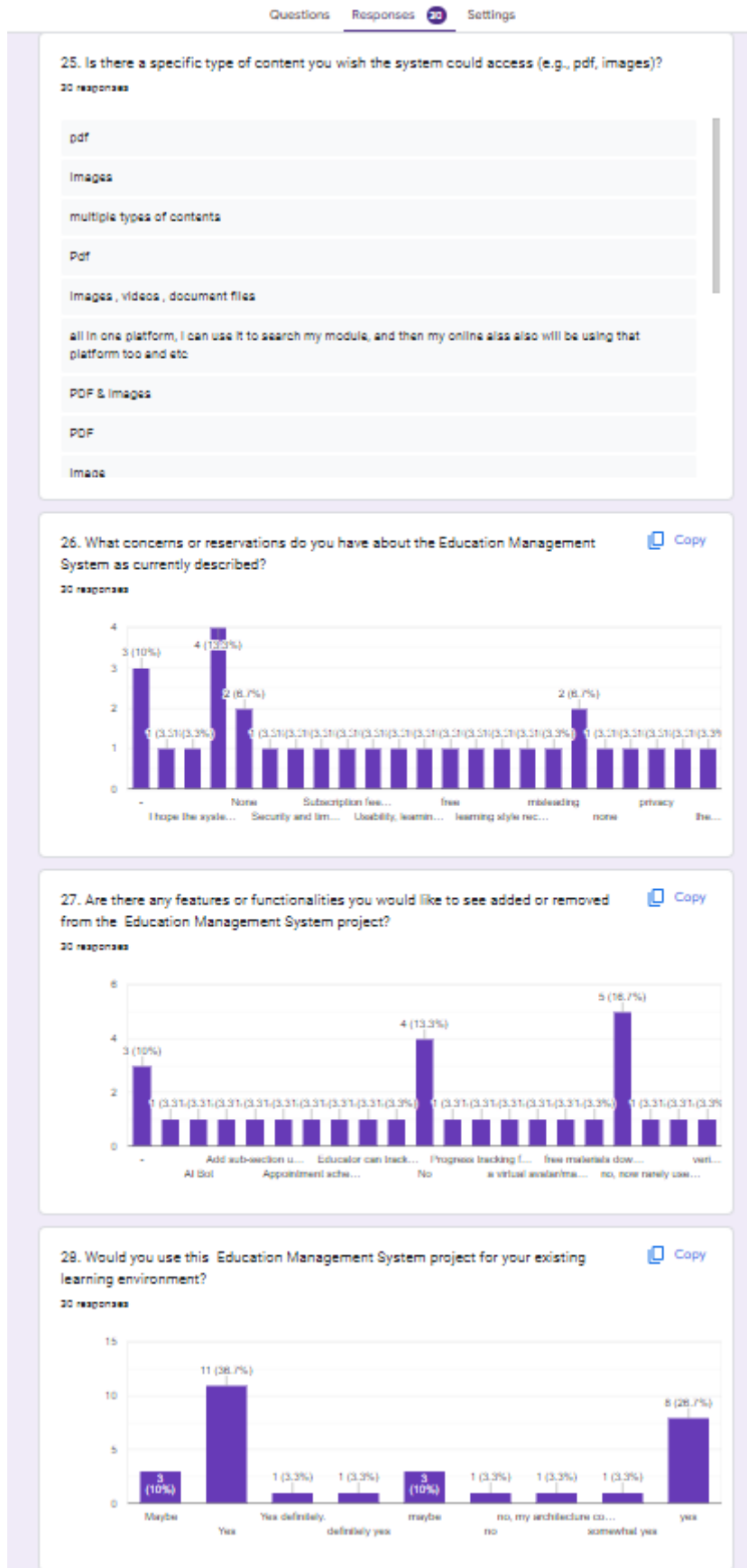


Figure B-5: Question 25 to 28.

Appendix C: Unit Test Cases

Test Case ID	TC001	Status	Pass
Test Case Title	Test User Registration		
Test Case Description	Verify that educators and students can register and create accounts with valid credentials.		
Test Steps	Test Data	Expected Result	Actual Result
<ol style="list-style-type: none"> Navigate to the registration page. Enter valid credentials for an educator. Submit the registration form. Verify the registration success message. Repeat the above steps for a student. 	Username: educator123 Password: SecurePass123	The user should be redirected to the login page.	The user redirected to the login page.

