



**School of Computer Sciences**

**CAT403 Computing Infrastructure Major Project**

**Final Report**

***CI23240012: NetEducation: Secure Interactive Learning  
Platform***

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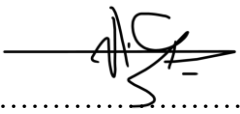
**Examiner: Dr. Vaithegy Doraisamy**

**Academic Session**

**2023/2024**

## DECLARATION

“I declare that the following is my own work and does not contain any *unacknowledged* work from any other sources. This report was undertaken to fulfill the requirements of the Undergraduate Major Project for the Bachelor of Science in Computer Science (Honors) program at Universiti Sains Malaysia”.

Signature : .....

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Date : 28 May 2024

## **ABSTRAK**

Walaupun pendidikan dalam talian mengalami transformasi, ia menghadapi cabaran dalam menyediakan pengalaman praktikal dan pembelajaran interaktif kepada murid. Persekitaran pembelajaran tradisional memberi lebih tumpuan kepada teori daripada praktis, menyebabkan pelajar mempunyai pengetahuan asas tetapi tidak kemahiran praktikal. Pada masa yang sama, kebimbangan mengenai keselamatan siber seperti peningkatan mendadak dalam ketirisan data di Malaysia menunjukkan keperluan untuk memperkuat data pendidikan digital. Dengan menangani masalah ini, projek NetEducation diketengahkan sebagai sebuah usaha penting yang menyediakan kaedah komprehensif untuk pembelajaran dalam talian dalam teknologi rangkaian. Modul seperti "Log Masuk", Pentadbir, dan Pengguna mempunyai fungsi khusus yang mengintegrasikan ciri keselamatan yang kuat, seperti perlindungan fail sekuriti, data log dan "2FA", untuk menjamin keselamatan maklumat pengguna. Konsol "terminal" di platform ini menekankan pengalaman praktikal, menyambungkan teori dan amalan, sementara ciri interaktif seperti kuiz meningkatkan penglibatan pengguna. Sebuah persekitaran pembelajaran dalam talian yang inovatif, selamat, dan merentasi disiplin yang membolehkan pelajar untuk menukar pengetahuan dari teori kepada kecekapan adalah tujuan yang ingin dipenuhi dalam membina sistem ini. NetEducation berusaha untuk mengubah pembelajaran dalam talian dengan menyediakan orang dalam pelbagai bidang dengan persekitaran pembelajaran digital yang menyeluruh, menarik, dan selamat.

## **ABSTRACT**

The landscape of online education, while transformative, faces challenges in delivering practical hands-on experiences and interactive learning. Traditional platforms prioritize theory over application, leaving learners with foundational knowledge but lacking essential practical skills. In tandem, cybersecurity concerns, exemplified by a surge in data breaches in Malaysia, underscore the urgency to fortify digital education against evolving threats. Addressing these issues, the NetEducation project emerges as a pioneering initiative, offering a holistic approach to online learning in network technology. Its distinctive modules which are Login, Admin, and User, integrate robust security measures, including Two-Factor Authentication, file security and log audit ensuring the safeguarding of user data. The platform prioritizes hands-on experience through a styled console, bridging theory with practice, while interactive elements like quizzes enhance engagement. The anticipated outcome is a cutting-edge and secure online learning environment that transcends disciplines, empowering learners to translate theoretical understanding into practical proficiency. NetEducation aims to redefine online education, fostering a comprehensive, engaging, and secure digital learning experience for individuals across diverse fields.

## **ACKNOWLEDGEMENTS**

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## **LIST OF ABBREVIATIONS AND SYMBOLS**

HTML	- Hypertext Markup Language
HTTP	- HyperText Transport Protocol
USM	- Universiti Sains Malaysia
PHP	- Hypertext Preprocessor
GUI	- Graphical User Interface
2FA	- Two-factor authentication
DDoS	- Distributed Denial-of-Service
SDG	- Sustainable Development Goal
IDE	- Integrated Development Environment
PDF	- Portable Document Format
OTP	- One-time password
RDBMS	- Relational Database Management System
CSS	- Cascading Style Sheets

# 1 INTRODUCTION

## 1.1. Background

In the ever-evolving landscape of education, online learning platforms have emerged as pivotal instruments for delivering knowledge and skills to a global audience. The flexibility and accessibility they offer have revolutionized the way individuals acquire expertise in various domains. However, within the specialized field of network technology, a set of distinct challenges persists, hindering the effectiveness of current online learning platforms.

The deficiencies primarily lie in the lack of hands-on training opportunities, a dearth of interactive learning approaches, and concerns surrounding the security of these platforms. Traditional online resources often prioritize theoretical understanding over practical application, leaving aspiring network professionals with foundational knowledge but lacking crucial real-world skills. Additionally, there is a lack of high-quality, affordable online learning resources available to students. This can make it difficult for students to find the resources they need to succeed in online learning [1]. Security, a paramount consideration in the digital realm, is often an afterthought, leaving these platforms vulnerable to various threats. Security in an eLearning platform is essential to ensure the safety and privacy of users' data and the integrity of the learning content. Security measures aim to protect against unauthorized access, data breaches, cyber-attacks, and other threats that may compromise the eLearning platform [2].

In response to these challenges, the NetEducation project takes center stage as a pioneering initiative poised to redefine the standards of online learning in network technology. Recognizing the need for a holistic approach, NetEducation integrates a built-in styled console website, providing learners with a hands-on training environment where theoretical knowledge can be actively applied. This practical emphasis ensures that users not only comprehend networking principles but also gain proficiency in their practical implementation. The project further distinguishes itself by introducing a variety of interactive resources, including quizzes, to make the learning experience engaging and enjoyable.

Security is woven into the fabric of NetEducation. The implementation of Two-Factor Authentication (2FA) enhances user authentication, fortifying the platform against unauthorized access. Additionally, Distributed Denial of Service (DDoS) protection mechanisms are strategically deployed to ensure the platform's availability and stability, safeguarding the continuity of the learning experience. It also includes file upload security protocols. These protocols include stringent file type verification, ensuring that only authorized and safe file formats are accepted. Size limitations are enforced to mitigate the risk of potential denial-of-service attacks or system strain. Virus scan feature also will be implemented in this platform.

## 1.2. Problem Statements

The recent report by cybersecurity company Surfshark reveals alarming trends in Malaysia's cybersecurity landscape, indicating a substantial increase in data breaches during Q3 2023. Malaysia has been identified as the eighth most breached country globally, with a staggering 494,699 leaked user accounts. The severity of the situation is underscored by a remarkable 144% surge in the breach rate compared to Q2 2023, translating to an unsettling average of four Malaysian user accounts leaked every minute during Q3 2023. A critical concern is the breach density, where Malaysia ranks fifth globally, with approximately 5,436 accounts breached per day. This statistic paints a disconcerting picture of the cybersecurity landscape in Malaysia, signifying a heightened risk for individuals and organizations alike [3]. The need for a comprehensive and proactive approach to cybersecurity is evident. Identifying the root causes of these breaches, understanding the vulnerabilities in existing systems, and implementing effective countermeasures are imperative to mitigate the escalating threat landscape.

The current landscape of online learning platforms faces a pervasive challenge transcending specific disciplines a deficiency in hands-on training opportunities and an absence of an interactive approach. Traditional online resources continue to prioritize theoretical content, leaving learners across diverse domains without the essential hands-on experience crucial for practical skill development. The preliminary study shows there are three main challenges among students and educators during the pandemic in relation to online learning: a lack of interactive content, a lack of appropriate resources, and a lack of professional development opportunities [1]. The reliance on static content, irrespective of the subject matter, limits learner engagement and hampers the effectiveness of knowledge retention and application. The evolution of online learning platforms into general educational spaces has yet to address these foundational challenges, impeding the holistic development of learners and hindering their ability to translate theoretical understanding into practical proficiency across diverse disciplines.

Web-based administrative dashboards have become a viable technique to enhance the administration and delivery of web-based interventions, in addition to web-based programs. This includes several crucial elements, including preserving steady website performance, guaranteeing security, controlling user access and permissions, and updating information. Despite the utility and use of administrative dashboards, there are no research studies exploring the user experience of an administrative dashboard related to web-based behavioural interventions. Thus, there is an opportunity for further research to optimize existing functionalities and address limitations to better support administrative dashboard users [8]. Without comprehensive support, these tasks can become overwhelming, leading to potential downtime, security vulnerabilities, outdated information, and suboptimal user experiences. Thus, there is a pressing need for a dedicated solution to assist the administrator in effectively managing and monitoring the system website, ensuring its smooth operation and alignment with organizational objectives.



### **1.3. Motivation**

The motivation behind crafting this platform is underpinned by a resolute commitment to redefine education in the aftermath of the COVID-19 era, where online learning has seamlessly integrated into the fabric of our educational landscape. With a notable surge in the preference for online learning due to its inherent convenience and flexibility, our platform aspires to capitalize on this shift and transcend traditional educational paradigms. Importantly, we are driven by the imperative to instill confidence in learners by prioritizing the security of their data. The following basic security aspects should be met for e-learning platforms: authenticity, access control, confidentiality, integrity, availability, non-repudiation [4]. By making the platform a secure haven for personal and academic information, we aim to establish an environment where users can focus wholeheartedly on their educational journey, unburdened by concerns about the safety of their data. This commitment to both innovation and security lies at the heart of our motivation to create an online learning platform that is not only convenient and dynamic but also steadfastly protective of user trust and privacy.

### **1.4. SDG Alignment**

The NetEducation platform aligns with the United Nations' Sustainable Development Goal 4 (SDG 4), which aims to ensure inclusive and equitable quality education and promote lifelong learning opportunities for all, particularly within the Malaysian context. Education in Malaysia still predominantly relies on traditional methods, creating a gap that NetEducation seeks to bridge by implementing ICT to elevate the learning experience. Traditional educational methods often limit access to resources and personalized learning experiences, especially in rural and underserved areas. By leveraging digital tools and online learning environments, NetEducation enhances access to a wide range of educational materials and interactive content, making learning more engaging and effective. This integration of technology facilitates flexible learning schedules, allows for real-time feedback, and provides opportunities for collaborative learning, thereby transforming the educational landscape in Malaysia. Through these innovations, NetEducation ensures that students receive a modern, high-quality education that equips them with the necessary skills for the future, bridging the gap between traditional education and the demands of the digital age.

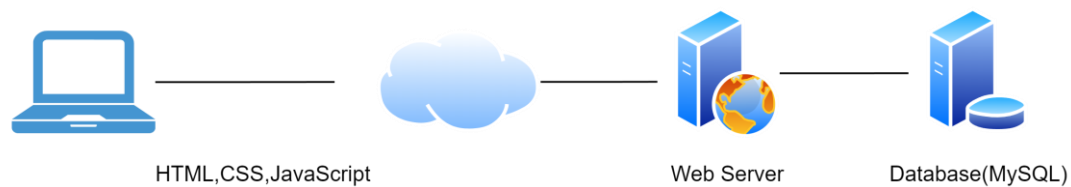
## 1.5. System Objectives

The objective of this project are:

- To propose a secure centralise and stop center for learning websites by implementing security features.
- To propose a structured learning activities that offer theory and practical knowledge.
- To assist the administrator in managing and monitoring the system website.

## 1.6. Proposed Solutions

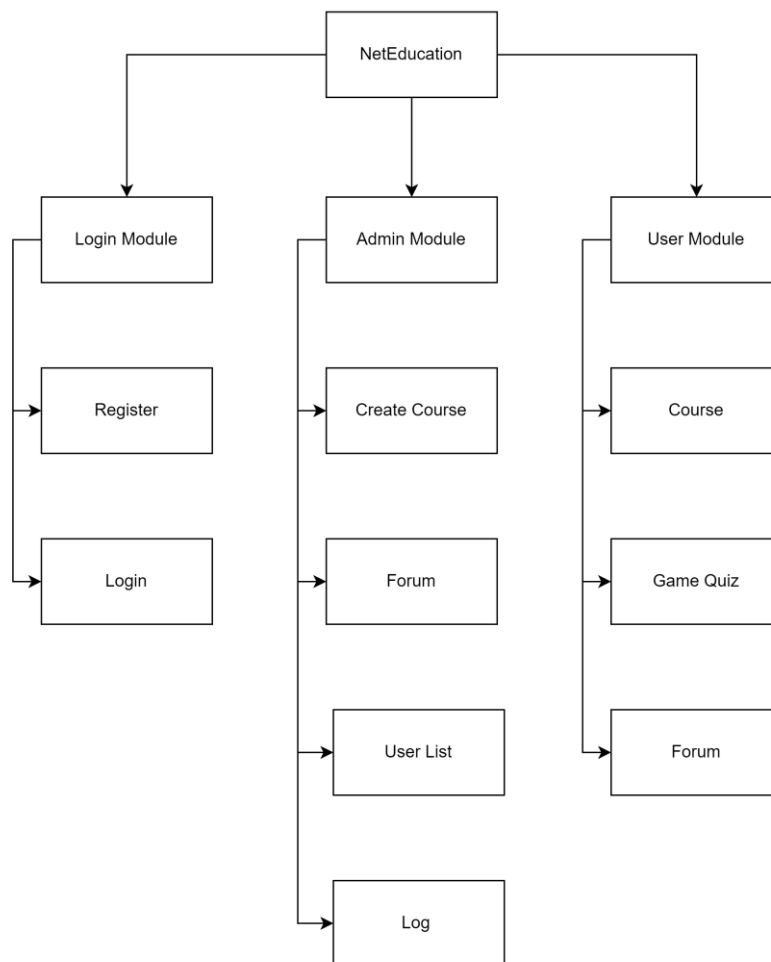
### 1.5.1 System Architecture

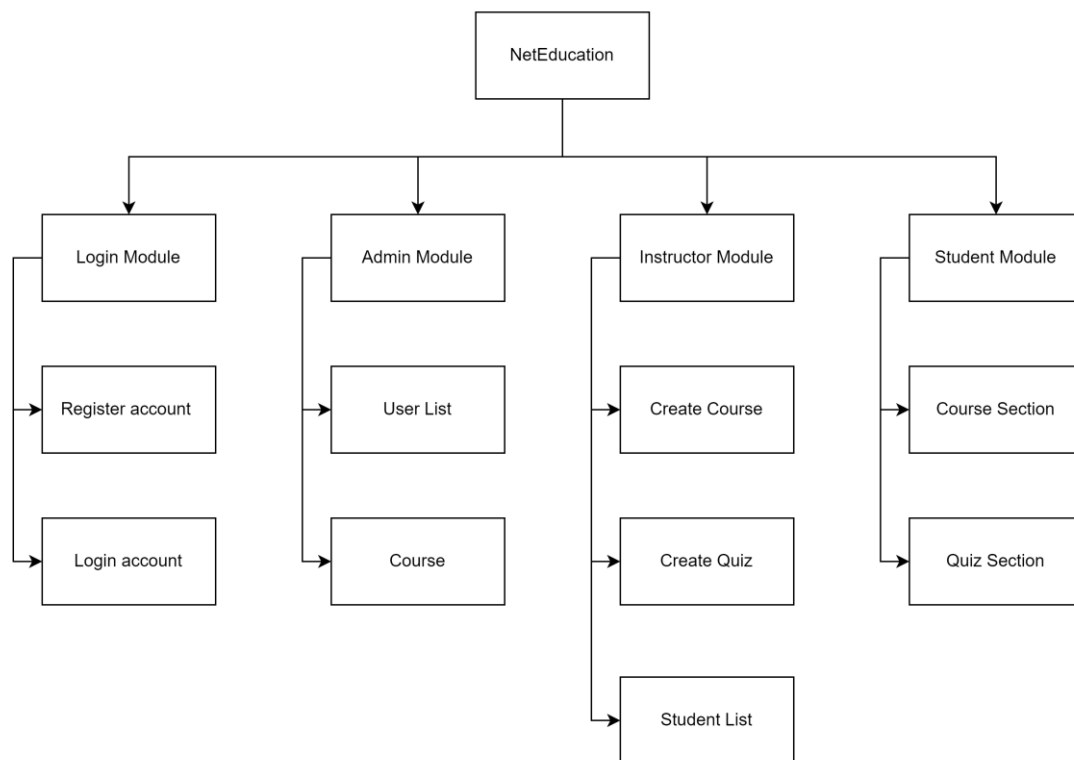


**Figure 1.6-1: System Architecture**

The figures above show the detailed architecture diagram of the NetEducation project. This project consist of one platform which is a web application used by system admin, instructor, and students. The front-end web application is built by using HTML, CSS, and JavaScript with the Laravel framework. For the back end, this web application use PHP programming language that is connected to the front end and the database. For the database, this web application use MySQL for the storage of information.

