MDA692 – Data Analysis Capstone Project

E-learning Platform for Courses with Real-Time Analytics

Prepared by
MIT235544 (Arafat Hossan)
MIT240256 (Imtiaz Ahmed Rahat)
MIT231859 (Juma Valentine Mareva)

Supervisor Name: Dr Qamar Hussain
Client Contact Name: Arif Systems
Industry Name: Skill Sync

School of IT and Engineering

Trimester T1_2025

Acknowledgement

We would like to start this report with our heartfelt thanks to our lecturer for his support, guidance and valuable advice during the course of this assignment

We equally value each contribution from each member of our group for their participation. It has been a rewarding experience to research companies like Apple and Amazon and analyze how innovation shapes the way businesses operate.

We hope this will reflect the joint effort of each member and the knowledge we gain. Innovation in today's competitive business environment is most essential. We hope the report serves that purpose well enough.

Table of Contents

Table of Figures

Abstract

This project is all about developing an e-learning platform that employs real-time analytics to enhance online learning to be more interactive, responsive, and effective. Most existing platforms merely display students' progress after the fact, and hence it is hard for teachers to know who is struggling until it is too late. We aim to build a system that provides teachers with real-time feedback about student activity, so they can intervene and provide help at the moment it's needed, not weeks from now.

We're still in the development phase, but the plan is to include features like course creation, student enrolment, assignment and quiz management, and dashboards for students, teachers, and admins. The real-time aspect is central to the platform; it's what will help identify who's keeping up, who might be falling behind, and how course materials are being used.

We're building the platform using Python for the backend, React.js for the frontend, PostgreSQL for the database, and Apache Kafka for processing real-time data. We're using D3.js for the dashboards and visualizations to display the data in a form that is easy to read at a glance. We're also considering carefully making the platform secure and GDPR-compliant.

Each member of the team has taken on specific roles namely: frontend, backend, database, and analytic and we're working through a weekly schedule to make sure everything comes together smoothly. While there's still a lot to do, the aim is clear: to build a smarter, more helpful e-learning experience that benefits both students and teachers.

1. Introduction

In the dynamic education world today, technology is one of the drivers shaping how we will learn. E-learning platforms have stormed the world in trying to reach students spread over a large geographical area. Most of those are lacking real-time feedback on the performance of students and the degree of their engagement. [1] This leads often to a failure by the teachers to act on the students in time and thus missing the opportunities to enhance their learning journey.

This paper describes an E-learning platform whose development seeks to fix this very issue by incorporating real-time analytics. It means to provide speedy access to information about what the students are doing to the teachers so that at the instance itself they can adjust their teaching methodologies and let the student get an easy grasp of progress. [2]

It begins with the statement of the problem, followed by research questions to guide the project. Besides that, it cites literature that underlines the importance of real-time analytics in learning. The document proceeds to clearly state what the objectives of the project are, what the implementation is intended to realize, and what will be required for the project to be successful—a sneak preview of what will be required for the project to be a success, including insights from the client meetings and technical details that will ensure seamless rollout.

By the end of this document, it shall be vividly clear how this E-learning platform strives to enhance the E-learning experience with real-time analytics and provides a data-driven method of education that will benefit teachers and learners alike.

2. Project Detailed Design

2.1 Summary of Literature Review

In exploring the literature, what's clear is that there is growing need for smarter e-learning systems, those that accomplish more than simply offering content and rather enable genuine interaction and timely feedback. Conventional systems operate for the most part in a lagged fashion: students complete work, and teachers only then see how they are doing. The lag has the effect of causing teachers to lose opportunities to intervene at the point of greatest need.

The research indicates that real-time analytics can close the gap considerably. Studies show that when teachers get to see real-time information, such as how active their students are, how students

are doing on quizzes, or what subjects are confusing them, they're more effective at modifying their instruction in the moment. This kind of immediate feedback generates more responsive, individualized learning. [3]

There is also strong emphasis on the value of clear, graphical representations of data. Tools like D3.js are a frequent mention because they could take raw numbers and turn them into simple graphs and dashboards, which can be a total game-changer for both students and teachers. Literature always reminds us that data is accompanied by responsibility; role-based access control, privacy, and security are essential, especially in educational environments where individual information is handled.