Test Case ID	TC002	Status	Pass
Test Case Title	Test Duplicate Registration		
Test Case Description	Ensure that the system prevents registration with already existing username.		
Test Steps	Test Data	Expected Result	Actual Result
<ol style="list-style-type: none"> Register a new user with a specific username (e.g., uniqueUser123). Attempt to register another user 	First Registration: <ul style="list-style-type: none"> Username: uniqueUser123 Email: uniqueuser@example.com Password: UniquePass123 	An error message indicating the username is already	An error message indicating the username is already

<p>with the same username.</p> <p>3. Verify that the system prevents the registration of the second user with the duplicate username.</p> <p>4. Check that an appropriate error message is displayed.</p>	<p>Second Registration:</p> <ul style="list-style-type: none"> • Username: uniqueUser123 • Email: anotheruser@example.com • Password: AnotherPass123 	<p>taken should be displayed.</p>	<p>taken is displayed.</p>
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Test Case ID	TC003	Status	Pass
Test Case Title	Test Secure Login		
Test Case Description	Test secure login with correct credentials for both educators and students.		
Test Steps	Test Data	Expected Result	Actual Result
<ol style="list-style-type: none"> 1. Navigate to the login page. 2. Enter valid credentials for an educator. 3. Submit the login form. 4. Verify successful login and redirection to the educator's dashboard. 5. Repeat the above steps for a student. 	<p>Username: educator123</p> <p>Password: SecurePass123</p>	<p>The user should be redirected to their respective dashboards</p>	<p>The user redirected to their dashboards</p>

Test Case ID	TC004	Status	Pass
Test Case Title	Test Incorrect Login Credentials		

Test Case Description	Ensure that the system prevents registration with already existing username.		
Test Steps	Test Data	Expected Result	Actual Result
<ol style="list-style-type: none"> Navigate to the login page. Enter incorrect credentials for both educator and student. Submit the login form. Verify that the system displays an error message for incorrect credentials. 	<p>Educator Incorrect Login:</p> <ul style="list-style-type: none"> Username: educator123 Password: WrongPass123 <p>Student Incorrect Login:</p> <ul style="list-style-type: none"> Username: student456 Password: WrongPass123 	An error message indicating invalid username or password should be displayed	An error message indicating invalid username or password is displayed

Test Case ID	TC005	Status	Pass
Test Case Title	Test Profile Update		
Test Case Description	Verify that educators and students can update their profiles with new information.		
Test Steps	Test Data	Expected Result	Actual Result
<ol style="list-style-type: none"> Log in as an educator or student. Navigate to the profile update page. Update personal information (e.g., email, phone number). Submit the updated profile information. Verify that the profile information is 	<p>New password: admin1234</p> <p>New Profile color: red</p>	The profile information should be updated successfully	The profile information is updated successfully

updated successfully. 6. Log out and log back in to ensure the updated information persists			
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Test Case ID	TC007	Status	Pass
Test Case Title	Test Access Learning Materials		
Test Case Description	Verify that students can access and view the learning materials uploaded by educators.		
Test Steps	Test Data	Expected Result	Actual Result
<ol style="list-style-type: none"> 1. Log in as a student. 2. Navigate to the page where learning materials are listed. 3. Access and view the uploaded learning materials. 4. Verify that the student can view and download the materials. 	Learning Material Available: Introduction to Machine Learning	The student should be able to view and download the learning materials	The student can view and download the learning materials

Test Case ID	TC008	Status	Pass
Test Case Title	Test Create Classroom		
Test Case Description	Test the ability of educators to create a new classroom.		
Test Steps	Test Data	Expected Result	Actual Result
<ol style="list-style-type: none"> 1. Log in as an educator. 2. Navigate to the classroom creation page. 	Name: Advanced Machine Learning	The new classroom should be	The new classroom is created successfully