### 1.5.2 Module Diagram



**Figure 1.6-2: Module Diagram**

NetEducation consists of three major modules which are Login Module, Admin Module, and User Module.

The web application's login module combines two essential features: user login and account registration. The first step for anyone looking to use the platform's services is to register for an account. Users access the registration page and enter personal data, including a distinct username, email address, and strong password. After submission, the system verifies the data entered, making sure that certain requirements—like having a strong password and a distinct username—are met. Additionally, a two-factor authentication procedure will be used to verify the account. Data that has been successfully validated is safely kept in the system's database, creating a new user profile on the platform. After registering, users can go to the login page to continue accessing the resources and features of the application.

The admin module within the web application plays a pivotal role in user management, offering administrators the functionalities to add, delete, and view user accounts.

Administrators use a dedicated panel to add user accounts, entering important information like a distinct username, email address, and strong password. It is possible to specify additional attributes, like user roles, which results in the creation of a new account that is safely kept in the system database. When necessary, administrators can quickly and effectively delete user profiles using the deletion function, keeping the user database safe and current. In addition, viewing user accounts gives administrators a thorough overview that includes usernames, email addresses, and pertinent roles or permissions, improving their ability to manage users within the web application. Administrators can also add or delete courses that users have created. Additionally, the admin module includes forum management features, allowing administrators to oversee discussion forums, moderate content, and manage user participation to ensure a safe and productive environment for all users.

The user module allows individuals to create quizzes, upload files and create courses. Users use a specialized interface to input subject title, description and other relevant course information during the course creation process, ensuring robust security measures for file uploads to meet predefined standards and reduce potential threats. Users can browse available courses, access detailed course information, enrol in courses, and take quizzes, receiving immediate feedback on their performance. Additionally, the module includes forum features that allow users to engage in discussions, ask questions, and share insights related to their courses. By participating in forum threads, posting new topics, and replying to existing discussions, users can enhance interaction and knowledge sharing, fostering a comprehensive and engaging learning environment.

## **1.7. Benefits and Uniqueness of the Proposed Solutions**

The proposed solutions not only redefine the learning experience but also prioritize the critical element of security, further distinguishing the platform in the crowded online education landscape. In recognizing the heightened importance of safeguarding user data, the platform has implemented robust security measures, including Two-Factor Authentication (2FA), Log and File upload verification. This commitment to security ensures that users can engage in the learning process with confidence, knowing that their personal information is safeguarded against unauthorized access and potential cyber threats. The seamless integration of innovative teaching methods with a steadfast focus on security elevates the platform's uniqueness, offering a comprehensive and secure online learning environment that is at the forefront of educational technology. This dual commitment to transformative learning and user data protection underscores the platform's dedication to providing a cutting-edge and trustworthy educational experience for learners across diverse disciplines.

The integration of a built-in styled console provides users with an immersive hands-on experience, seamlessly bridging theoretical knowledge with practical skills, establishing the platform as a leader in comprehensive network technology understanding. Users do not need to download another software to learn the practical part. Adding to its uniqueness is the infusion of interactive elements like games and quizzes, transforming the learning journey into an engaging and enjoyable experience. Users actively participate, reinforcing complex concepts effectively.

## 1.8. Organization of the Report

Chapter 1 is basically describing the Introduction of proposed solution which is NetEducation: Secure Interactive Learning Platform. Besides, the problems within projects have also been discussed in chapter 1. The motivation for initiating this project and the objectives of it have been clearly stated with the benefits and uniqueness of the proposed solution.

Chapter 2 is the Background and Related work have been discussed with analysis of their strengths, weaknesses complying with security components, functionalities, especially encryption and decryption methods that have been implemented. In addition to that, few enhancements have been proposed to the solution to overcome the weaknesses of existing systems.

Chapter 3 is the System Requirement and Analysis which includes the system requirements, analysis of the project. It also includes the project scope, planning, methodology used, system capabilities and limitations.

Chapter 4 is the Design System and Implementation which includes the Design Modeling components such as the architecture diagram, detailed sequence diagram, algorithms, and pseudocodes. It also includes the user interface diagram about how each GUI is interacted by user. This chapter mainly describes the detailed of the implementation flow or data flow extend from the Chapter 3 aspects.

Chapter 5 is the System Testing and Evaluation. The section mainly describes the testing scenarios and strategies being used throughout the development of the project. All the scenarios and test case raised are in the “PASSED” status before distributing towards to the public usage.

Chapter 6 is the Conclusion that summarizes the overall report and highlights the future works.

## **2 BACKGROUND & RELATED WORK**

### **2.1. Introduction**

The digital era has witnessed a paradigm shift in education, with learners and educators alike seeking versatile, interactive, and secure online environments. As the demand for such platforms grows, understanding the strengths and limitations of existing systems becomes crucial for advancing the field. This section will explain about the background of online learning platforms and explore related works, with a specific focus on comparing three relevant systems with our proposed system, NetEducation which is a new project.

### **2.2. Related System**

This section will review three relevant systems such as e-LATiH, EDUKATE and gurupanda. Several online learning platforms have emerged to address the diverse needs of users, each with its unique features and approaches. In this comparative exploration, we analyze three prominent systems, considering factors such as user authentication, course management, interactivity, and security measures. By evaluating these systems, we aim to glean insights into their respective strengths and identify areas for improvement, contributing to the ongoing discourse on optimizing online learning experiences.



### 2.2.1. System A: e-LATiH

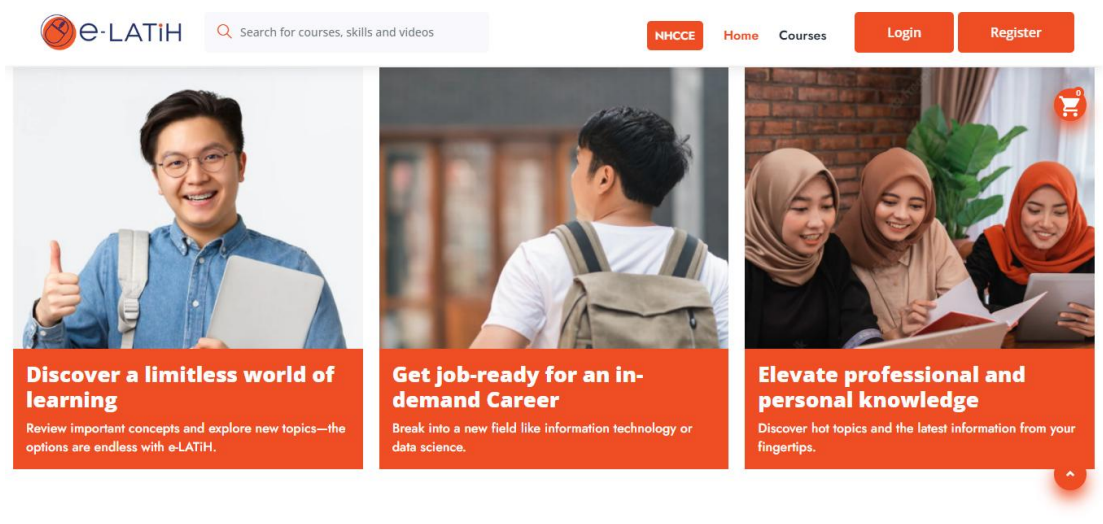
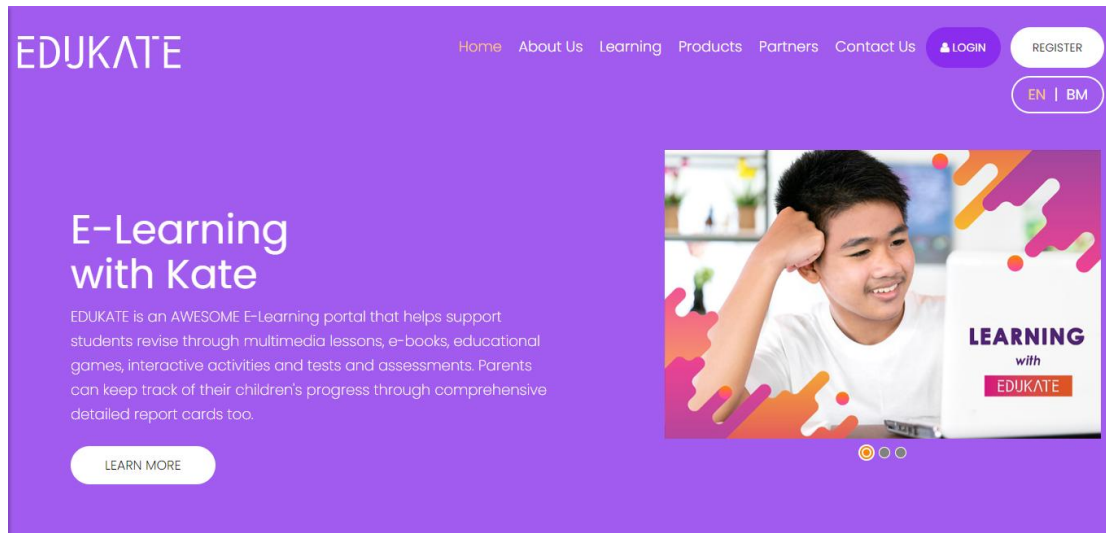


Figure 2.2-0-1: e-LATiH Main Page

e-LATiH is Malaysia's premier online learning platform developed by Human Resource Development Corporation (HRD Corp) to provide Malaysians with the opportunity to develop their skills and knowledge [5]. They provide courses in Leadership, Marketing, Financial, Digital Technologies and more. The platform offers a range of free courses as a starting point, allowing users to initiate their learning journey without any upfront fees. As users progress, they have the option to access premium content from renowned partners and collaborators, representing some of the world's leading educational resources. The flexibility provided by e-LATiH is highlighted, granting learners the autonomy to choose when, where, and how they engage with the educational material. This adaptability accommodates diverse schedules and learning preferences, making it convenient for individuals to integrate learning into their daily lives.

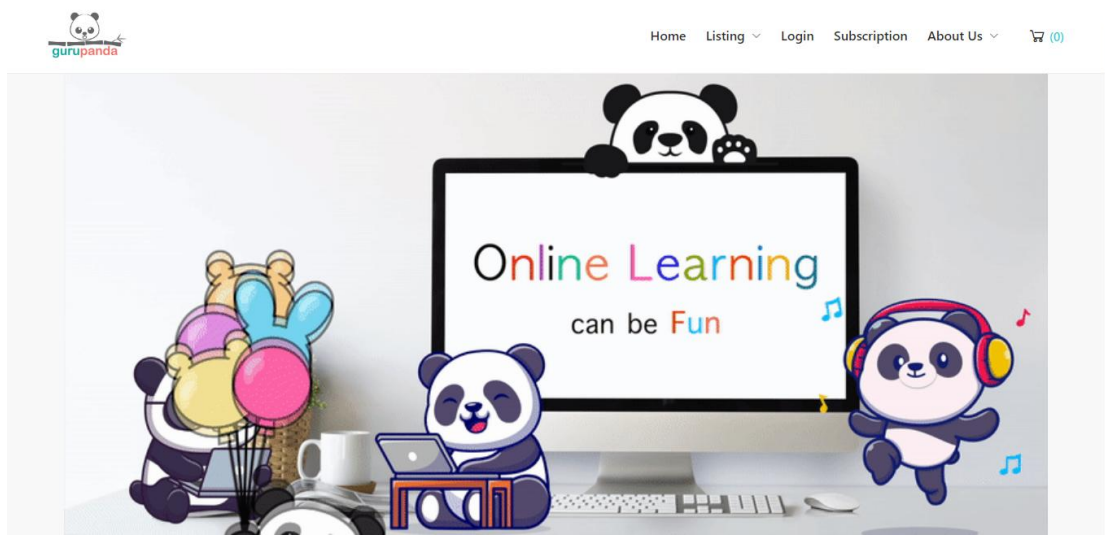
### 2.2.2. System B: EDUKATE



**Figure 2.2-0-2: EDUKATE Main page**

EDUKATE is a E-Learning technology platform that helps support students' learning of Math, Science and English. Their portal offers a comprehensive educational experience, featuring a pre-test tool to assist parents in evaluating their child's current grasp of subjects. The platform encompasses multimedia lessons that cover every topic in the national syllabus, providing a thorough educational resource [6]. Furthermore, e-books are accessible for all subjects, offering supplementary learning materials. To enhance the enjoyment of learning, the portal integrates educational games directly tied to the topics under study, seamlessly blending fun and education for a captivating learning experience.

### 2.2.3. System C: gurupanda



**Figure 2.2-0-3: gurupanda Main Page**

gurupanda stands as Malaysia's premier E-Learning platform. The platform not only connects students with the best study materials but also serves as a gateway for young minds to achieve their goals and pursue their dreams. gurupanda proactive approach is evident in its commitment to helping students prepare for various examinations, including UPSR, PT3, and more [7]. The platform's curated collection comprises top-rated study materials, quizzes, and animated videos, empowering students, schools, and teachers alike. This dynamic resource provides the knowledge and experience necessary to navigate and succeed in examinations, solidifying gurupanda reputation as a leading force in the educational landscape.