2.2 Objectives of the Project

This major project aims to design an e-learning platform for courses through real-time analytics. The admin creates courses in this next-generation e-learning platform and assigns teachers to the same courses. Teachers evaluate the examination and upload it with respect to the courses. Students register, enroll for the course, and make payments. This uses real-time analytics to help better student engagement for improved learning outcomes. In addition, there will also be a dashboard for the students, teachers, and admin. Teachers can leverage continued insights into student performance with relevant and impactful learning interventions.

i. The design and installation of an intuitive user interface that provides instructors and students with ease of access to real-time metrics, course materials, and platform navigation.
ii. Real-time analytics tools can be leveraged to capture the data and report course completion rates, student engagement, etc. with insights.
iii. Provide reporting resources to allow instructors to analyze student data to trend student progress and facilitate pedagogical adjustments.
iv. Take necessary security measures to protect user information and follow the law.
v. Put it into live learning environments; monitor its performance and iteratively develop based on usage by actual end-users.

2.3 Detailed Design

2.3.1 Platform Overview

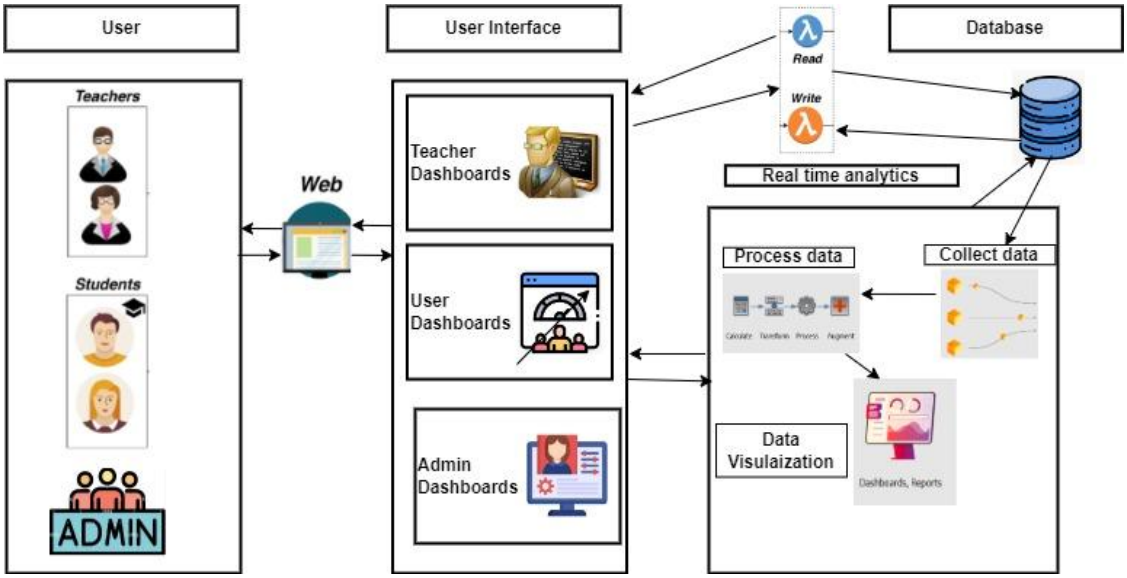


Figure 1: Platform Overview

2.3.2 User Relational Diagram

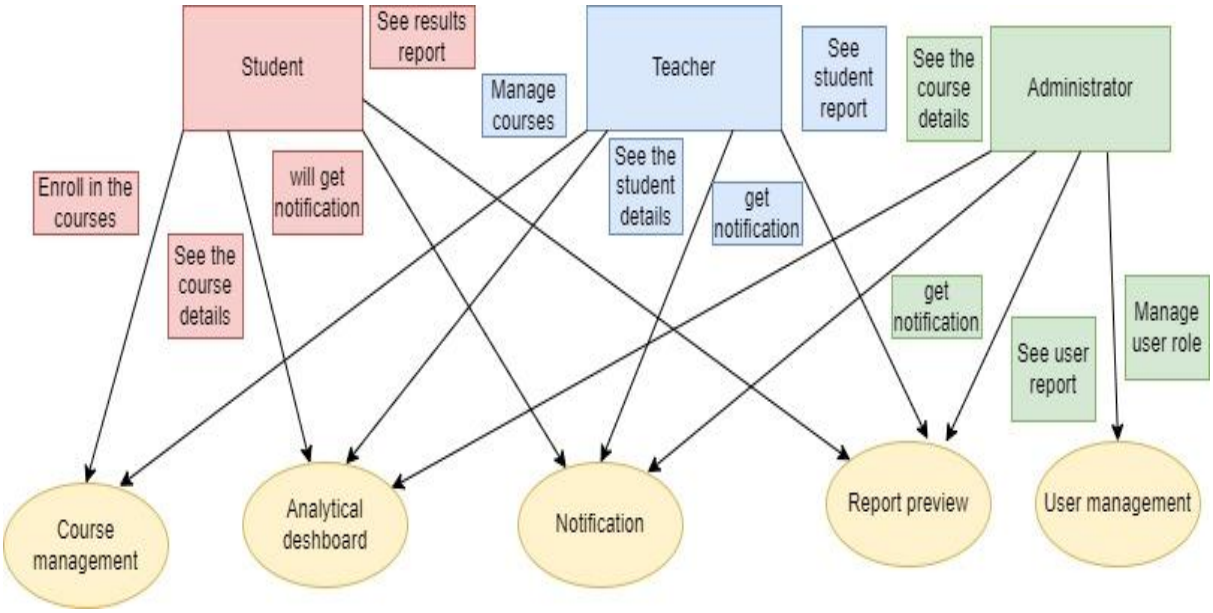


Figure 2: Users Relational Diagram

2.3.3 Use-Case Diagrams

2.3.3.1 Student Use-Case Diagram

This design focuses on how students interact with the various components of the e-learning platform. The main sections are:

Course: Contains course ID, course name, description, Instructor ID, start date and end date. It becomes the main unit of interaction between students and the board.

Modules: There are many modules in courses, identified by module ID, module name, course ID, content and duration.

Students: A student entity contains attributes such as student ID, name, email, password, enrollment date and course enrolled in it.