<ol style="list-style-type: none"> 3. Enter the required information for a new classroom (e.g., name, description). 4. Submit the form to create the classroom. 5. Verify that the new classroom is created and visible in the list of classrooms. 	<p>Description:</p> <p>A class focused on advanced topics in machine learning.</p>	<p>created successfully</p>	
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Test Case ID	TC009	Status	Pass
Test Case Title	Test View Performance Analytics		
Test Case Description	Ensure educators can view performance analytics of student progress in the classroom.		
Test Steps	Test Data	Expected Result	Actual Result
<ol style="list-style-type: none"> 1. Log in as an educator. 2. Navigate to the performance analytics page 3. Click See Analytic History 4. View the performance analytics data (e.g., charts, graphs). 5. Verify that the data accurately reflects student progress and performance. 	-	<p>Performance analytics data should be displayed accurately</p>	<p>Performance analytics data are displayed accurately</p>

Test Case ID	TC010	Status	Pass
Test Case Title	Test Personalized Learning Recommendations		

Test Case Description	Verify that the system can generate personalized learning plan based on performance data.		
Test Steps	Test Data	Expected Result	Actual Result
<ol style="list-style-type: none"> 1. Log in as an educator. 2. Navigate to the personalized learning recommendations page. 3. Generate recommendations based on student performance data. 4. Review the generated recommendations. 	-	The system should generate personalized learning recommendations based on the student's performance data.	The system generates personalized learning recommendations based on the student's performance data successfully

Test Case ID	TC011	Status	Pass
Test Case Title	Test Learning Progress Completion		
Test Case Description	Ensure students can mark their own learning progress complete.		
Test Steps	Test Data	Expected Result	Actual Result
<ol style="list-style-type: none"> 1. Log in as a student. 2. Navigate to the learning progress page. 3. Mark a specific learning task or journey as complete. 4. Verify that the progress status is updated to "Complete." 5. Unmark the task and verify that the status updates back to "In Progress." 	-	The task status should update correctly to "Complete" when marked as complete.	The task status is update correctly to "Complete" when marked as complete.

Test Case ID	TC012	Status	Pass
Test Case Title	Test Post Announcements		
Test Case Description	Test that educators can post announcements in the classroom.		
Test Steps	Test Data	Expected Result	Actual Result
<ol style="list-style-type: none"> 1. Log in as an educator. 2. Navigate to the announcements page for a specific classroom. 3. Create a new announcement (e.g., text, title). 4. Submit the announcement. 5. Verify that the announcement is posted and visible to students in the classroom. 	<p>Title: Exam Reminder</p> <p>Content: The exam for the semester will be held next week. Please prepare accordingly.</p> <p>Type: Quiz</p>	The announcement should be posted successfully.	The announcement is posted successfully.

Test Case ID	TC013	Status	Pass
Test Case Title	Test Send Messages in Classroom		
Test Case Description	Check that educators and students can send and receive messages within the classroom.		
Test Steps	Test Data	Expected Result	Actual Result
<ol style="list-style-type: none"> 1. Log in as a student or educator. 2. Navigate to the messaging interface within a specific classroom. 3. Send a new message to another user. 	<p>Message</p> <p>Content: Can you provide more details about the upcoming project?</p>	The message should be sent and received in real-time.	The message is sent and received in real-time.

4. Verify that the message is sent and received successfully.			
5. Check that the recipient receives the message in real-time.			

Test Case ID	TC014	Status	Pass
Test Case Title	Test Q&A Interaction		
Test Case Description	Verify that students can ask questions anonymously and educators can respond in the classroom.		
Test Steps	Test Data	Expected Result	Actual Result
<ol style="list-style-type: none"> 1. Log in as a student. 2. Navigate to the Q&A section of a specific classroom. 3. Post a new question anonymously. 4. Log in as an educator. 5. Navigate to the Q&A section of the same classroom. 6. Answer the posted question. 7. Verify that the answer is posted and visible to the students. 8. Log in as a student again and ensure that the answer is visible. 	<p>Question Content: What are the key topics for the upcoming exam?</p> <p>Answer Content: The key topics are chapters 5 through 8 of the textbooks.</p>	The question should be posted anonymously and visible to educators	The question is posted anonymously and visible to educators

Test Case ID	TC015	Status	Pass
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Test Case Title	Test Upvote Questions		
Test Case Description	Test that educators & students can upvote questions in the Q&A feature.		
Test Steps	Test Data	Expected Result	Actual Result
<p>Log in as a student or educator.</p> <p>Navigate to the Q&A section of a specific classroom.</p> <p>Find an existing question.</p> <p>Upvote the question.</p> <p>Log in as another student.</p> <p>Verify that the upvote is reflected and visible.</p>	-	The question should receive the upvote and the count should be updated.	The question receives the upvote and the count should be updated.