## 2.3. Summary of Related Systems

**Table 2.3-1: Comparison of Related Systems**

Features	e-LATiH	EDUKATE	gurupanda	NetEducation
2FA authentication				✓
DDoS protection/WAF	✓	✓	✓	✓
File upload verification				✓
Interactive quiz		✓	✓	✓
Interactive course	✓	✓	✓	✓
Course Management	✓			✓

E-LATiH boasts several advantages, including robust defenses against cyber threats with DDoS protection and a Web Application Firewall (WAF), ensuring the platform's stability and security. The interactive course features enhance user engagement and provide an enriched learning experience, while the integrated course management system facilitates efficient organization and administration of educational content. However, notable disadvantages include the absence of Two-Factor Authentication (2FA), potentially impacting user account security. Additionally, the platform lacks specific security measures such as file upload security verification, which could leave user-uploaded content vulnerable. The absence of interactive quizzes diminishes the platform's potential for real-time assessment and feedback, limiting its effectiveness in evaluating student comprehension and engagement.

EDUKATE presents several advantages, including robust defenses against cyber threats such as DDoS attacks with implemented DDoS protection and a Web Application Firewall (WAF). The incorporation of interactive courses and quizzes enhances the learning experience, promoting engagement and knowledge retention. However, notable disadvantages include the absence of Two-Factor Authentication (2FA), which may compromise user account security, and the lack of file upload security verification, potentially exposing the platform to security vulnerabilities related to uploaded files. Additionally, the platform lacks a comprehensive course management system, limiting the instructor capabilities for organizing educational content.

gurupanda presents several advantages, including robust defenses against cyber threats with features like DDoS protection and Web Application Firewall (WAF), ensuring the platform's stability and security. The incorporation of interactive courses and quizzes enhances the overall learning experience, providing engaging and dynamic educational content for users. However, gurupanda currently lacks certain security measures such as Two-Factor Authentication (2FA) and file upload security verification, potentially leaving user accounts and uploaded content susceptible to unauthorized access or malicious uploads. Additionally, the absence of a comprehensive course management system may limit the instructor's capabilities.

## **2.4. Brief Introduction of the Proposed Work**

When it comes to online learning platforms, NetEducation is a model to follow, offering an extensive range of benefits. A secure learning environment is ensured by the platform's strong security features, which fortify user accounts and guard against cyber threats. These features include file upload security verification, DDoS protection, and Two-Factor Authentication (2FA). Additionally, NetEducation sets itself apart by offering learners dynamic and captivating educational content through interactive courses and quizzes. The platform provides instructors with the necessary tools for efficient organization, oversight, and modification of instructional materials, including effective course management. With its all-encompassing strategy, NetEducation is positioned as a solution that prioritizes user security while also improving the overall learning process with interactive features and extensive course management capabilities.

### **3 SYSTEM REQUIREMENTS / ANALYSIS**

#### **3.1. Project Scope**

The project scope for NetEducation is defined by its three key modules, each catering to specific user roles and contributing to a comprehensive online learning experience. The Login Module focuses on providing a secure and user-friendly authentication process, incorporating features such as user login, account registration with Two-Factor Authentication (2FA), and robust data validation. The Admin Module empowers administrators with efficient user and course management tools, including the ability to add, delete, and view user accounts through a dedicated admin panel. The User Module facilitates course creation and management, allowing to input course details, securely share materials via file uploads with verification. Also it enhances the learning journey by providing a user-friendly interface for browsing courses, seamless enrollment, and active participation in quizzes. Collectively, these modules define the extensive scope of NetEducation, aiming to deliver a secure, user-centric, and interactive online learning platform.

#### **3.2. System Capabilities**

This project is expected to provide the following functionalities:

1. Authentication and User Management
2. Admin panel
3. Course Creation and Management
4. View User List
5. File Upload Security and Verification
6. Interactive Learning Features
7. Forum

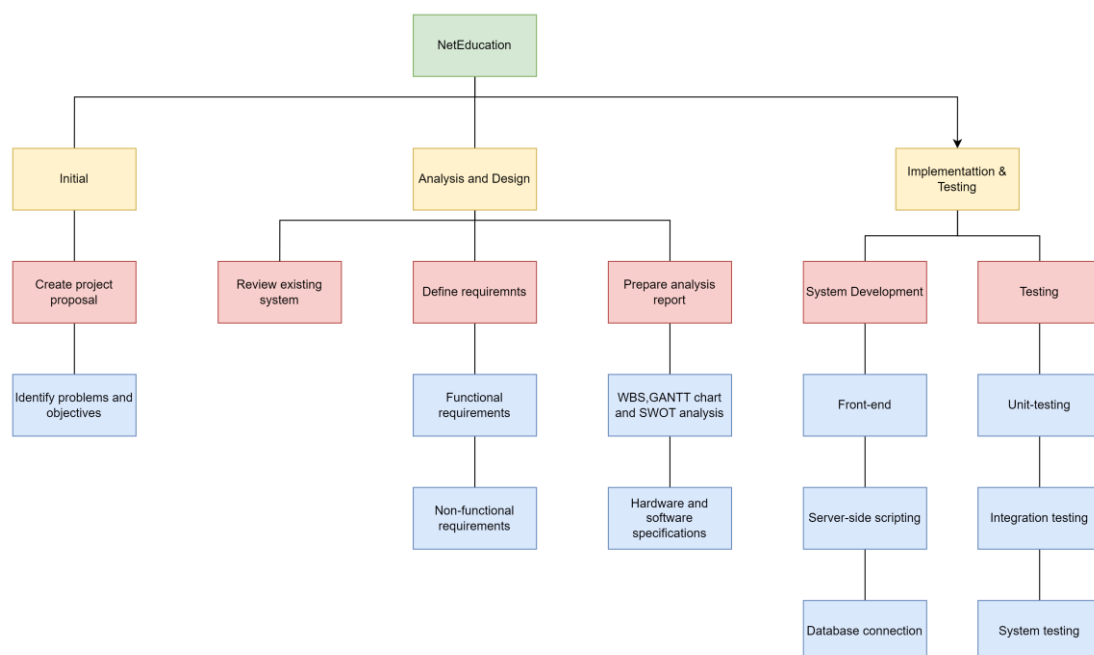
### 3.3. System Limitations

NetEducation has some limitations. The platform's responsiveness and effectiveness are contingent on users having stable internet connectivity. Additionally, while the system prioritizes security with features like Two-Factor Authentication (2FA) and file upload security verification, it is not entirely immune to evolving cybersecurity threats. Also, 2FA login makes the user take more time to access the website. Furthermore, the platform's performance may vary across different devices, and users may encounter compatibility issues on certain browsers or operating systems and does not support mobile apps.

### 3.4. Project Management

#### 3.4.1. Work Breakdown Structure (WBS)

A Work Breakdown Structure (WBS) is a hierarchical decomposition of a project into smaller, more manageable components. It systematically breaks down the entire scope of work into individual tasks or deliverables, providing a clear and organized view of the project's structure.

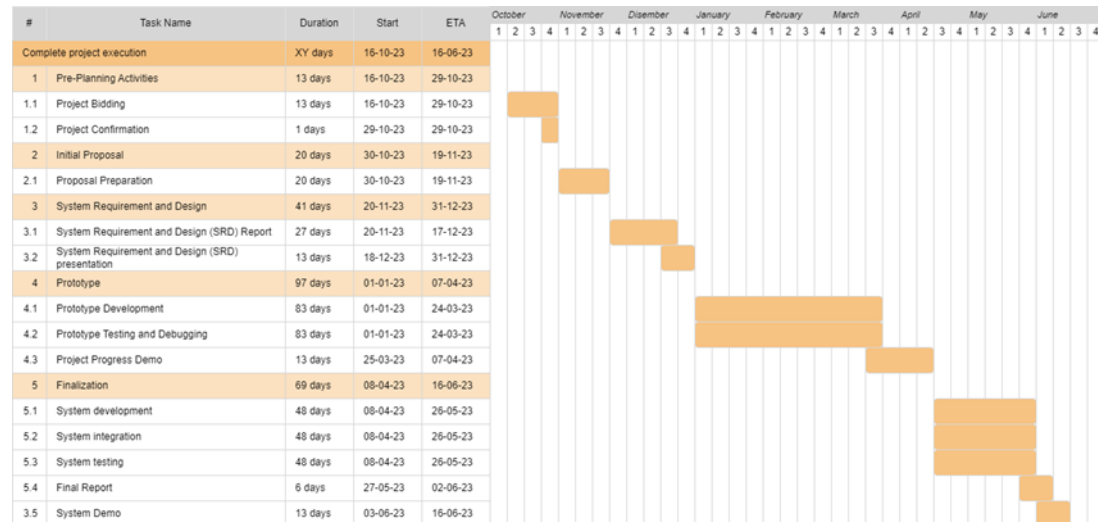


**Figure 3.4-1: Work breakdown structure (WBS)**



### 3.4.2. Gantt Chart

A Gantt Chart is a visual representation of a project schedule that illustrates the start and finish dates of various project elements or tasks.



**Figure 3.4-2: Gantt Chart**

### 3.4.3. Swot Analysis

SWOT analysis is a strategic planning tool that helps organizations assess their internal strengths and weaknesses, as well as external opportunities and threats. The acronym SWOT stands for Strengths, Weaknesses, Opportunities, and Threats.

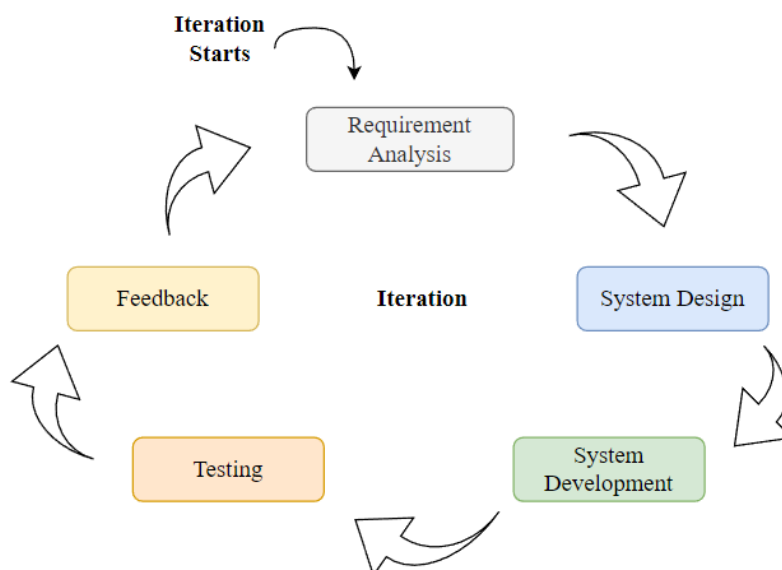
**Table 3.4-1: SWOT Analysis**

Strength	Weakness
<ul style="list-style-type: none"> <li>The inclusion of interactive resources, such as games and quizzes, enhances user engagement and reinforces networking concepts in an enjoyable manner.</li> <li>Robust security features, including Two-Factor Authentication (2FA) and DDoS protection, instill confidence in users regarding the privacy and integrity of their data.</li> </ul>	<ul style="list-style-type: none"> <li>Being solely web-based may pose a limitation for users because user cannot use it as mobile app.</li> <li>Users in areas with limited internet connectivity may face challenges accessing the website</li> </ul>
Opportunities	Threats
<ul style="list-style-type: none"> <li>Security components implemented here are adapted to the latest technology.</li> <li>Collaboration with industry-recognized certification programs can enhance the platform's credibility</li> </ul>	<ul style="list-style-type: none"> <li>Despite robust security measures, evolving cybersecurity threats pose an instructing risk to user data and platform integrity.</li> <li>Intense competition from other online learning platforms could impact user retention.</li> </ul>

### 3.5. Development Methodology

Throughout this project, agile methodology is practiced from the beginning to the end of the development. This approach is suitable to be used as it requires iterations of revising and modification which is similar to the customer interactions where in this case it is the interactions from supervisor and examiner. Feedbacks and suggestion will be provided from each stage which are the resources to improve the system gradually from time to time. By using agile development, tasks are divided into few categories within iterations and each iteration will revise and enhance previous development and try to improve and increase usability and functionalities of features until the system fully utilize the requirement of customers.

Apart from agile approach, adaptive approach is used during the development of project. As the requirements change for the improvements, current system design might have difficulty on synchronizing modification technically, there is a need of adapting incoming changing. Hence, dynamic changing, and continual planning are required from time to time to ensure all the requirements needed are well fit into the system by alternative ways or methods.



**Figure 3.5-1: Activities Performed in Agile Methodology**

### 3.6. Analysis of Proposed Solution/Project

#### 3.6.1. Functional Requirements

Functional requirements define the specific features and functionalities that a system must possess to meet the needs of its users. These requirements detail what the system should do and how it should perform various tasks.

**Table 3.6-1: Functional Requirements**

Functional	Requirement
User Authentication	<ul style="list-style-type: none"> <li>Users (students, teachers, and administrators) should be able to create accounts and log in securely using a username and password.</li> </ul>
Security Features	<ul style="list-style-type: none"> <li>Implement Two-Factor Authentication (2FA) to enhance user account security.</li> <li>Integrate Distributed Denial of Service (DDoS) protection measures to safeguard the platform against cyber threats.</li> <li>File verification to verify file upload.</li> <li>Log audit</li> </ul>
Create course	<ul style="list-style-type: none"> <li>Provide admin and user with tools to manage study materials</li> </ul>
View materials	<ul style="list-style-type: none"> <li>The platform must feature a centralized place for study materials, including documents, presentations, and multimedia resources.</li> </ul>
View quiz	<ul style="list-style-type: none"> <li>Implement interactive resources such as quizzes to engage users actively and reinforce learning.</li> </ul>
Forum	<ul style="list-style-type: none"> <li>Provide user to discuss in the platform</li> </ul>
Manage user	<ul style="list-style-type: none"> <li>Provide admin to add and delete user</li> </ul>

### 3.6.2. Non-Functional Requirements

Non-functional requirements represent aspects of a system that are not related to specific behaviors or features but are critical for the system's overall effectiveness, usability, and performance.