Enrollment: Students can register for courses, and your registration is identified by registration ID, student ID, course ID and registration date. Module status is monitored here.

Quiz: Each module contains tests identified by test ID, module ID, test title and total marks. Students can attempt the exam, and the results will be tracked with product ID, exam ID, student ID, score, date of attempt and notification.

Assignments: Modules can also include assignments that have an assignment ID, module ID, assignment title, due date, and maximum marks. Students submit assignments associated with the student's submission details, including submission ID, assignment ID, student ID, submission date, grades received, feedback, and test result.

Notifications: Students will receive tutor notifications, assignment results, test results and other platform related messages. Notifications have attributes such as Notification ID, Teacher ID, Message, Post Date, and Notification Method.

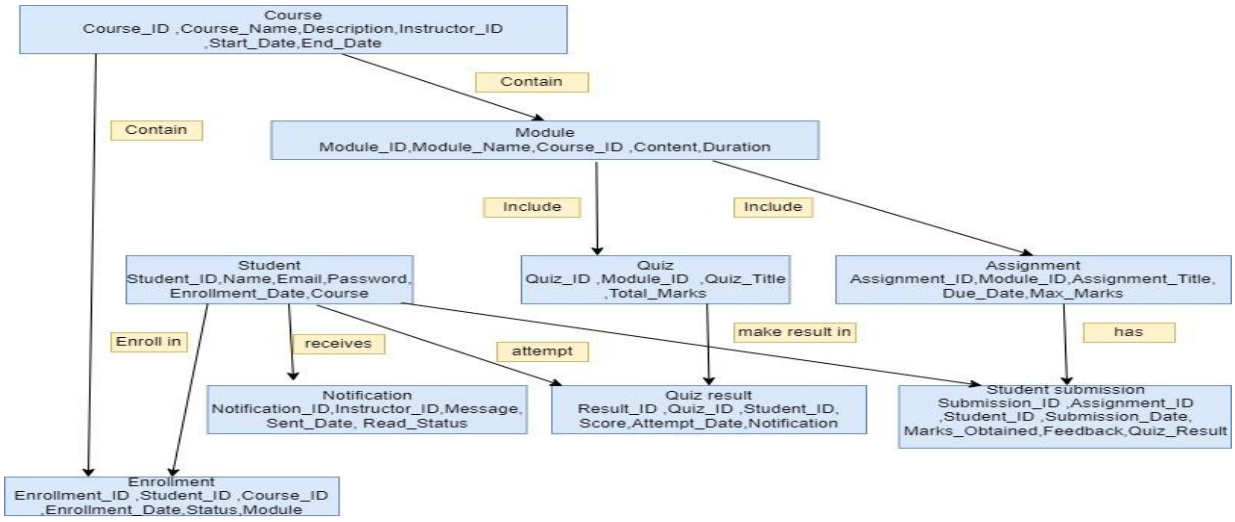


Figure 3:Students Use-case Diagram

2.3.3.2 Teacher Use-Case Diagram

This use case diagram shows the interactions between the teacher and the e-learning platform and following are the main features:

Course Management: Teachers have the ability to manage courses which includes adding, updating or deleting course information. Course ID, name, description, start date, end date and Instructor ID.

Module management: In each lesson, teachers can create and manage modules. Each module is associated with a lesson, which contains information including module ID, module name, content and duration. Teachers can update or edit the content and topics of the module.

Assignment Creation and Review: Instructors are responsible for creating assignments and attributes such as assignment ID, module ID, title, due date, and maximum marks. They receive and review student submissions, evaluate their work and provide feedback. Submissions include information such as submission ID, assignment ID, student ID, submission date, grades earned, feedback and relevant test results.