Test Case ID	TC016	Status	Pass
Test Case Title	Test Validate User Permissions		
Test Case Description	Test to ensure only authorized users can access or perform specific actions (e.g., upload materials).		
Test Steps	Test Data	Expected Result	Actual Result
<ol style="list-style-type: none"> 1. Log in as an unauthorized user. 2. Attempt to perform actions such as uploading materials or creating a classroom. 3. Verify that the user is denied access or 	-	Unauthorized users should be denied access to restricted actions.	Unauthorized users are denied access to restricted actions.

<p>provided with an appropriate error message.</p> <ol style="list-style-type: none"> 4. Log in as an authorized user (e.g., educator). 5. Perform the same actions and verify that they succeed. 			
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Test Case ID	TC017	Status	Pass
Test Case Title	Test Received Message		
Test Case Description	Ensure message are received in real time within a classroom		
Test Steps	Test Data	Expected Result	Actual Result
<ol style="list-style-type: none"> 1. Log in as a student or educator. 2. Send a message to another user within the classroom. 3. Log in as the recipient. 4. Verify that the message is received in real-time. 5. Check that the message appears in the messaging interface. 	-	The message should be received by the recipient in real-time.	The message is received by the recipient in real-time.

Test Case ID	TC018	Status	Pass
Test Case Title	Display Upcoming Tests and Assignments		
Test Case Description	Test the dashboard for students to show upcoming tests and assignments.		
Test Steps	Test Data	Expected Result	Actual Result

<ol style="list-style-type: none"> 1. Log in as a student. 2. Navigate to the dashboard or calendar view for upcoming tests and assignments. 3. Verify that upcoming tests and assignments are displayed. 4. Ensure that the displayed information is accurate and includes relevant details. 	-	<p>Upcoming tests and assignments should be displayed correctly on the dashboard.</p>	<p>Upcoming tests and assignments are displayed correctly on the dashboard.</p>
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Appendix D: UAT Test Cases

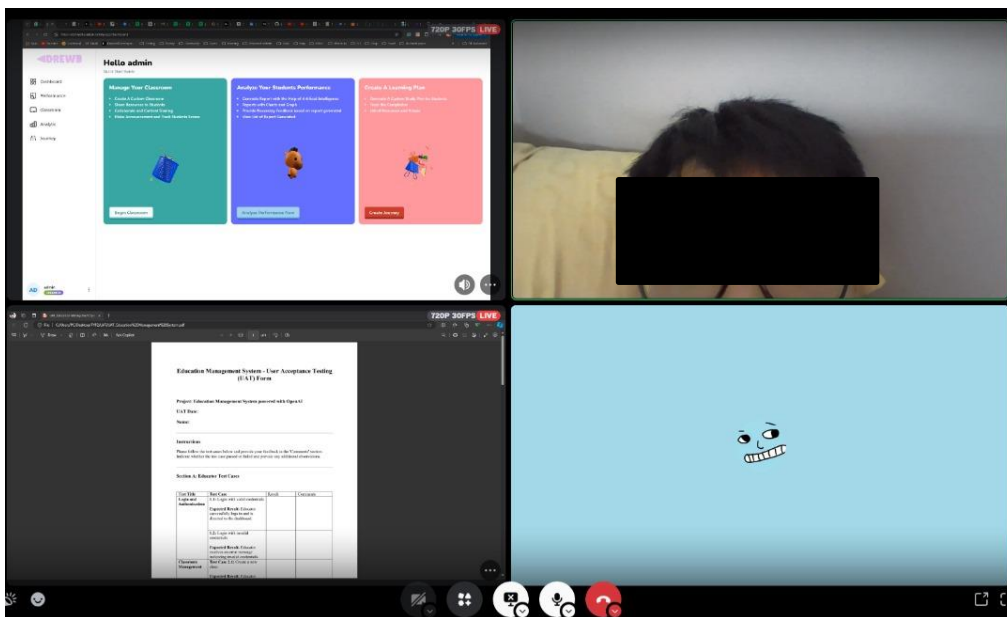


Table D-1: Conducting UAT Remotely

Education Management System - User Acceptance Testing (UAT) Form

Project: Education Management System powered with OpenAI

UAT Date: 27-8-2024

Test Case: UAT001

Instructions

Please follow the test cases below and provide your feedback in the 'Comments' section. Indicate whether the test case passed or failed and provide any additional observations.