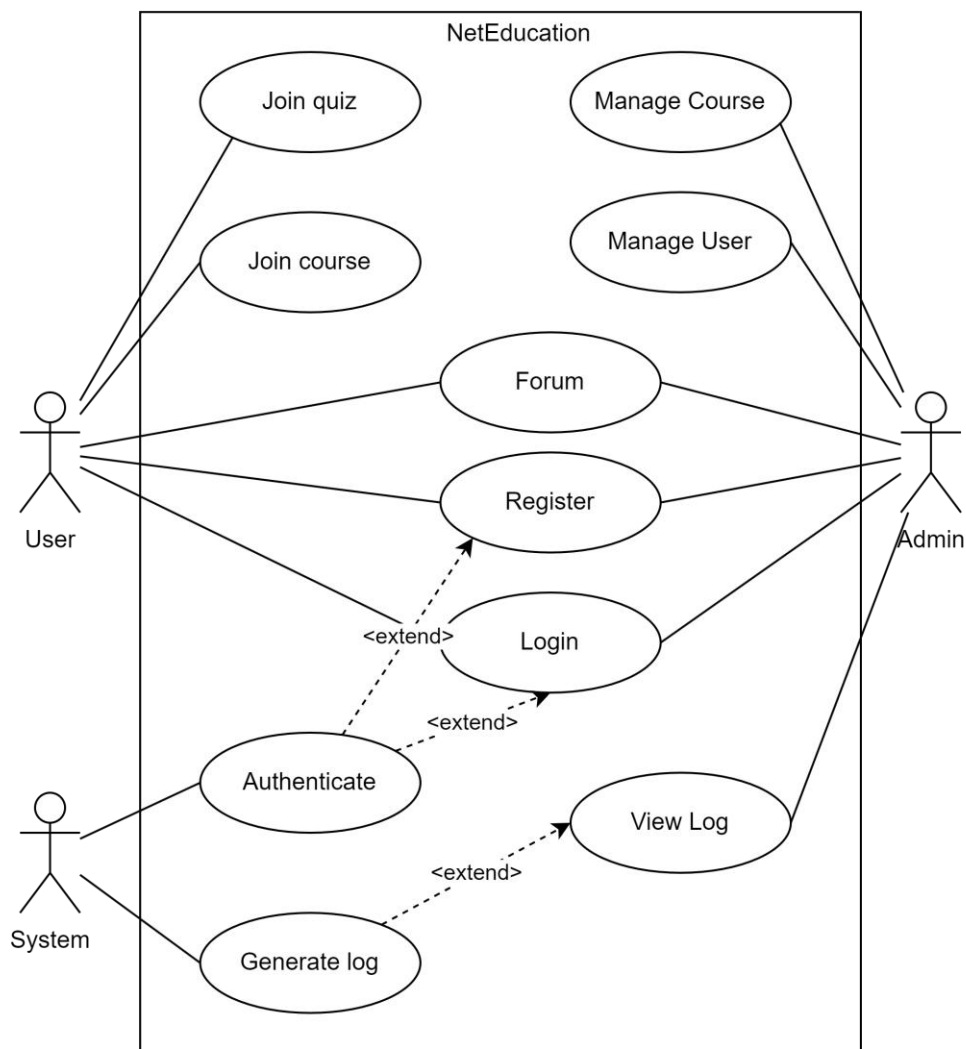
**Table 3.6-2: Non-Functional Requirements**

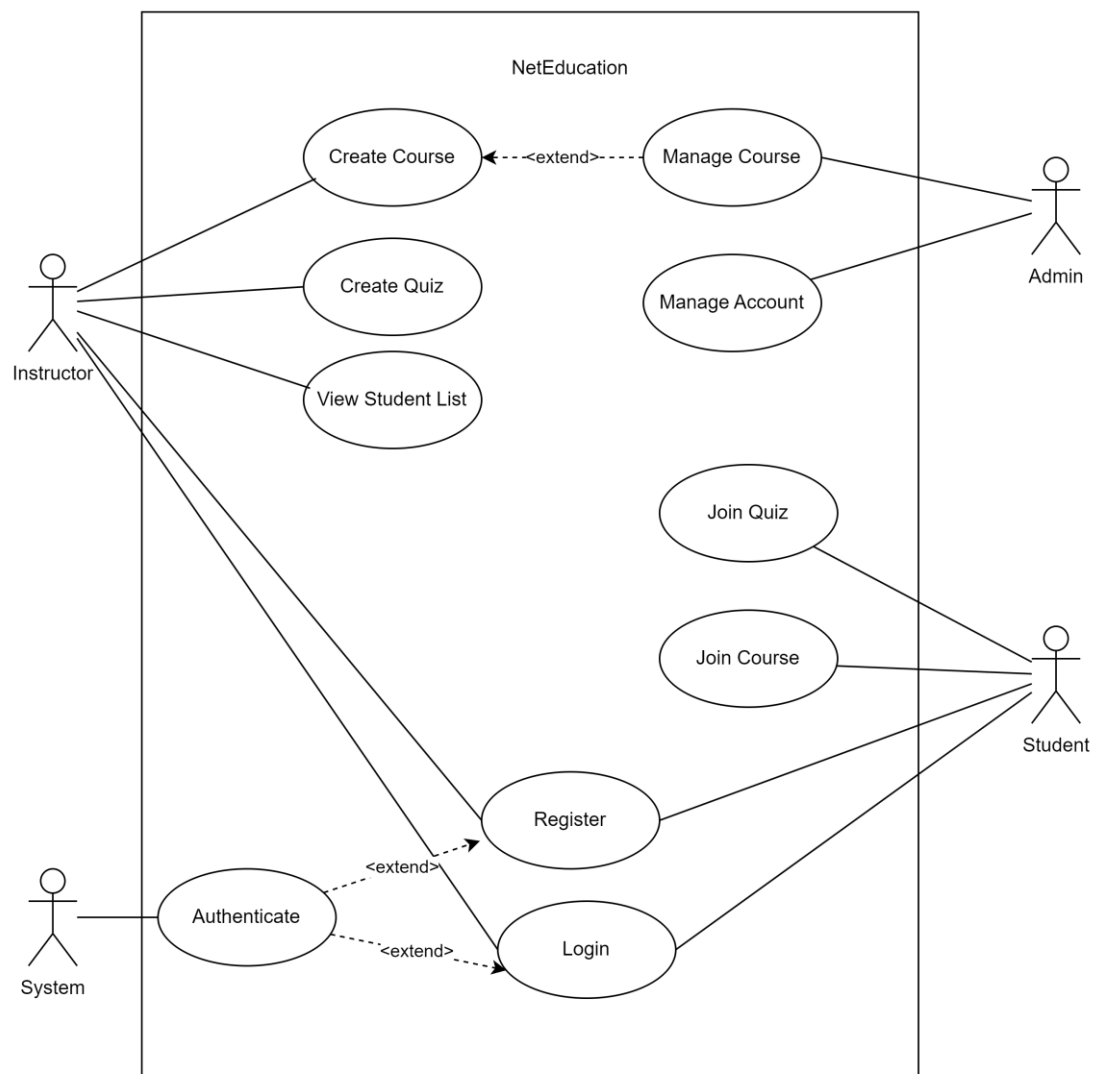
Non-Functional	Requirement
Performance	The system should perform efficiently, with quick response times for user interactions and minimal latency.
Security	The system must adhere to security best practices to protect user data and ensure a secure authentication process.
Usability	The system should provide a user-friendly interface, ensuring ease of use for both organizers and attendees.
Reliability	The system must be reliable, with minimal downtime and robust mechanisms for data backup and recovery.
Scalability	The system should be scalable to accommodate a growing number of users.

### 3.7. UML/ Design diagram

#### 3.7.1. Use Case Diagram

A use case diagram is a visual representation in Unified Modeling Language (UML) that illustrates the interactions between different actors and the various use cases or functionalities of a system.



**Figure 3.7-1: Use Case Diagram**

### 3.7.2 Use Case Description

A use case description provides a detailed narrative of how a particular functionality or feature within a system will be utilized by actors (users or external systems). It typically includes a step-by-step walkthrough of the interactions between the user (or external system) and the system itself.

**Table 3.7-1: Use Case Description of Register Account**

Use case name:	Register account	
Scenario:	Create a new account for new User	
Triggering event:	A User wants to use the application	
Brief description:	User must input their Username and password needed by the system to create a new account.	
Actors:	User	
Related use cases:	-	
Stakeholders:	User	
Preconditions:	User must be new and do not have any old account.	
Postconditions:	New User account is created.	
Flow of activities:	Actor	System
	1. User fills in the Username and password in the system.	1. Create a new account for the User. 2. Verify the Username and password.
Exception conditions:	1. User have their existing account.	



**Table 3.7-2: Use Case Description of Login Account**

Use case name:	Login account	
Scenario:	Log in the account using existing account.	
Triggering event:	Users want to log in using their existing account.	
Brief description:	User must input their Username and password.	
Actors:	User	
Related use cases:	-	
Stakeholders:	User	
Preconditions:	User must have their own existing account.	
Postconditions:	User logged in using their existing account.	
Flow of activities:	Actor	System
	1. User fills in the Username and password in the system.	1. Verify the Username and password.
Exception conditions:	1. User have not yet sign up.	

**Table 3.7-3: Use Case Description of Manage Account**

Use case name:	Manage user	
Scenario:	Administrator needs to manage user accounts	
Triggering event:	New users need to be added, existing users need changes, or inactive users need to be removed.	
Brief description:	The administrator accesses the user management page and performs CRUD operations on user accounts.	
Actors:	Administrator	
Related use cases:	-	
Stakeholders:	Administrator	
Preconditions:	Administrator logged in	
Postconditions:	User accounts are created, read, updated, or deleted as needed.	
Flow of activities:	Actor	System
	1 Click add button 2 Click edit button 3 Click delete button	1.1.System display the new user 1.2.System recorded and save to database  2.1.System display the edit user 2.2System recorded and save to database  3.1.System delete the user has been selected 3.2.System display the current user
Exception conditions:	1.1 System cannot manage the user account	

**Table 3.7-4: Use Case Description of Manage Course**

Use case name:	Manage course	
Scenario:	Administrator needs to manage course content	
Triggering event:	New course need to be added, existing course need changes, or certain course need to be deleted	
Brief description:	The administrator accesses the course management page and performs CRUD operations on course content	
Actors:	Administrator	
Related use cases:	-	
Stakeholders:	Administrator	
Preconditions:	Administrator logged in	
Postconditions:	Course content are created, read, updated, or deleted as needed.	
Flow of activities:	Actor	System
	1 Click add button 2 Click edit button 3 Click delete button	1.1 System display the new data 1.2 System recorded and save to database  2.1.System display the edit data 2.2.System recorded and save to database  3.1.System delete the data has been selected 3.2.System display the current user
Exception conditions:	1.1 System cannot manage the course	

**Table 3.7-5: Use Case Description of Create Forum**

Use case name:	Create forum	
Scenario:	Users add the forum content	
Triggering event:	Users publish new forum discussion	
Brief description:	User will enter the content	
Actors:	User	
Related use cases:	-	
Stakeholders:	User	
Preconditions:	User have a new message	
Postconditions:	User add the forum description	
Flow of activities:	Actor	System
	1. User enter the content	1. Store in database. 2. Show the course content
Exception conditions:	1. Lost connection	

**Table 3.7-6: Use Case Description of View Log**

Use case name:	View log	
Scenario:	Admin view log generated by system	
Triggering event:	User activity in system	
Brief description:	Admin click view log	
Actors:	Admin	
Related use cases:	-	
Stakeholders:	Admin	
Preconditions:	User activity occurred in system	
Postconditions:	Admin click view log	
Flow of activities:	Actor	System
	1. Admin click view log	2.Show the log
Exception conditions:	Lost connection	

**Table 3.7-7: Use Case Description of Generate Log**

Use case name:	Generate log	
Scenario:	System generates log audit	
Triggering event:	User activity in system	
Brief description:	System will generate log activity performed by user	
Actors:	System	
Related use cases:	-	
Stakeholders:	System	
Preconditions:	User activity occurred in system	
Postconditions:	System generates log audit	
Flow of activities:	Actor	System
	1. System generates log audit	2. Show the log
Exception conditions:	No activity performed	

**Table 3.7-8: Use Case Description of Join Course**

Use case name:	Join course	
Scenario:	User want to join a course	
Triggering event:	User press the join course button	
Brief description:	User select the join course button in the list course details	
Actors:	User	
Related use cases:	-	
Stakeholders:	User	
Preconditions:	User press the join course button	
Postconditions:	User has join the course	
Flow of activities:	Actor	System
	1.User press join button	1. store in database
Exception conditions:	1. User lost connection	

**Table 3.7-9: Use Case Description of Join Quiz**

Use case name:	Join quiz	
Scenario:	User want to join a quiz	
Triggering event:	User press the join quiz button	
Brief description:	User select the join quiz button in the list quiz details	
Actors:	User	
Related use cases:	-	
Stakeholders:	User	
Preconditions:	User press the join quiz button	
Postconditions:	User has join the quiz	
Flow of activities:	Actor	System
	1.User press join button	1. store in database
Exception conditions:	2. User lost connection	