Quiz Management: Teachers can create and administer unit-based tests. This exam includes features like exam ID, module ID, title and all the marks. Teachers monitor student test scores and review results such as Result ID, Test ID, Student ID, Grade, and Attempt Date.

Notifications: Teachers send notifications to students about quiz results, homework updates, or general announcements. Notifications include Notification ID, Master ID, Message, Sent Date, and Post Status.

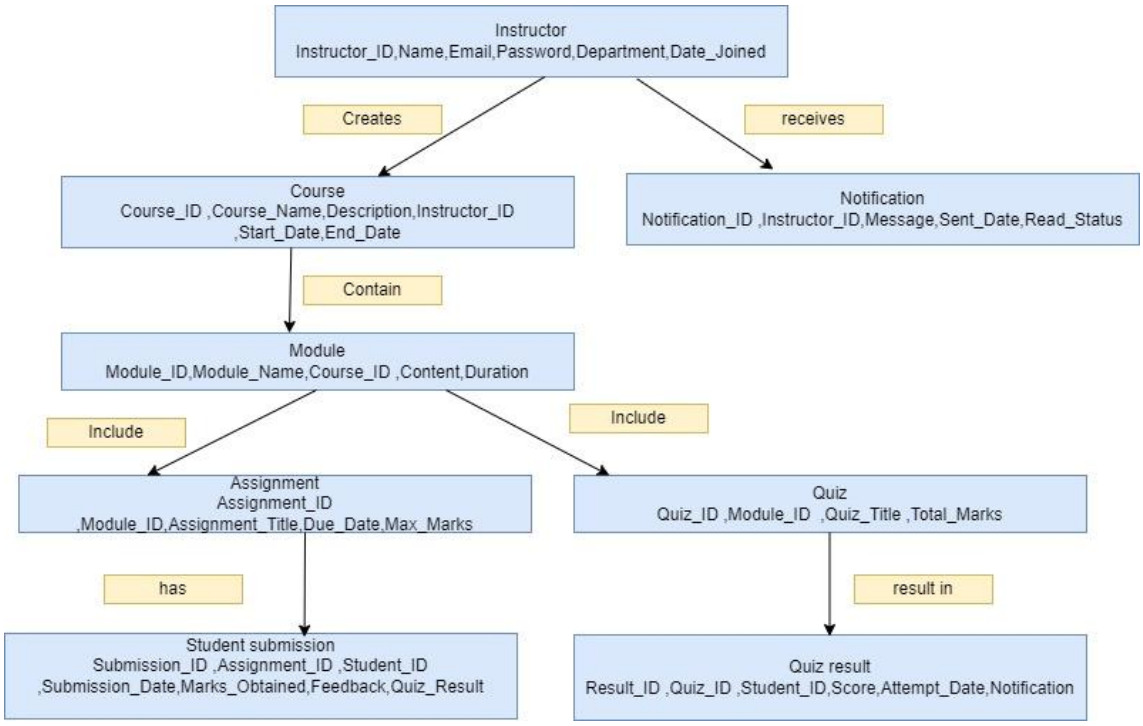


Figure 4:Teachers' Use-case Diagram

2.3.3.3 Administrator Use-Case Diagram

The use case diagram for the administrator focuses on the controls and operations of the e-learning platform. The main features are:

Course Management: Administrators oversees all course management activities, including adding, updating or deleting courses and details such as course ID, name, description, Instructor ID, start date and end date. Administrators can also appoint course instructors.

User Management: Administrators are responsible for managing user accounts (students and teachers) on the platform. This includes creating accounts, managing passwords and deleting users as needed. Administrator information includes attributes such as administrator ID and administrator role.

Module management: Administrators ensure that learning modules are correct, each module has a module ID, module name, content, duration and links to relevant courses.

System Notifications: Administrators control the distribution of system notifications, including system updates, important deadlines, and policy changes. Notifications contain information such as notification ID, administrator ID, message, sent date and notification status.

Monitoring and Reporting: Administrators can monitor platform performance, including student enrollment, course completion rates, job offers, and test scores. This data can be used to generate reports for management or to provide feedback to improve the platform.