Section A: Educator Test Cases

Test Title	Test Case	Result	Comments
Login and Authentication	1.1: Login with valid credentials		

	<p>Expected Result: Educator successfully logs in and is directed to the dashboard.</p>		
	<p>1.2: Login with invalid credentials</p> <p>Expected Result: Educator receives an error message indicating invalid credentials.</p>		
Classroom Management	<p>Test Case 2.1: Create a new class</p> <p>Expected Result: Educator successfully creates a new class and it appears on the dashboard.</p>		
	<p>Test Case 2.2: Create a new announcement</p> <p>Expected Result: Educator can successfully create a new announcement and it appears on the Announcement Tab</p>		
Student Management	<p>Test Case 3.1: Add a student to a class</p> <p>Expected Result: Educator can successfully add a student to a class.</p>		
	<p>Test Case 3.2: Add feedback for a student from a class</p>		

	<p>Expected Result: Educator can successfully view the student feedback in the Student Profile</p>		
Test and Performance Analytics	<p>Test Case 4.1: Add test scores for a student</p> <p>Expected Result: Educator can add test scores for a student, and the scores are saved correctly.</p>		
	<p>Test Case 4.2: Update test scores for a student</p> <p>Expected Result: Educator can update existing test scores, and the changes are reflected.</p>		
	<p>Test Case 4.3: View performance analytics</p> <p>Expected Result: Educator can view analytics and reports on student performance.</p>		
	<p>Test Case 4.4: Generate performance analytics</p> <p>Expected Result: Educator can view results on student performance generated by Open AI.</p>		

Section B: Student Test Cases

Test Title	Test Case	Result	Comments
Login and Authentication	1.1: Login with valid credentials Expected Result: Student successfully logs in and is directed to the dashboard.	Pass	
	1.2: Login with invalid credentials Expected Result: Student receives an error message indicating invalid credentials.	Pass	No Clear Login Error Prompt
Classroom	Test Case 2.1: View list of enrolled classes Expected Result: Student can view a list of all classes they are enrolled in.	Pass	
	Test Case 2.2: Access class details Expected Result: Student can access detailed information for each class.	Pass	
	Test Case 2.3: Access class Announcement Expected Result: Student can access latest announcement for each class.	Pass	

Communication	Test Case 3.1: Send a message to an educator Expected Result: Student can send a message to an educator and receive a response.	Pass	
	Test Case 4.2: Receive message Expected Result: Student receives new messages.	Pass	
Test and Performance Analytics	Test Case 4.1: View test scores Expected Result: Student can view test scores in a table	Pass	
	Test Case 4.2: View feedback Expected Result: Student can update feedback provided by Educators.	Pass	
	Test Case 4.3: View performance analytics Expected Result: Student can view analytics and reports on student performance.	Pass	
	Test Case 4.4: Generate performance analytics Expected Result: Student can view results on student performance generated by Open AI.	Failed	Failed to generate

Additional Feedback

Please provide any additional comments or feedback on the application below:

The system works smoothly and nice

Education Management System - User Acceptance Testing (UAT) Form

Project: Education Management System powered with OpenAI

UAT Date: 27-8-2024

Test Case: UAT002

Instructions

Please follow the test cases below and provide your feedback in the 'Comments' section. Indicate whether the test case passed or failed and provide any additional observations.