### 3.7.3 Sequence Diagram

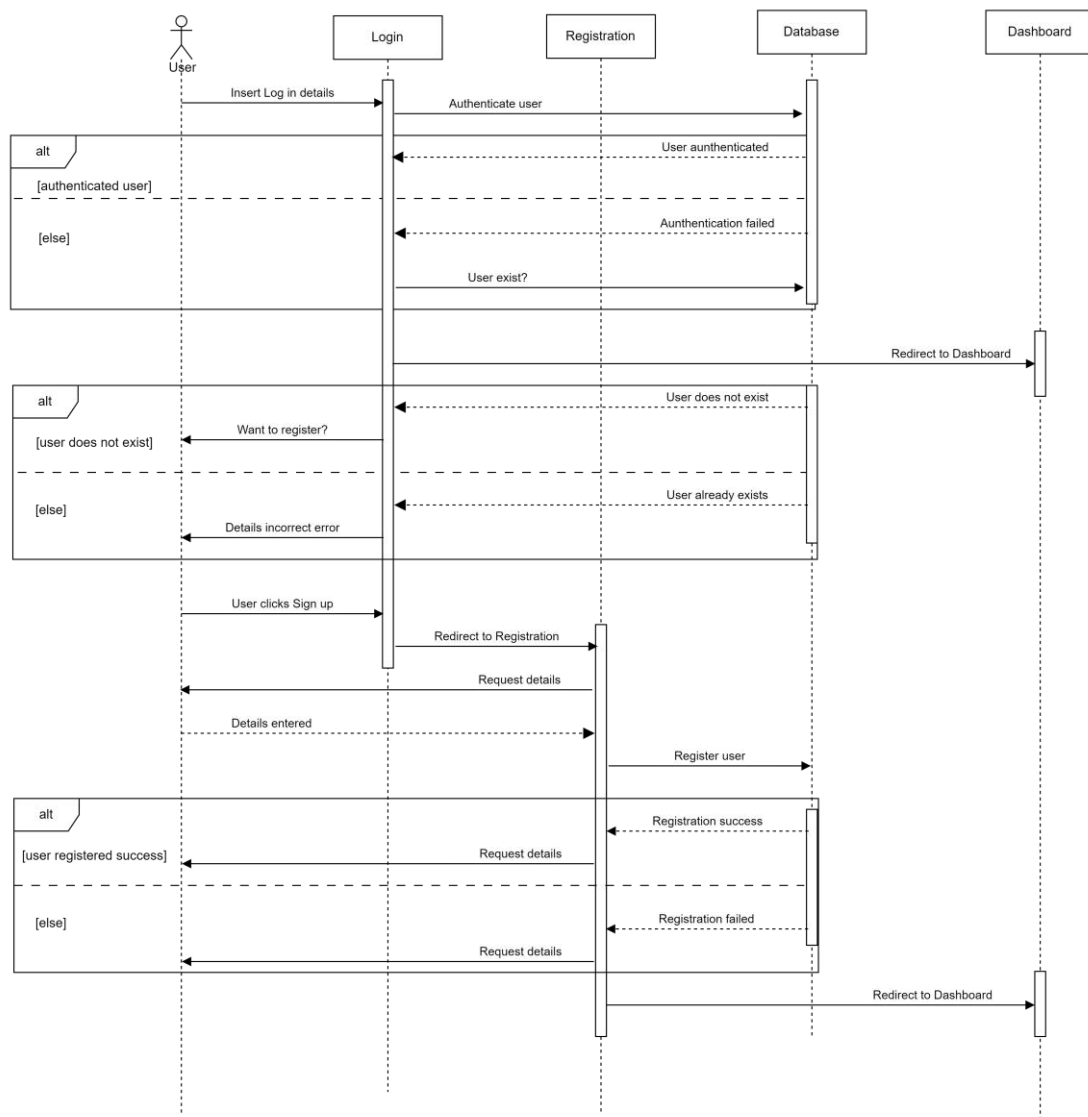
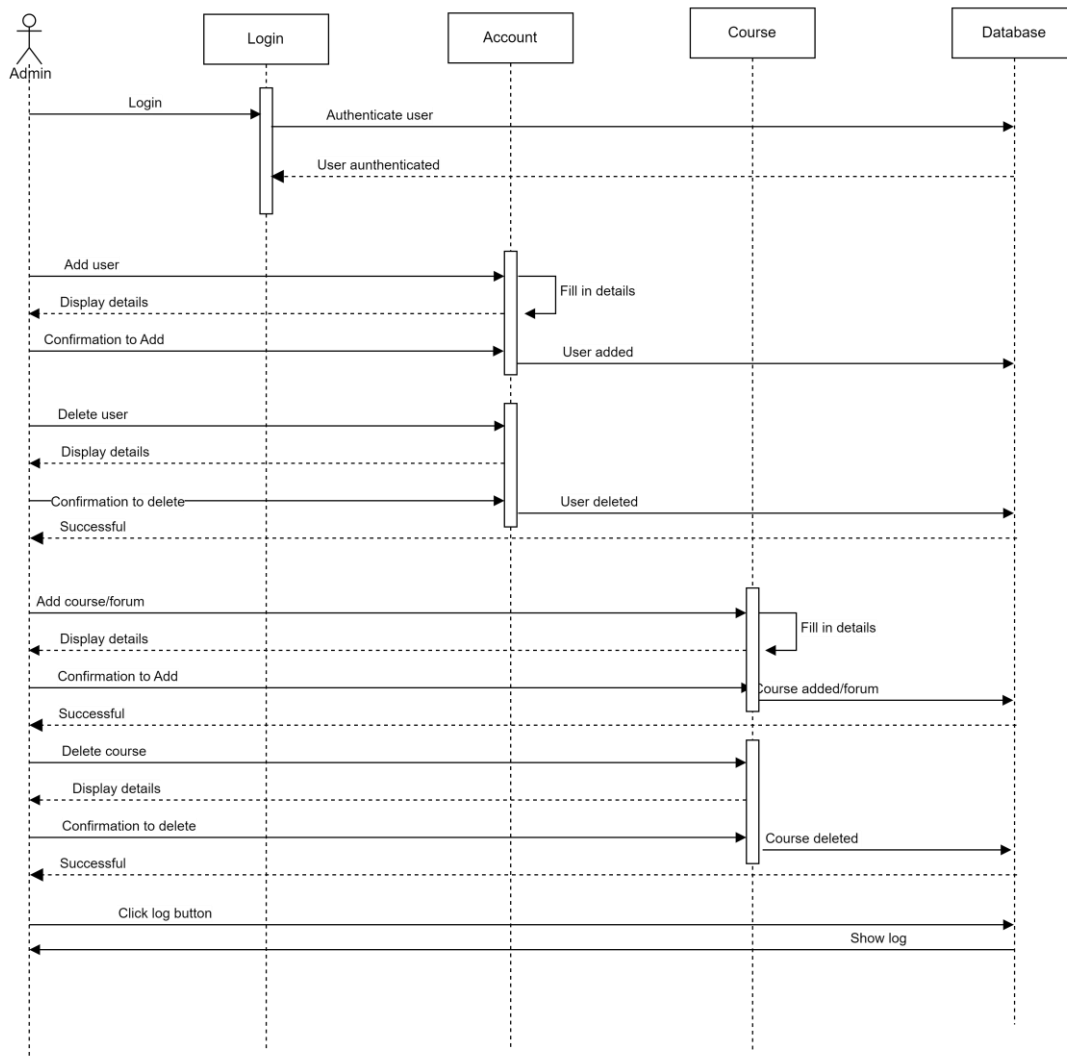


Figure 3.7-2: Sequence Diagram of Login Module

Based on Figure 3.7-2, The login module in NetEducation is designed to provide a secure and user-friendly authentication process. When a user navigates to the login page, they are prompted to enter their login credentials, typically comprising a unique username and a password. Once the user submits their details, the server initiates the authentication process. If the entered details are correct, the server proceeds to the next step, which involves an additional layer of security through Two-Factor Authentication (2FA). In the 2FA process, an OTP (One-Time Password) code is generated and sent to the user's registered email address. The user is then prompted to input this OTP code to complete the authentication. If the OTP code is successfully verified, the user is redirected to their personalized dashboard, granting them access to the platform's features and resources.

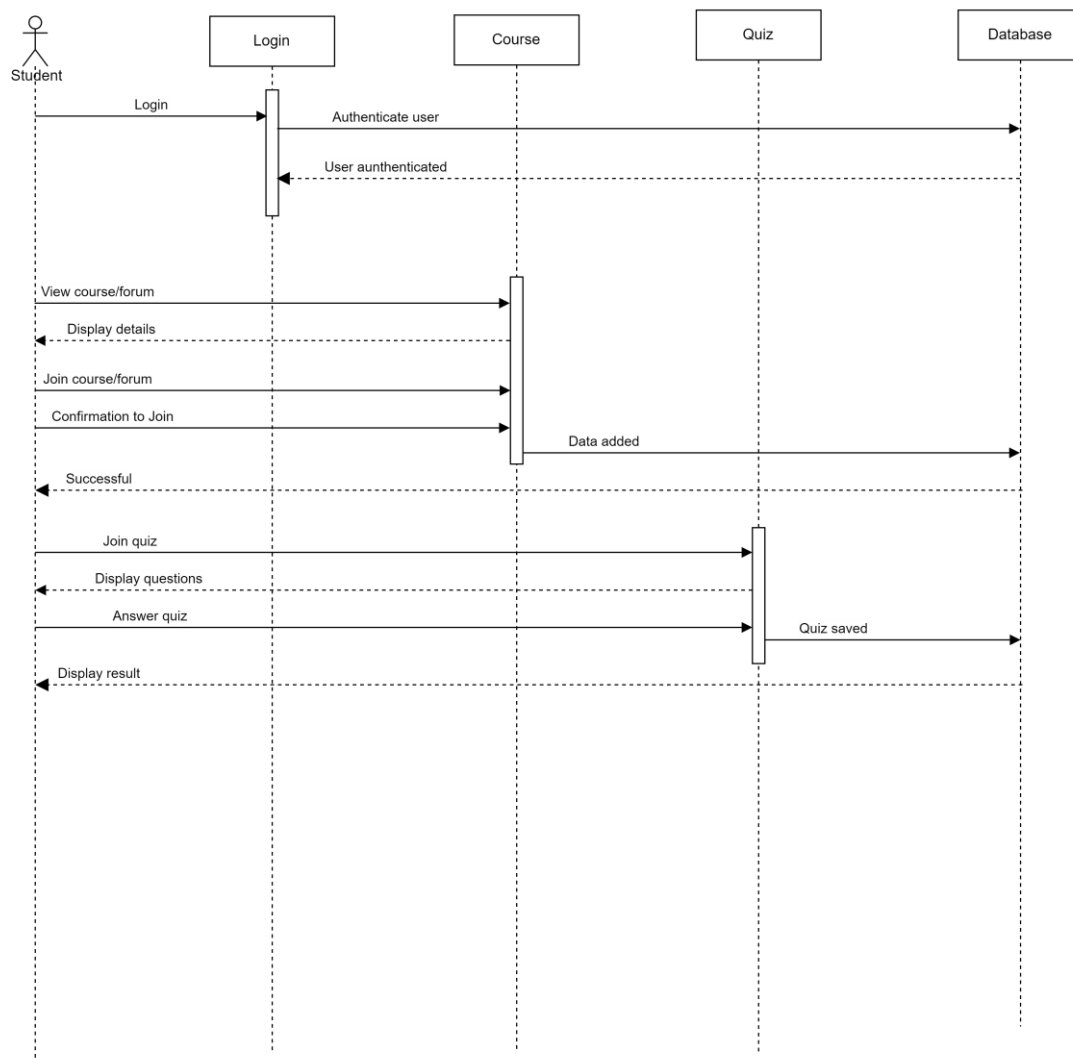
In the event of authentication failure, the system provides clear feedback. The failure could result from various scenarios, such as the user not existing in the system or incorrect login details. To enhance user experience, the system distinguishes between these scenarios and provides appropriate error messages to guide the user in resolving the issue. For users who do not have an existing account and wish to sign up, the process is straightforward. They are directed to a sign-up page where they input their details. If the provided information is accurate and meets the necessary criteria, the user is seamlessly redirected to their dashboard, completing the sign-up process. This multi-step login module ensures a robust and secure authentication mechanism while offering a user-friendly experience for both existing and new users of the NetEducation platform.

**Figure 3.7-3: Sequence Diagram of Admin Module**

Based on Figure 3.7-3, The admin module in NetEducation empowers administrators with comprehensive tools to manage both user accounts and courses, ensuring efficient oversight of the platform. When an administrator accesses the login page and successfully logs in, they are directed to the admin dashboard. Within the "Manage Account" page, administrators can add new users by filling in the required details, such as a unique username, email address, and password. Upon submission, this information is updated in the database, creating a new user account. Administrators also have the authority to delete user accounts, providing a streamlined process for user management. A successful deletion prompts a confirmation message, ensuring clarity and accountability in account management.

In the "Manage Course" page, administrators exercise control over the platform's course offerings. They can add new courses, contributing to the diversity of available learning materials. This ensures that the platform stays dynamic and responsive to evolving educational needs. Additionally, administrators can delete courses, offering a measure of content curation. This deletion capability extends to courses created by instructors or other administrators, providing a centralized control mechanism.

Furthermore, the admin module includes a "View Log Audit" page, where administrators can review detailed records of all actions performed within the system. This feature enhances transparency and accountability by logging actions such as user account modifications and course management activities. Additionally, administrators can access the "Manage Forum" page, where they can oversee discussion forums, moderate content, and manage user interactions. This ensures a healthy and productive online community, promoting active and respectful engagement among users.

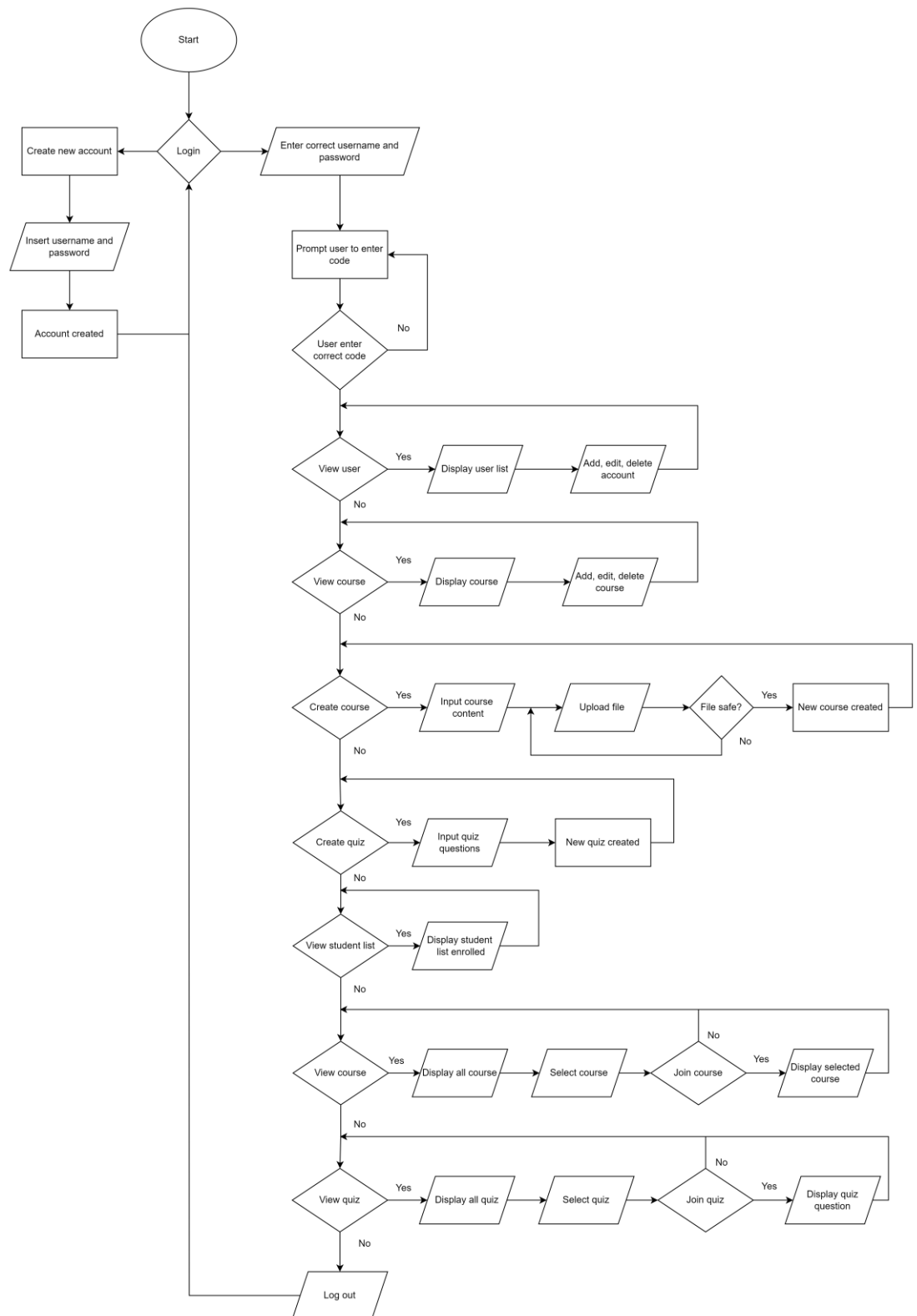
**Figure 3.7-4: Sequence Diagram of Student Module**

Based on Figure 3.7-5, The student module in NetEducation is designed to offer a seamless and interactive learning experience for students. Upon entering the login page and successfully logging in, students are directed to their personalized dashboard. In the "Course" page, students gain access to a comprehensive list of available courses. They have the freedom to explore and choose courses that align with their interests and learning goals. Once a student identifies a course they wish to enroll in, they can join the course, and this enrollment status is securely stored in the database. This feature ensures that students have a record of the courses they are participating in, facilitating easy tracking of their learning journey.