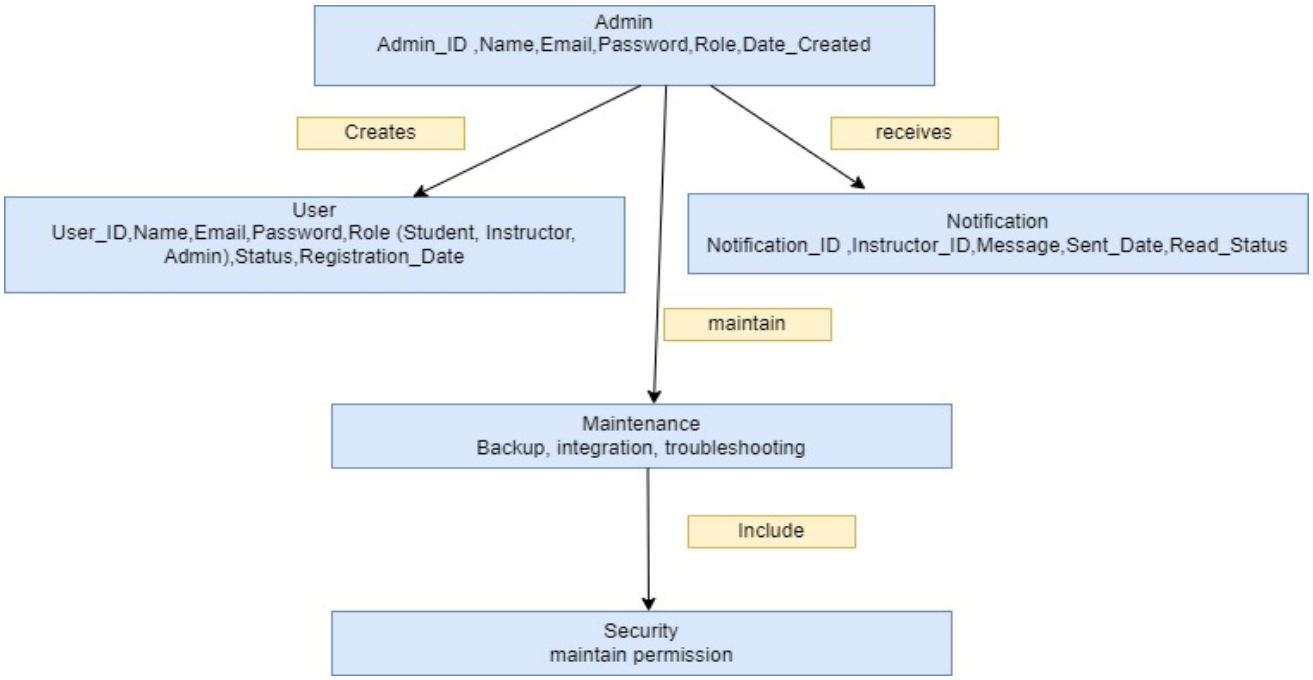


Figure 5:Administrator Use-case Diagram