Section A: Educator Test Cases

Test Title	Test Case	Result	Comments
Login and Authentication	1.1: Login with valid credentials Expected Result: Educator successfully logs in and is directed to the dashboard.		
	1.2: Login with invalid credentials Expected Result: Educator receives an error		

	message indicating invalid credentials.		
Classroom Management	Test Case 2.1: Create a new class Expected Result: Educator successfully creates a new class and it appears on the dashboard.		
	Test Case 2.2: Create a new announcement Expected Result: Educator can successfully create a new announcement and it appears on the Announcement Tab		
Student Management	Test Case 3.1: Add a student to a class Expected Result: Educator can successfully add a student to a class.		
	Test Case 3.2: Add feedback for a student from a class Expected Result: Educator can successfully view the student feedback in the Student Profile		
Test and Performance Analytics	Test Case 4.1: Add test scores for a student Expected Result: Educator can add test scores for a student, and		

	the scores are saved correctly.		
	Test Case 4.2: Update test scores for a student Expected Result: Educator can update existing test scores, and the changes are reflected.		
	Test Case 4.3: View performance analytics Expected Result: Educator can view analytics and reports on student performance.		
	Test Case 4.4: Generate performance analytics Expected Result: Educator can view results on student performance generated by Open AI.		

Section B: Student Test Cases

Test Title	Test Case	Result	Comments
Login and Authentication	1.1: Login with valid credentials Expected Result: Student successfully logs in and is directed to the dashboard.	Pass	
	1.2: Login with invalid credentials	Pass	

	Expected Result: Student receives an error message indicating invalid credentials.		
Classroom	Test Case 2.1: View list of enrolled classes Expected Result: Student can view a list of all classes they are enrolled in.	Pass	
	Test Case 2.2: Access class details Expected Result: Student can access detailed information for each class.	Pass	
	Test Case 2.3: Access class Announcement Expected Result: Student can access latest announcement for each class.	Pass	
Communication	Test Case 3.1: Send a message to an educator Expected Result: Student can send a message to an educator and receive a response.	Pass	
	Test Case 4.2: Receive message Expected Result: Student receives new messages.	Pass	

Test and Performance Analytics	Test Case 4.1: View test scores Expected Result: Student can view test scores in a table	Pass	
	Test Case 4.2: View feedback Expected Result: Student can update feedback provided by Educators.	Pass	
	Test Case 4.3: View performance analytics Expected Result: Student can view analytics and reports on student performance.	Pass	
	Test Case 4.4: Generate performance analytics Expected Result: Student can view results on student performance generated by Open AI.	Pass	

Additional Feedback

Please provide any additional comments or feedback on the application below:

The software on mobile view is not too optimize, recommend to improve Mobile UI

Education Management System - User Acceptance Testing (UAT) Form

Project: Education Management System powered with OpenAI

UAT Date: 22-8-2024

Test Case: UAT004

Instructions

Please follow the test cases below and provide your feedback in the 'Comments' section. Indicate whether the test case passed or failed and provide any additional observations.

Section A: Educator Test Cases

Test Title	Test Case	Result	Comments
Login and Authentication	1.1: Login with valid credentials Expected Result: Educator successfully logs in and is directed to the dashboard.	Pass	
	1.2: Login with invalid credentials Expected Result: Educator receives an error message indicating invalid credentials.	Pass	
Classroom Management	Test Case 2.1: Create a new class Expected Result: Educator successfully	Pass	

	creates a new class and it appears on the dashboard.		
	Test Case 2.2: Create a new announcement Expected Result: Educator can successfully create a new announcement and it appears on the Announcement Tab	Pass	
Student Management	Test Case 3.1: Add a student to a class Expected Result: Educator can successfully add a student to a class.	Pass	
	Test Case 3.2: Add feedback for a student from a class Expected Result: Educator can successfully view the student feedback in the Student Profile	Pass	
Test and Performance Analytics	Test Case 4.1: Add test scores for a student Expected Result: Educator can add test scores for a student, and the scores are saved correctly.	Pass	
	Test Case 4.2: Update test scores for a student Expected Result: Educator can update	Pass	

	existing test scores, and the changes are reflected.		
	Test Case 4.3: View performance analytics Expected Result: Educator can view analytics and reports on student performance.	Pass	
	Test Case 4.4: Generate performance analytics Expected Result: Educator can view results on student performance generated by Open AI.	Pass	

Section B: Student Test Cases

Test Title	Test Case	Result	Comments
Login and Authentication	1.1: Login with valid credentials Expected Result: Student successfully logs in and is directed to the dashboard.		
	1.2: Login with invalid credentials Expected Result: Student receives an error message indicating invalid credentials.		
Classroom	Test Case 2.1: View list of enrolled classes		