Within each course, students encounter a "Quiz" section, providing an opportunity to assess their understanding of the material. The quiz section comprises questions related to the course content, allowing students to test their comprehension and reinforce their learning. This interactive element enhances the overall learning experience, enabling students to actively engage with the course material and gauge their progress. In summary, the student module focuses on providing students with easy access to courses, allowing them to join and track their enrolled courses. The inclusion of quizzes within each course enhances the learning process by offering a practical assessment tool. NetEducation ensures that students have a user-friendly interface to navigate their courses, fostering a dynamic and engaging online learning environment.

Additionally, the student module includes a "Manage Forum" feature. This allows students to participate in course-related discussion forums, fostering collaboration and peer interaction. In these forums, students can ask questions, share insights, and engage in discussions about the course material. This feature enhances the sense of community and provides an additional layer of support for students as they navigate their learning journey.

### 3.7.4 Flowchart of Overall Diagram



**Figure 3.7-5: Flowchart of Overall Diagram**

The overall flowchart of NetEducation's process begins with the "Login" module. Upon accessing the login page, users, whether administrators, instructors, or students, input their credentials. The system then authenticates the user's details. If the authentication is successful, the user is directed to their respective dashboard based on their role.

For the Admin, after logging in, administrators have access to the admin dashboard. Within the "Manage Account" page, administrators can add new users by providing necessary details, which are then updated in the database. Admins can also delete user accounts, receiving a confirmation prompt upon successful deletion. In the "Manage Course" page, administrators can add new courses, contributing to the platform's content diversity, and delete existing courses. Successful additions or deletions prompt confirmation messages.

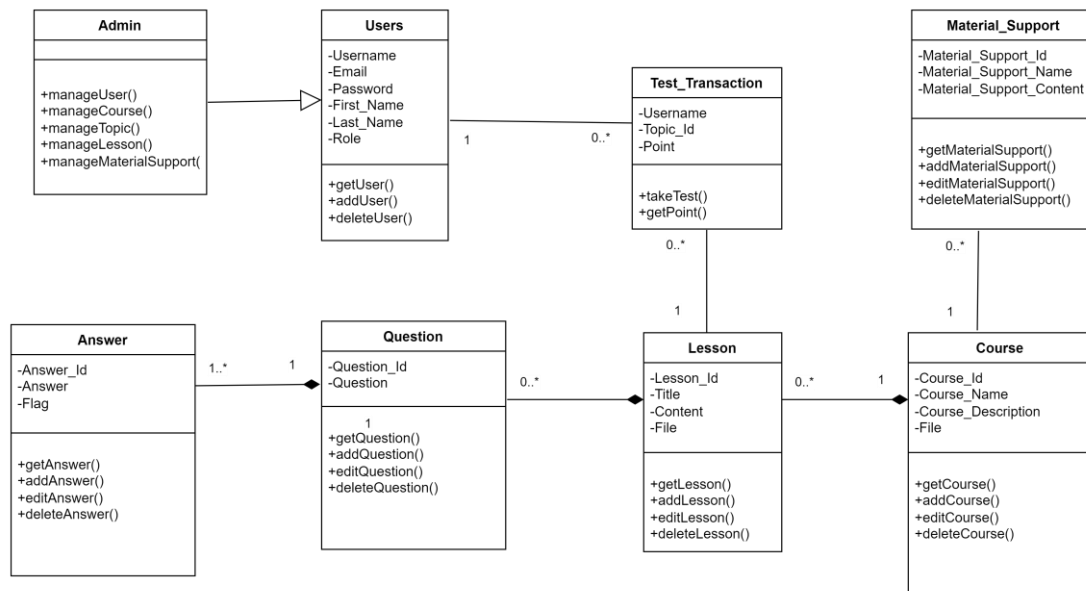
For User, it begins with user logging in and accessing their dashboard. In the "Course" page, user view a list of available courses and can join courses of interest. Within each course, the "Quiz" section allows students to test their understanding through interactive questions related to the course content.

Overall, the flowchart depicts a user-centric experience, with each module offering tailored functionalities. The authentication process ensures secure access, while the administrative, instructor, and student modules provide specific tools and interactions to meet the diverse needs of users within the NetEducation platform.



### 3.7.5 Class Diagram

A class diagram is a fundamental component of Unified Modeling Language (UML) used in software engineering to visually represent the structure and relationships within a system. It provides a static view of the system, illustrating the classes, their attributes, methods, and the associations between them.



**Figure 3.7-6: Class Diagram of NetEducation**

### 3.8. Technology Deployed and Hardware

#### 3.8.1. Hardware Specification

**Table 3.8-1: Hardware specification**

Laptop	
Processor	AMD Ryzen 5 2500U with Radeon Vega Mobile Gfx 2.00 Ghz
System	AMD x64-based processor
Memory	8.00 GB
Display	Full HD Display
Render	Radeon Graphics AMD
Hard Disk Capacity	1TB
Operating System	64-bit Operating System Microsoft Windows 10 Home Single Language

### **3.8.2 Software Specifications**

Visual Studio Code- Free source code editor that support debugging, syntax highlighting, code suggestion and completion and other extensions for simplifying and assisting in programming.

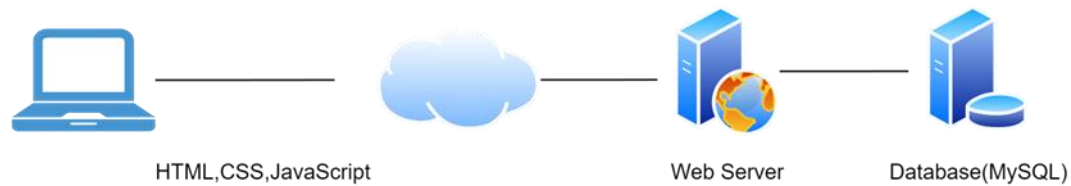
Framework: Laravel - Laravel is a PHP web application framework renowned for its elegant syntax, developer-friendly features, and robust set of tools. It provides developers with a clean and readable way to define routes quickly, especially for simple functionalities or actions.

Programming language: JavaScript, PHP- JavaScript is a versatile scripting language primarily used for client-side web development. It runs in web browsers, enabling the creation of interactive and dynamic user interfaces. JavaScript is a versatile scripting language primarily used for client-side web development. It runs in web browsers, enabling the creation of interactive and dynamic user interfaces.

Database: MySQL – It is an open-source relational database management system (RDBMS), plays a pivotal role in managing and organizing structured data. It provides a robust platform for creating, modifying, and extracting information from databases.

## 4 SYSTEM DESIGN & IMPLEMENTATION

### 4.1. System Architecture



The NetEducation website employs a three-tier system architecture consisting of the Presentation Layer, Application Layer, and Data Layer, leveraging technologies such as HTML, JavaScript, CSS, and PHP, with MySQL as the database. When users interact with the website, they initiate actions through the Presentation Layer, which is built using HTML for structuring content, CSS for styling, and JavaScript for dynamic and interactive elements. This layer handles the user interface, allowing users to navigate through courses, take quizzes, participate in forums, and manage their profiles. All user inputs and interactions are captured and sent to the web server, which acts as the bridge to the Application Layer.

The Application Layer, developed using PHP, processes the inputs received from the Presentation Layer. This layer contains the business logic and is responsible for authenticating users, handling user requests, and processing form submissions. For instance, when a user logs in or enrolls in a course, PHP scripts manage these processes by interacting with the Data Layer. The Data Layer, supported by a MySQL database, stores all persistent data, including user information, course content, quiz results, and forum discussions. The web server queries the database to retrieve or update this data as needed. This structured flow ensures seamless and efficient data handling, from user interaction at the front end to data processing and storage at the back end, thereby delivering a responsive and secure online learning platform.

## 4.2. Design Modeling

### 4.2.1. Detailed System Sequence Diagram

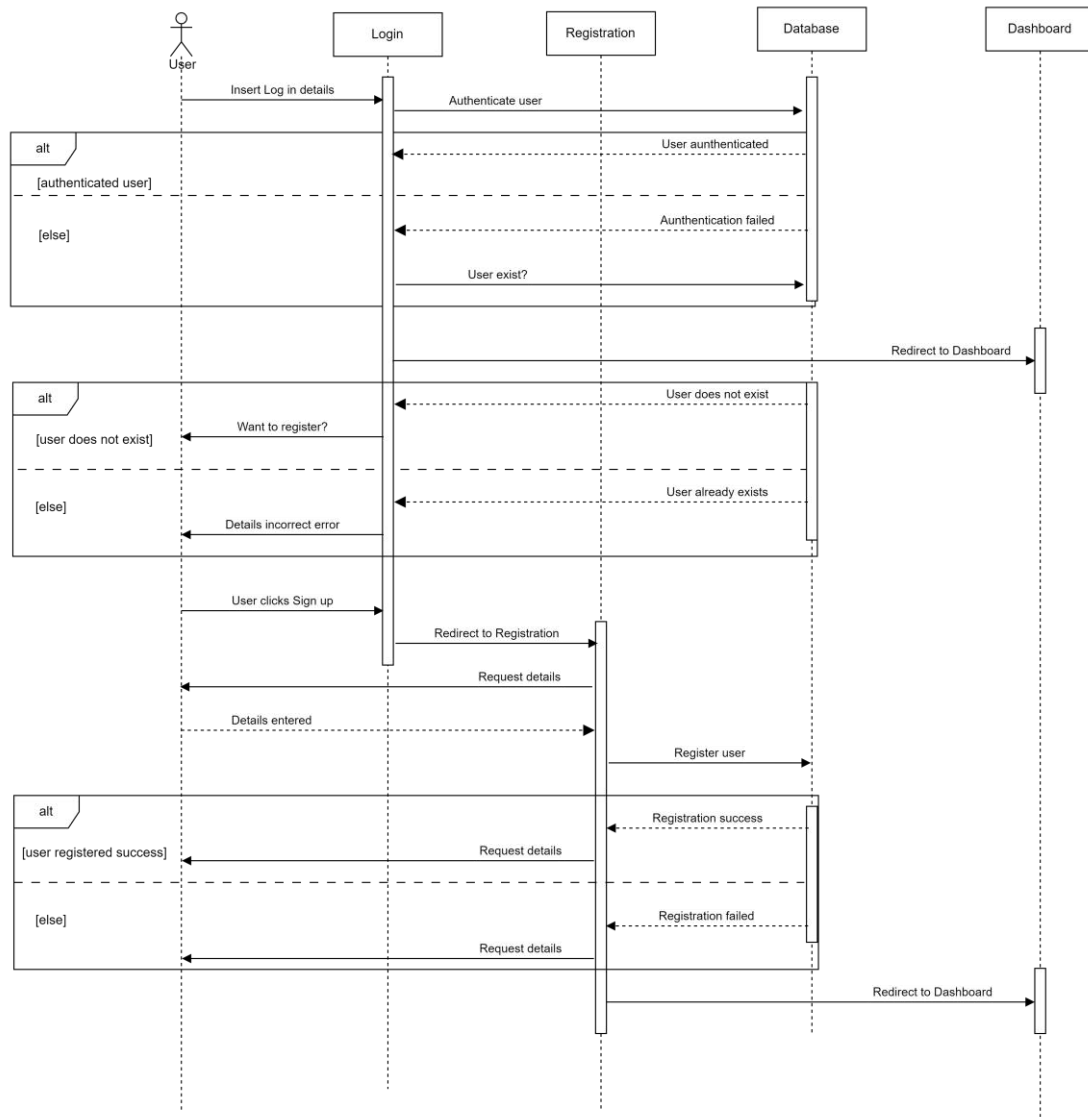
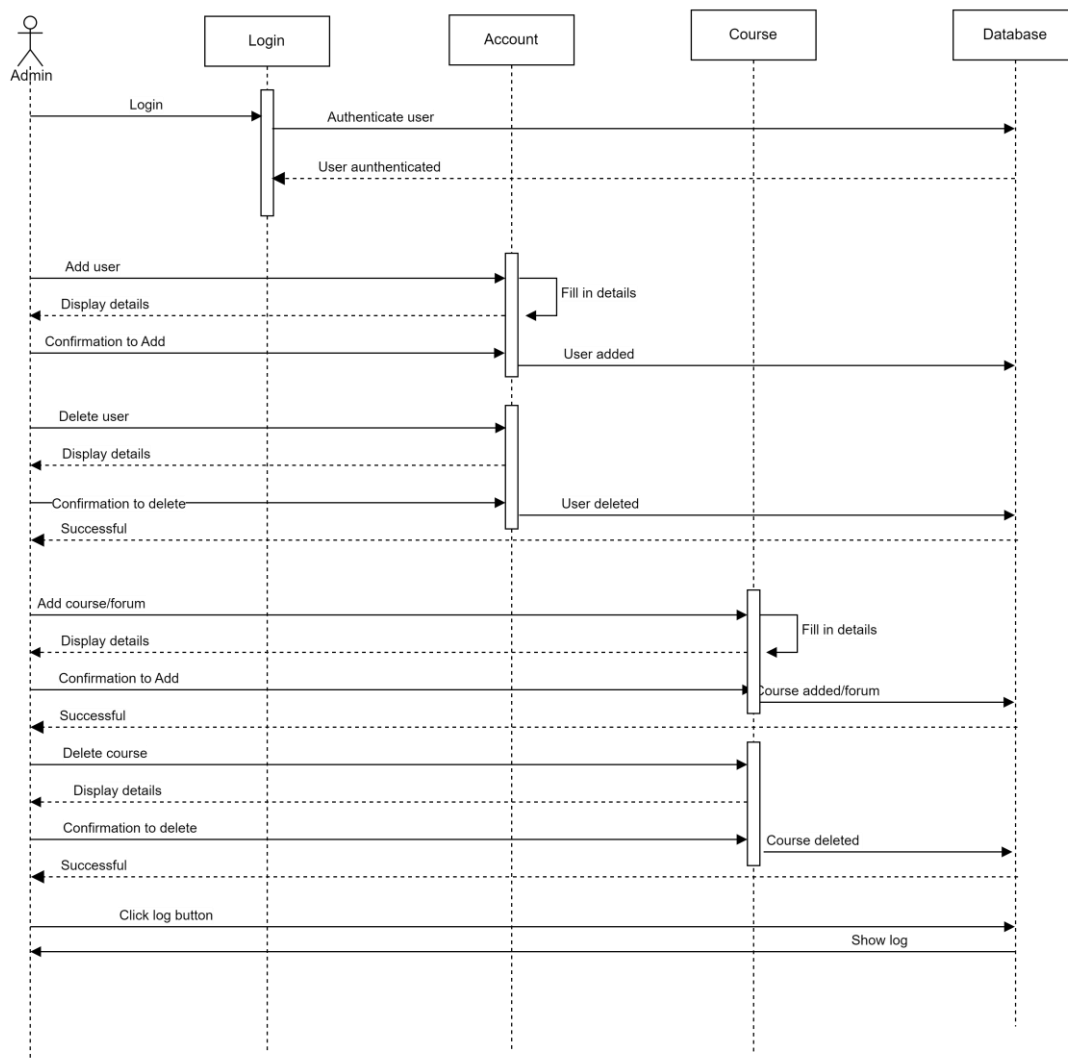