2.3.4 Project System Design

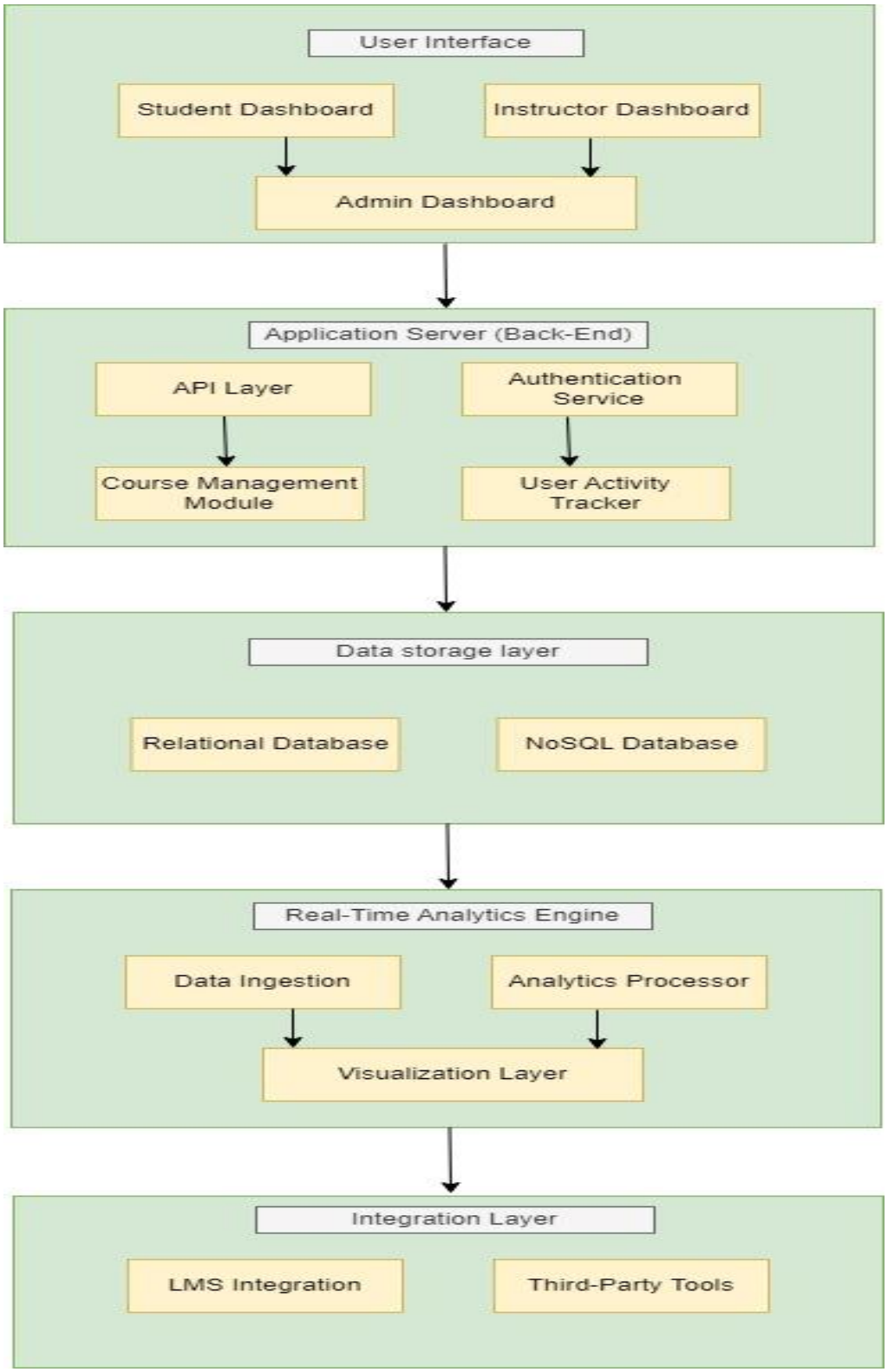
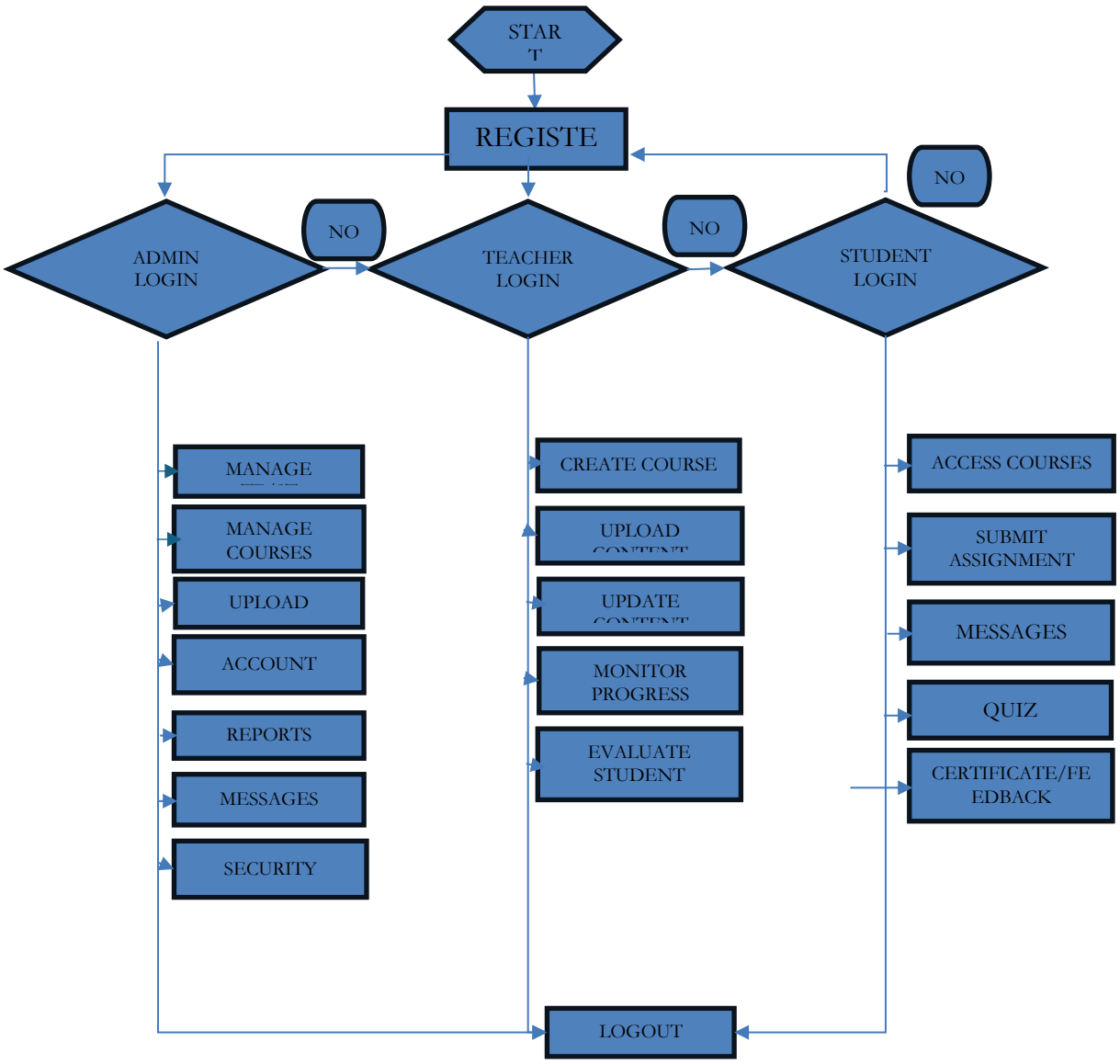