	<p>Expected Result: Student can view a list of all classes they are enrolled in.</p>		
	<p>Test Case 2.2: Access class details</p> <p>Expected Result: Student can access detailed information for each class.</p>		
	<p>Test Case 2.3: Access class Announcement</p> <p>Expected Result: Student can access latest announcement for each class.</p>		
Communication	<p>Test Case 3.1: Send a message to an educator</p> <p>Expected Result: Student can send a message to an educator and receive a response.</p>		
	<p>Test Case 4.2: Receive message</p> <p>Expected Result: Student receives new messages.</p>		
Test and Performance Analytics	<p>Test Case 4.1: View test scores</p> <p>Expected Result: Student can view test scores in a table</p>		
	<p>Test Case 4.2: View feedback</p>		

	Expected Result: Student can update feedback provided by Educators.		
	Test Case 4.3: View performance analytics Expected Result: Student can view analytics and reports on student performance.		
	Test Case 4.4: Generate performance analytics Expected Result: Student can view results on student performance generated by Open AI.		

Additional Feedback

Please provide any additional comments or feedback on the application below:

The design is appealing and friendly to end user.

Education Management System - User Acceptance Testing (UAT) Form

Project: Education Management System powered with OpenAI

UAT Date: 7-9-2024

Test Case: UAT005

Instructions

Please follow the test cases below and provide your feedback in the 'Comments' section. Indicate whether the test case passed or failed and provide any additional observations.

Section A: Educator Test Cases

Test Title	Test Case	Result	Comments
Login and Authentication	1.1: Login with valid credentials Expected Result: Educator successfully logs in and is directed to the dashboard.	Pass	
	1.2: Login with invalid credentials Expected Result: Educator receives an error message indicating invalid credentials.	Pass	
Classroom Management	Test Case 2.1: Create a new class Expected Result: Educator successfully	Pass	

	creates a new class and it appears on the dashboard.		
	Test Case 2.2: Create a new announcement Expected Result: Educator can successfully create a new announcement and it appears on the Announcement Tab	Pass	
Student Management	Test Case 3.1: Add a student to a class Expected Result: Educator can successfully add a student to a class.	Pass	
	Test Case 3.2: Add feedback for a student from a class Expected Result: Educator can successfully view the student feedback in the Student Profile	Pass	
Test and Performance Analytics	Test Case 4.1: Add test scores for a student Expected Result: Educator can add test scores for a student, and the scores are saved correctly.	Pass	
	Test Case 4.2: Update test scores for a student Expected Result: Educator can update	Pass	

	existing test scores, and the changes are reflected.		
	Test Case 4.3: View performance analytics Expected Result: Educator can view analytics and reports on student performance.	Pass	
	Test Case 4.4: Generate performance analytics Expected Result: Educator can view results on student performance generated by Open AI.	Pass	

Section B: Student Test Cases

Test Title	Test Case	Result	Comments
Login and Authentication	1.1: Login with valid credentials Expected Result: Student successfully logs in and is directed to the dashboard.		
	1.2: Login with invalid credentials Expected Result: Student receives an error message indicating invalid credentials.		

Classroom	<p>Test Case 2.1: View list of enrolled classes</p> <p>Expected Result: Student can view a list of all classes they are enrolled in.</p>		
	<p>Test Case 2.2: Access class details</p> <p>Expected Result: Student can access detailed information for each class.</p>		
	<p>Test Case 2.3: Access class Announcement</p> <p>Expected Result: Student can access latest announcement for each class.</p>		
Communication	<p>Test Case 3.1: Send a message to an educator</p> <p>Expected Result: Student can send a message to an educator and receive a response.</p>		
	<p>Test Case 4.2: Receive message</p> <p>Expected Result: Student receives new messages.</p>		
Test and Performance Analytics	<p>Test Case 4.1: View test scores</p> <p>Expected Result: Student can view test scores in a table</p>		

	<p>Test Case 4.2: View feedback</p> <p>Expected Result: Student can update feedback provided by Educators.</p>		
	<p>Test Case 4.3: View performance analytics</p> <p>Expected Result: Student can view analytics and reports on student performance.</p>		
	<p>Test Case 4.4: Generate performance analytics</p> <p>Expected Result: Student can view results on student performance generated by Open AI.</p>		