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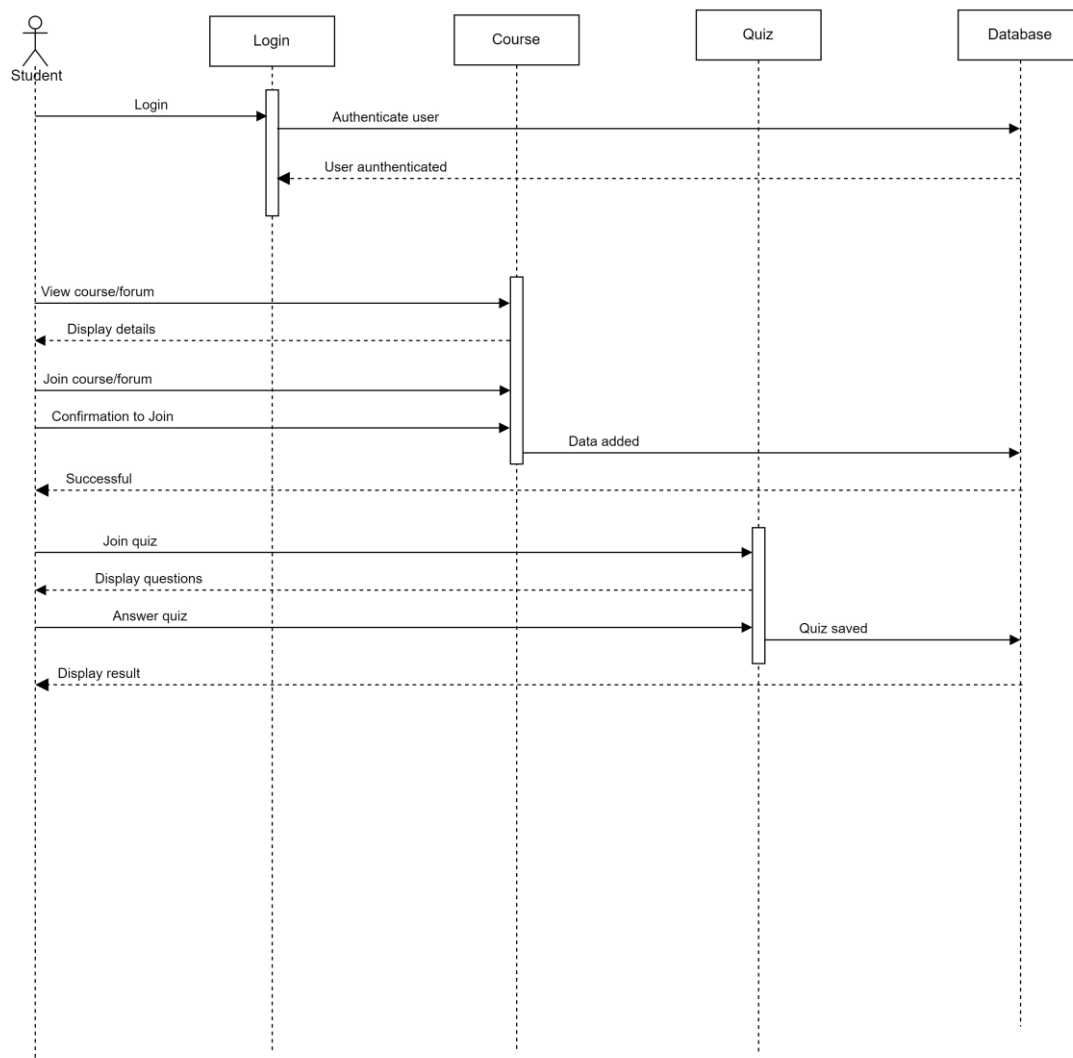
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**Figure 4.1-3: Sequence Diagram of Student Module**

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## 4.2.2 Class Diagram

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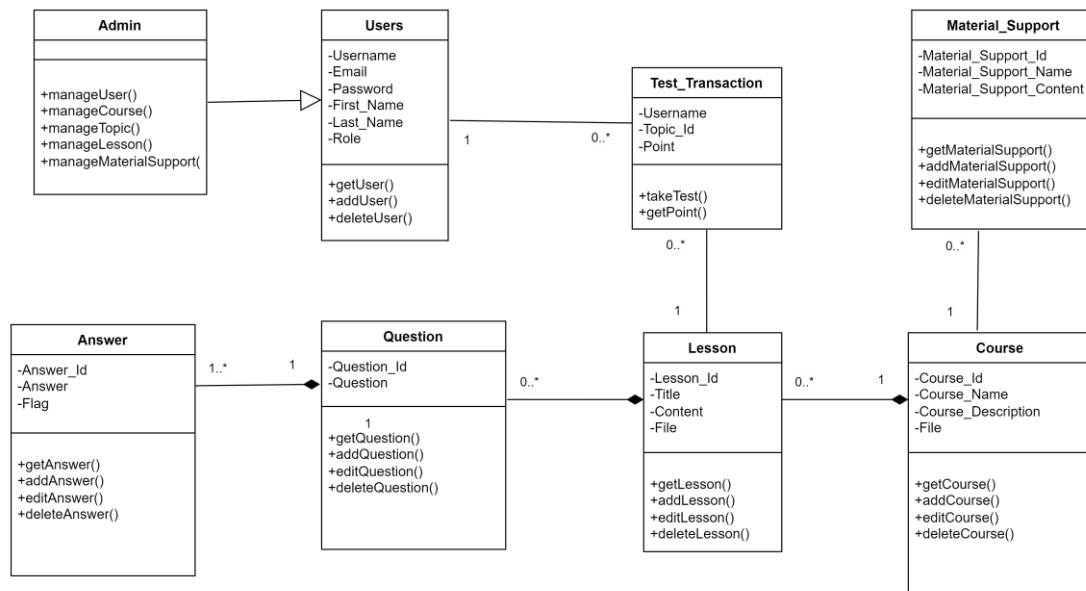


Figure 4.1-4: Class Diagram of NetEducation

## 4.3. User Interface Design

## 4.5. Implementation Strategy

The implementation strategy for the NetEducation system follows a bottom-up approach, ensuring that each component is developed and tested individually before integrating them into the larger system. This strategy begins with the creation and verification of individual modules, such as user authentication, course management, quiz functionalities, and forum interactions. By focusing on the smallest units of the system first, developers can ensure each module functions correctly and meets the specified requirements. For example, user login and registration features are built and tested in isolation to confirm their functionality and security.

Once these individual components are stable, they are gradually integrated to form more complex subsystems, such as the complete course management system or the forum module. This incremental integration allows for thorough testing at each stage, identifying and resolving any issues that arise from the interaction between modules. Finally, these subsystems are combined to form the full NetEducation platform, ensuring a smooth and error-free integration process. This bottom-up approach not only enhances the reliability and performance of the system but also facilitates easier troubleshooting and debugging, leading to a robust and cohesive online learning environment.

## 5 SYSTEM TESTING & EVALUATION

### 5.1. Testing Strategies

The NetEducation system must undergo comprehensive system testing once it has been successfully designed to ensure it functions as intended. System testing is essential to confirm that the system meets the criteria outlined in the system requirements and analysis. Additionally, this phase allows developers to identify faults that may not have been detected during the development process. Several types of testing have been undertaken, including unit testing, integration testing, and usability testing. Unit testing verifies individual components for correct functionality, integration testing ensures that combined modules work together seamlessly, and usability testing assesses the system's user-friendliness and overall experience. These testing strategies collectively ensure that the NetEducation system is robust, reliable, and ready for deployment.

#### 5.1.1. Unit Testing

Unit Testing is the first testing strategy used to verify the software at its smallest unit, focusing on individual functionalities. As a bottom-up approach in development, the software is built and accumulated function by function. Therefore, all unit functions are tested before integrating each function or module. For example, in a login module, individual functions such as "validate username," "validate password," and "authenticate user" would be tested separately to ensure they perform correctly. Only after these unit tests pass successfully will the functions be integrated to form the complete login process. This ensures that each component works correctly on its own before becoming part of the larger system, facilitating easier identification and resolution of issues early in the development process.

#### 5.1.2. Integration Testing

Integration testing involves combining unit codes to test for any abnormal conditions within the flow of each module. The primary objective of integration testing is to determine hidden and unexpected errors, especially during the passing of data through different units of functions, which may not be detected in unit testing. For instance, in the NetEducation system, integration testing would entail combining the File Upload

Security Feature with the course management part to ensure that uploaded files undergo proper verification and meet security standards without affecting system functionality. Similarly, integrating the Two-Factor Authentication (2FA) mechanism with the Login Module ensures that additional security measures do not disrupt the user authentication process. Additionally, testing the integration of Log Audit Security with various modules ensures that system activities and user actions are appropriately logged and recorded for security and auditing purposes. This comprehensive approach to integration testing helps ensure that all security features work seamlessly together to maintain the system's integrity and protect against potential threats.

### 5.1.3. Usability Testing

Usability testing is employed to assess whether the subsystem or the system meets the proposed requirements. This evaluation encompasses both functional and non-functional requirements, including functionality, security, usability, and other miscellaneous aspects. It serves as the final internal testing phase for the system, ensuring that the entire system operates seamlessly from the graphical user interface (GUI) to the backend algorithms, as specified in the expected system requirements. This test is conducted by simulating user interactions with the system, starting from the initial login process. The simulation is executed in a single run to demonstrate that the system functions uninterrupted and is ready for public user testing. Users can navigate through all functions, interact with elements, and assess the effectiveness of implemented security measures. This thorough usability testing ensures that the system is user-friendly, functional, and secure before it is deployed for public use.

## 5.2. Test Cases

Test Case ID	Test Scenario	Expected Result	Test Status
Log in Components			
TC101	Enter the proper password and registered username to log in.	Successfully logged in; redirected to home page.	Passed
TC102	Log in with an incorrect username format.	The log-in button will be disabled and the error message "should be a valid username address" will be shown.	Passed
	Use an unregistered username to log in.	Username not found and log-in error message.	Passed
	Log in with an invalid password, both, and a different password case than what was intended.	Incorrect password message and log-in failure.	Passed
	Use a brief password to log in.	The log in button will be disabled and the error message "should be at least 8 characters long and include number" will be shown.	Passed
	Enter OTP number from Google Authenticator	Successfully logged in; redirected to home page.	Passed

	Enter wrong OTP number from Google Authenticator	Incorrect number message and log-in failure.	Passed
Register Components			
	Enter a valid username, email, and strong password	Successfully registered; redirected to 2fa page	Passed
	Enter a username that is already registered in the system.	Registration failed; error message: "Username already exists" displayed.	Passed
	Enter an email address in an invalid format (e.g., "user@domain").	Registration failed; error message "Invalid email format" displayed.	Passed
	Enter a password that does not meet the strength criteria (e.g., "password123").	Registration failed; error message "Password is too weak" displayed.	Passed
	Leave the username field empty and enter a valid email and password.	Registration failed; error message "Username is required" displayed.	Passed
	Leave the email field empty and enter a valid username and password.	Registration failed; error message "Email is required" displayed.	Passed
	Leave the password field empty and enter a valid username and email.	Registration failed; error message "Password is required" displayed.	Passed
	Enter a password and confirm password that do not match.	Enter a password and confirm password that do not match.	Passed



	Enter a valid username, email, and password but fail 2FA verification	Registration failed; error message "Two-Factor Authentication failed" displayed.	Passed
	Enter valid username, email, and password, and successfully complete the 2FA verification.	Successfully registered; redirected to login page.	Passed
Dashboard Components			
	Log in with valid credentials and navigate to the dashboard.	Successfully logged in; redirected to the dashboard displaying user-specific data such as course list, quiz game list, and course management options.	Passed
	Attempt to navigate to the dashboard content URL like course list, quiz game list, and course management options without logging in.	Redirected to login page with an error message "Please log in to access the dashboard."	Passed
	Log in and navigate to the dashboard. Check the section displaying the list of enrolled courses.	Dashboard correctly displays a list of courses the user is enrolled in.	Passed
	Log in and navigate to the dashboard. Check the section displaying the list of available quiz games.	Dashboard correctly displays a list of available quiz games.	Passed

	Log in and navigate to the dashboard. Click on the "View Course" button in the course management section.	Redirected to the course details page, displaying all relevant information about the selected course.	Passed
	Log in and navigate to the dashboard. Click on the "Create Course" button in the course management section.	Redirected to the course creation page, allowing the user to input course details and save the new course.	Passed
	Log in and navigate to the dashboard. Click on the "Profile" button.	Redirected to the user's profile page, displaying personal information and options to update profile details.	Passed
	Log in and navigate to the dashboard. Click on the "Logout" button.	Successfully logged out; redirected to the login page.	Passed
	Access the platform without being logged in.	The login button is visible and accessible on the landing page.	Passed
	Log in, navigate to the dashboard, and verify security features like session timeout or 2FA prompts.	Security features function correctly; user is prompted for re-authentication if needed.	Passed
Course Page Components			
	Navigate to a course page after selecting a course from the dashboard.	Course page displays complete course details including title, description, and course content.	Passed

	After clicking the course, navigate to the course page and access the course content.	Course content such as lectures, videos, and reading materials are accessible and displayed correctly.	Passed
	Click the "Play" button on the video.	Video starts playing smoothly without any issues.	Passed
	Adjust the volume slider while the video is playing.	Volume changes accordingly without any issues.	Passed
	Click the "Fullscreen" button while the video is playing.	Click the "Fullscreen" button while the video is playing.	Passed
	Click the "Picture-in-Picture" button while the video is playing.	Video enters Picture-in-Picture mode and can be moved	Passed
	Change the playback speed of the video.	Video playback speed changes accordingly (e.g., 1.5x, 2x).	Passed
	Click the "Download" button for the video.	Video starts downloading to the user's device.	Passed
	Click on a topic in the sidebar to view its content.	The sidebar expands to show the subtopics under the selected topic; main content area updates to display the selected topic's content.	Passed

	Click the button or icon to open and close the sidebar.	Sidebar opens and closes smoothly, adjusting the main content area accordingly.	Passed
	Click on a topic to expand its dropdown menu and select a subtopic.	Dropdown menu expands to show subtopics; clicking on a subtopic updates the main content area to display relevant information.	Passed
	Navigate to the quiz section and attempt an MCQ quiz.	User can select answers for each question; all selected answers are registered.	Passed
	Click the "Submit" button after completing the quiz.	Quiz is submitted; results page shows correct answers and points earned for each question.	Passed
	After submitting the quiz, review the feedback provided.	Correct answers are highlighted; explanations (if any) and points are displayed.	Passed
	Click the "Play" button on the video, but the video fails to play.	Error message displayed indicating that the video cannot be played.	Passed
	Adjust the volume slider while the video is playing, but volume does not change.	Error message displayed indicating that the volume adjustment failed.	Passed