Figure 6:Project System Design

2.3.5 Flow Chart



2.3.5 Data Model Diagrams

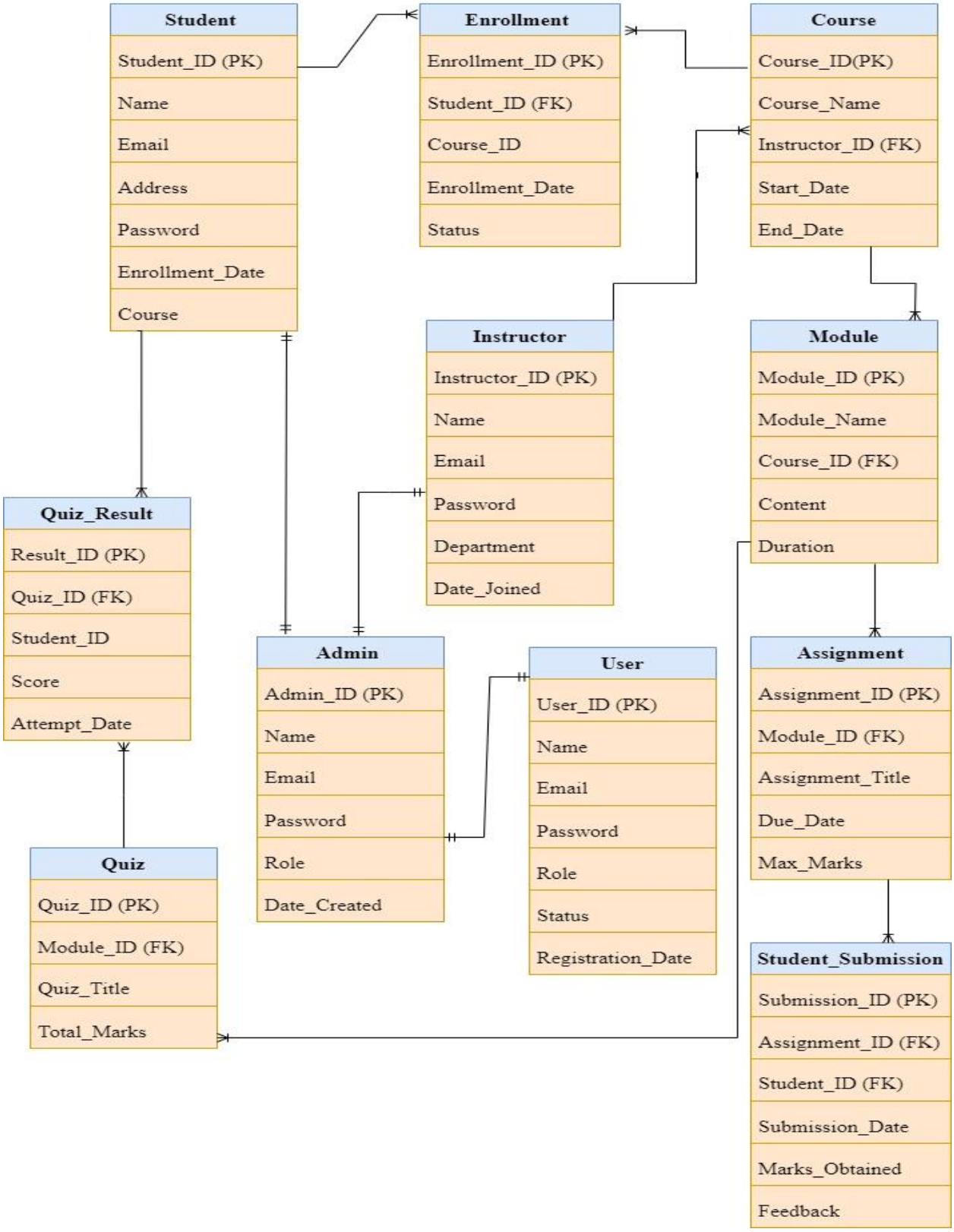


Figure 7: Data Model Diagram

3. Detailed Roles and Responsibilities

3.1 MIT240256

Arafat Hossan – Front end & backend developer

- Design the overall system architecture, including database schema, server-side logic, and client-side interface.
- Guide and support team members in implementing features based on technical requirements.
- Break down tasks for the team and assign responsibilities.
- Review code to ensure best practices, security, scalability.
- Identify and resolve technical issues or roadblocks.
- Develop and implement server-side logic, APIs, and services to handle user authentication, data retrieval, and course management.
- Design and implement the database schema according to the platform's data model.
- Ensure the integrity, availability, and security of the platform's data.
- Manage database backups, migrations, and restoration processes.
- Optimize database performance, including query optimization and indexing.

3.2 MIT240256

Imtiaz Ahmed Rahat – Database Designer and Developer

- Overseeing the design of the database, making sure that all data models are appropriately normalized and efficient.
- Integrating the real-time analytics engine to enable the tracking of student interactions and course progress.
- Securing the backend services, which includes implementing role-based access control (RBAC) for students, instructors, and admins.
- Working closely with the front-end developer to ensure a seamless experience for users.
- Monitor server performance, optimize queries, and troubleshoot any server-related issues.
- Collaborate with both the front-end and back-end developers to guarantee a smooth integration.
- Ensure that the technical documentation is kept up to date and aligned with development changes.

3.3 MIT231859

Juma Valentine Mareva – Data Analyst

- Creating a pipeline for analytics: collecting, processing, and visualizing the data.
- Work with developers to build in real-time analytics into the platform.
- Design the charts and graphs that comprise the analytics dashboard; some common ones are course student performance and class progress.
- Analyze and give recommendations based on the trends and patterns reflected in the data.
- Ensure the reports of analytics are understandable and actionable to students and instructors alike.
- Liaise with the QA engineer on the accuracy of data reporting.
- Installation and configuration of servers, environments, and hosting platforms.

4. Table of weekly activities

WEEK	ACTIVITY	DESCRIPTION	DELIVERABLES/OUTCOME
1-2	UI/UX Design & Frontend Development	Start the designing and developing the front-end interfaces for the e- learning system (student, admin, and instructor dashboards)	Initial UI/UX pages, basic frontend components