Additional Feedback

Please provide any additional comments or feedback on the application below:

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	<p>Test Case 2.2: Create a new announcement</p> <p>Expected Result: Educator can successfully create a new announcement and it appears on the Announcement Tab</p>		
Student Management	<p>Test Case 3.1: Add a student to a class</p> <p>Expected Result: Educator can successfully add a student to a class.</p>		
	<p>Test Case 3.2: Add feedback for a student from a class</p> <p>Expected Result: Educator can successfully view the student feedback in the Student Profile</p>		
Test and Performance Analytics	<p>Test Case 4.1: Add test scores for a student</p> <p>Expected Result: Educator can add test scores for a student, and the scores are saved correctly.</p>		
	<p>Test Case 4.2: Update test scores for a student</p> <p>Expected Result: Educator can update</p>		

	existing test scores, and the changes are reflected.		
	Test Case 4.3: View performance analytics Expected Result: Educator can view analytics and reports on student performance.		
	Test Case 4.4: Generate performance analytics Expected Result: Educator can view results on student performance generated by Open AI.		

Section B: Student Test Cases

Test Title	Test Case	Result	Comments
Login and Authentication	1.1: Login with valid credentials Expected Result: Student successfully logs in and is directed to the dashboard.	Pass	
	1.2: Login with invalid credentials Expected Result: Student receives an error message indicating invalid credentials.	Pass	
Classroom	Test Case 2.1: View list of enrolled classes	Pass	

	Expected Result: Student can view a list of all classes they are enrolled in.		
	Test Case 2.2: Access class details Expected Result: Student can access detailed information for each class.	Pass	
	Test Case 2.3: Access class Announcement Expected Result: Student can access latest announcement for each class.	Pass	
Communication	Test Case 3.1: Send a message to an educator Expected Result: Student can send a message to an educator and receive a response.	Pass	
	Test Case 4.2: Receive message Expected Result: Student receives new messages.	Pass	
Test and Performance Analytics	Test Case 4.1: View test scores Expected Result: Student can view test scores in a table	Pass	
	Test Case 4.2: View feedback	Pass	

	Expected Result: Student can update feedback provided by Educators.		
	Test Case 4.3: View performance analytics Expected Result: Student can view analytics and reports on student performance.	Pass	
	Test Case 4.4: Generate performance analytics Expected Result: Student can view results on student performance generated by Open AI.	Pass	

Additional Feedback

Please provide any additional comments or feedback on the application below:

Very Nice Interface. Very Nice User Experience

Education Management System - User Acceptance Testing (UAT) Form

Project: Education Management System powered with OpenAI

UAT Date: 5-9-2024

Test Case: UAT008

Instructions

Please follow the test cases below and provide your feedback in the 'Comments' section. Indicate whether the test case passed or failed and provide any additional observations.

Section A: Educator Test Cases

Test Title	Test Case	Result	Comments
Login and Authentication	1.1: Login with valid credentials Expected Result: Educator successfully logs in and is directed to the dashboard.		
	1.2: Login with invalid credentials Expected Result: Educator receives an error message indicating invalid credentials.		
Classroom Management	Test Case 2.1: Create a new class Expected Result: Educator successfully		

	creates a new class and it appears on the dashboard.		
	<p>Test Case 2.2: Create a new announcement</p> <p>Expected Result: Educator can successfully create a new announcement and it appears on the Announcement Tab</p>		
Student Management	<p>Test Case 3.1: Add a student to a class</p> <p>Expected Result: Educator can successfully add a student to a class.</p>		
	<p>Test Case 3.2: Add feedback for a student from a class</p> <p>Expected Result: Educator can successfully view the student feedback in the Student Profile</p>		
Test and Performance Analytics	<p>Test Case 4.1: Add test scores for a student</p> <p>Expected Result: Educator can add test scores for a student, and the scores are saved correctly.</p>		
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	existing test scores, and the changes are reflected.		
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Section B: Student Test Cases

Test Title	Test Case	Result	Comments
Login and Authentication	1.1: Login with valid credentials Expected Result: Student successfully logs in and is directed to the dashboard.	Pass	
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Additional Feedback

Please provide any additional comments or feedback on the application below:

No additional feedback.