	Click the "Fullscreen" button while the video is playing, but the video fails to enter fullscreen mode.	Error message displayed indicating that fullscreen mode cannot be enabled.	Passed
	Click the "Picture-in-Picture" button while the video is playing, but the video fails to enter Picture-in-Picture mode.	Click the "Picture-in-Picture" button while the video is playing, but the video fails to enter Picture-in-Picture mode.	Passed
	Change the playback speed of the video, but the speed does not change.	Error message displayed indicating that playback speed adjustment failed.	Passed
	Click the "Download" button for the video, but the video fails to download.	Error message displayed indicating that the video download failed.	Passed
	Click on a topic that does not have any subtopics.	No dropdown menu appears; message displayed indicating no subtopics are available.	Passed
	Click the "Submit" button without answering all quiz questions.	Question without answer will indicate as wrong. Correct answers are highlighted; explanations (if any) and points are displayed.	Passed
	Click the "Next" button on the course page to proceed to the next content.	User is navigated to the next piece of content in the	Passed

		course; new content loads successfully.	
	Click the "Game Quiz" button to go to the game quiz page.	User is navigated to the game quiz page; game quiz interface loads successfully.	Passed
	Click the "Game Quiz" button but encounter a navigation error.	Error message displayed indicating the game quiz page cannot be loaded; user is not navigated to the game quiz page.	Passed
Game Quiz Components			
	Click the "Game Quiz" button to go to the game quiz page.	User is navigated to the game quiz page; game quiz interface with slider images loads successfully.	Passed
	Click on a specific object in the first slider image.	Popup box contain image or text appears with relevant information.	Passed
	Click on a specific object in the second slider image.	Popup box contain image or text appears with relevant information.	Passed
	Click on a specific object in the third slider image.	Popup box contain image or text appears with relevant information.	Passed
	Click on a specific object in the fourth slider image.	Popup box contain image or text appears with relevant information.	Passed

	Click the "Back" button on the popup.	Popup closes and returns to the slider image.	Passed
	Enter a specific word in the text input field in popup box and click "Submit."	New option or question appears based on the entered word.	Passed
	Click to open the image in the popup box and download it.	Image opens in a new tab and can be downloaded by the user.	Passed
	Click the "Terminal" button on the popup to open the mock terminal and enter the allowed commands (e.g., ls, pwd, whoami, feh, steghide, exiftool, ssh).	Terminal responds correctly to the allowed commands.	Passed
	Use the information from the slider image and terminal to answer the question on the left side.	Answer is submitted; user receives points.	Passed
	Answer the question correctly and view the leaderboard.	Leaderboard updates in real-time, displaying the correct rank, username, points.	Passed
	Click the "Game Quiz" button but encounter a navigation error.	Error message displayed indicating the game quiz page cannot be loaded.	Passed
	Click on a non-clickable object in the first slider image.	No popup appears; no interaction happens.	Passed

	Enter an incorrect word in the text input field and click "Submit."	Error message displayed indicating the word is incorrect; no new option or question appears.	Passed
	Click the "Terminal" button on the popup to open the mock terminal and enter disallowed commands (e.g., any command other than ls, pwd, whoami, feh, steghide, exiftool, ssh).	Terminal responds with "command not found."	Passed
	Use the information from the slider image and terminal but submit an incorrect answer to the question on the left side.	User is notified that the answer is incorrect; no points awarded.	Passed
	Submit an incorrect answer and view the leaderboard.	Leaderboard remains unchanged, no additional points or changes in rank.	Passed
Course Management Components			
	User clicks "Join Course" button	User is navigated to the list of courses page	Passed
	User clicks the "Create Course" button	User is navigated to the create course page	Passed
	User accesses the course management page and views the list of available courses.	Course list is displayed with course number, title, category, and "View" button for each course.	Passed



	User clicks the "View" button for a specific course in the course list.	User is navigated to the course page with the selected course's content.	Passed
	User accesses the course management page, but the course list fails to load.	Error message displayed indicating that the course list cannot be loaded.	Passed
	User clicks the "View" button for a specific course, but navigation to the course page fails.	Error message displayed indicating that the course page cannot be loaded.	Passed
	User clicks the "Add New" button and fills in the title, category, content, and uploads materials.	The system should successfully create a new course and display it in the course list.	Passed
	User clicks the "Edit" button for an existing course in the course list.	The system should navigate to the course edit page, allowing the user to update the course title, category, content, and upload materials.	Passed
	User clicks the "Delete" button for an existing course in the course list.	The system should prompt the user for confirmation and, upon confirmation, delete the course from the list.	Passed
	User attempts to create a new course by clicking the "Add New" button and filling in the	The system detects the spam attempt through the honeypot mechanism and	Passed

	required details. However, a spam attempt is made by filling in hidden honeypot fields.	redirects the user to a blank page, preventing the creation of the course.	
	User initiates the creation of a new course by clicking the "Add New" button and submitting the form. However, an invalid CSRF token is included in the submission.	The system identifies the invalid CSRF token and blocks the form submission, displaying an error message to the user.	Passed
	User fills in the details for creating a new course, including title, category, and content. However, malicious XSS scripts are injected into the input fields.	The system sanitizes the input data neutralizing the XSS scripts and ensuring that the course creation process proceeds without compromising system security.	Passed
	User attempts to upload course materials, including images and videos, while creating a new course.	Only image and video file types are accepted for upload.	Passed
	User upload malicious file in system.	Message error "This file is malicious" will show. Upload failed.	Passed
Admin Components			

	Admin clicks "Create Course" in the course management section.	Successfully navigates to the course management page.	Passed
	Admin clicks on each sidebar button (Home, Course, User, Log Audit).	Each click successfully navigates to the respective section without errors.	Passed
	Admin accesses the course section and views the list of courses.	Course list is displayed in a table format with relevant details and action buttons.	Passed
	Admin clicks the "View" button for a course.	Successfully views the content of the selected course.	Passed
	Admin clicks the "Edit" button for a course, modifies details, and saves changes.	Course details are successfully edited and updated.	Passed
	Admin clicks the "Delete" button for a course.	Course is successfully deleted from the system.	Passed
	Admin clicks the "Add New" button, fills in the title, category, content, and uploads an image.	Admin clicks the "Add New" button, fills in the title, category, content, and uploads an image.	Passed
	Admin accesses the user section and views the list of registered users.	User list is displayed with relevant details.	Passed
	Admin selects a user from the list and clicks the "Delete" button.	User account is successfully deleted from the system.	Passed

	Admin navigates to the log audit page and views logs.	Log audit list is displayed with detailed information.	Passed
	Admin clicks the "View" button on a log entry.	Detailed log information is displayed in new page.	Passed
	Admin clicks "Create Course" in the course management section, but navigation fails.	Error message displayed indicating navigation failure.	Passed
	Admin attempts to delete a course, but deletion fails.	Error message displayed indicating deletion failure.	Passed
	Admin attempts to delete a user account, but deletion fails.	Error message displayed indicating deletion failure.	Passed
	Admin clicks the "View" button on a log entry but viewing fails.	Error message displayed indicating viewing failure.	Passed
	Admin attempts to create a new course by clicking the "Add New" button and filling in the required details. However, a spam attempt is made by filling in hidden honeypot fields.	The system detects the spam attempt through the honeypot mechanism and redirects the user to a blank page, preventing the creation of the course.	Passed
	Admin initiates the creation of a new course by clicking the "Add New" button and submitting the form. However, an invalid CSRF token is included in the submission.	The system identifies the invalid CSRF token and blocks the form submission, displaying an error message to the admin.	Passed

	Admin fills in the details for creating a new course, including title, category, and content. However, malicious XSS scripts are injected into the input fields.	The system sanitizes the input data and become normal text.	Passed
	Admin attempts to upload course materials, including images and videos, while creating a new course.	Only image and video file types are accepted for upload.	Passed
	Admin attempts to upload malicious items	"This file detected as malicious" error will display	Passed
Profile Components			
	User navigates to the profile page.	The profile page displays the user's name and email address. A "Save" button allows the user to update any changes made to the profile information.	Passed
	User fills in the current password, new password, and confirms the new password, then clicks the "Save" button.	The system updates the user's password if the current password is correct and the new password meets the required criteria. A success message is displayed.	Passed

	User clicks on the "Delete Account" button.	A confirmation message asking if the user wants to delete their account is shown. The message includes a prompt to enter the password for confirmation. The user can then choose to cancel the operation or proceed with deleting the account.	Passed
	User navigates to the profile page but encounters an error	If there's an error loading the profile information, an error message should be displayed indicating the issue.	Passed
	User attempts to update the password with incorrect or mismatched information.	If the current password is incorrect or the new password and confirm password fields do not match, the system should display an error message indicating the issue. The user should be prompted to correct the errors before proceeding.	Passed
	User enters an incorrect password when attempting to delete the account.	If the entered password is incorrect, the system should display an error message indicating the issue and prompt the user to	Passed

		re-enter the password. The user should not be able to proceed with deleting the account until the correct password is provided.	

### 5.3. Summary of Testing

The NetEducation system underwent a thorough testing process to ensure its functionality and safety for users. The testing strategy encompassed Unit Testing, Integration Testing, and Usability Testing, covering both functional and non-functional requirements. Unit Testing verified individual functionalities to ensure correctness and performance, while Integration Testing focused on the interaction between combined unit codes, particularly emphasizing security features like file upload validation, Two-Factor Authentication (2FA), and audit log functionality. Usability Testing simulated user interactions to confirm seamless operation across the graphical user interface (GUI) and backend algorithms, ensuring uninterrupted navigation and effective security implementations.

Specific components such as the Dashboard, Course Page, Game Quiz, Course Management, Admin Components, and Profile Component underwent careful testing. The Dashboard's functionalities, including course list display, quiz game list navigation, course management, and profile access, operated successfully, alongside the login/logout functions. The Course Page's features, like video playback, volume control, full-screen mode, picture-in-picture, and download options, were verified, with sidebar navigation and quiz submissions displaying correct answers and points. Game Quiz pop-ups, object interactions in slider images, specific word input handling, and terminal button functionality were confirmed accurate, as was the leaderboard functionality.

In Course Management, tasks such as creating, viewing, editing, and deleting courses were tested thoroughly, with security measures like honeypot spam protection, CSRF protection, XSS protection, and file upload validation operational. Admin Components were validated for navigation between sections, course management actions, user management displaying registered users, and log audit functionality capturing detailed actions with accurate timestamps and user information.

The test results demonstrated that all intended functionalities worked as expected under normal conditions, meeting specified requirements. The system effectively managed error scenarios, such as invalid inputs, spam attempts, and security threats, without compromising performance or security. Comprehensive coverage of functional and security aspects was achieved, indicating a robust, secure, and user-friendly platform ready for deployment. The thorough testing strategy ensured seamless system functionality, providing users with a reliable and secure online learning experience.

#### **5.4. System evaluation**

The system evaluation of the NetEducation platform presents a critical analysis of its performance, highlighting both its strengths and limitations. One of the key advantages of the system lies in its comprehensive testing approach, which ensures robust functionality, effective security measures, and a user-friendly interface. The inclusion of features such as Two-Factor Authentication (2FA), file upload validation, and audit log functionality enhances the platform's security, safeguarding user data against potential threats. Additionally, the system's intuitive dashboard, course management capabilities, and interactive quiz components contribute to an engaging and seamless learning experience for users.

However, despite its strengths, the system does have certain limitations. One notable disadvantage is the potential complexity of managing and navigating through various components, especially for users who may not be technologically savvy. This could lead to a steep learning curve for some users, impacting their overall experience with the platform. Additionally, while the security measures implemented are robust, there is always a possibility of new vulnerabilities emerging over time, necessitating regular updates and maintenance to mitigate risks effectively.



Furthermore, while the system undergoes thorough testing, it may still encounter unforeseen issues or bugs in real-world usage scenarios. Continuous monitoring and feedback mechanisms are essential to identify and address any such issues promptly. Another limitation is the reliance on external services such as VirusTotal for file scanning, which could introduce dependencies and potential points of failure.

Overall, the NetEducation platform demonstrates considerable strengths in functionality, security, and user experience, making it a valuable tool for online learning. However, it is essential to acknowledge and address its limitations to ensure continued improvement and user satisfaction over time.

## **5.5. Summary of Importance Finding**

The summary of what we discovered during the testing of the NetEducation system is crucial for understanding how well it performs in different areas. We wanted to make sure that the system not only works properly but also keeps users' information safe and is easy for them to use. So, we ran various tests to check everything from signing up for the platform to managing courses and taking quizzes.

Through these tests, we found that the system works well overall. Users can easily sign up, manage their courses, and participate in quizzes without any major issues. We also made sure that the security features, like Two-Factor Authentication (2FA) and file checks, are doing their job to protect users' personal information. It's essential for users to feel safe when using an online platform, and these security measures help achieve that.

Additionally, we investigated how user-friendly the system is. We found that it's straightforward to navigate and perform tasks, which is great for users who may not be tech-savvy. However, we also noticed some areas where the system could be improved. For example, we want to make sure it's not too complicated for users to understand, especially when managing different parts of the platform. We also want to reduce reliance on outside services for checking files, as this could introduce potential vulnerabilities. By continuously monitoring and improving the platform based on these findings, we can ensure that it remains a reliable, secure, and user-friendly tool for online learning.

## 6 CONCLUSIONS & FUTURE WORK

In conclusion, the NetEducation project has successfully met its objectives by providing a secure, centralized platform for online learning. Through the implementation of robust security features such as Two-Factor Authentication (2FA), file upload validation, and audit logging, the system ensures the safety of user data and interactions. Additionally, the structured learning activities offered within the platform cater to both theoretical and practical knowledge, enhancing the overall learning experience. The administrator tools provided facilitate efficient management and monitoring of the system, ensuring smooth operation and user satisfaction.

The project demonstrates good design and implementation practices, with careful consideration given to security measures and user experience. The chosen implementation technologies, including HTML, JavaScript, CSS, PHP, and MySQL, are well-suited for developing a dynamic and scalable web application. The project's success is evident in its adherence to the specified requirements and its ability to fulfill the intended purpose of providing a comprehensive online learning platform.

Upon revisiting the system objectives, it is evident that the project has effectively addressed the need for a secure centralized learning platform. By implementing stringent security measures and protocols, the application ensures the confidentiality, integrity, and availability of user data and resources. Furthermore, the structured learning activities offered by the platform fulfill the objective of providing both theoretical and practical knowledge to users, enhancing their educational experience and skill development. The administrator tools provided also align with the objective of assisting in the efficient management and monitoring of the system, empowering administrators to maintain the platform's functionality and security.

In addition to the future work, another avenue for development involves deploying a virtual machine (VM) directly within the website. This feature would offer users the opportunity to engage in hands-on learning experiences within a controlled virtual environment. By integrating VM deployment capabilities, users can access pre-configured virtual environments directly from the platform, enabling them to practice and experiment with various software applications. Additionally, continued research and development efforts could focus on integrating advanced technologies such as artificial intelligence and machine learning to personalize the learning experience and provide tailored recommendations for users. Furthermore, ongoing updates and improvements to the security features and protocols will be essential to stay ahead of evolving cyber threats and ensure the continued safety and reliability of the platform. By continuously iterating and refining the NetEducation system, it can remain at the forefront of online learning platforms, providing a secure, comprehensive, and effective educational experience for users.

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## **6 APPENDICES**