3-6	Backend Development (User Management & Course Management)	Develop backend functionalities for user management (student, admin and instructor roles) and course management.	Backend code for user and course management features
7-8	Real-Time Analytics Module	Develop the real-time analytics module to track student activities and progress in real-time.	Analytics module integrated with the platform
9-10	Quiz, Assignment, and Submission Modules	Build the modules for quizzes, assignments, and student submissions, including storing results.	Fully functioning quiz, assignment, and submission features
11	Testing & Debugging	Conduct system integration testing, bug fixing, and ensure that all features work as expected.	Completed system testing report, bug fixes
12	Final Deployment & User Training	Deploy the platform on the production server and provide training to users (admins, instructors and students).	Deployed platform, training sessions, user guides

5. Installation of Software/ hardware Specifications:

The following are the different ways the e-learning platform with real-time analytics will be implemented:

Technology Stack

It has a frontend to create a user interface, we will be using react · js or Angular. js.

- Backend : Python to implement server-side logic
- Database: PostgreSQL relational data. We are going to implement some other technologies
- Real-time analytics tool : Apache Kafka for real-time data streaming. Think of it as batch and real-time analytics.

Software and Applications

- IDE: Write and maintain code using PyCharm / VS Code
- GitHub or GitLab for source control (eg, maintaining the code repositories)
- CI/CD: Jenkins/GitLab CI for testing and deployment pipes convertible in version-control files.
- Visualization Tools: Develop dashboards in D3.js that display graph view, heat maps et cetera based on real-time analytics.

Hardware

- Servers: 2 multi-core, minimum 32 GB RAM and 2 TB SSD storage for data storage and processing requirements. They use high-speed (1 Gbps) hosting for fast data transfer on the network.
- Backup: Cloud redundancy and finance disaster recovery mechanism on the AWS S3.
  Security and Compliance
- Secure: SSL/TLS protocols to secure the data while encrypting.
  Role-based access control would result in students, teachers and administrators having different accesses.
- GDPR Compliance: Set privacy laws to data handling

6.Other related Detailed Design

6.1. Analytical design

In analytical steps all types of data will collect from the databases. After that we will clean data and merging the data then describe the data,. also solve the issue if any data related issue found . Then will analysis this and show in the dashboard by using different types of graphs.

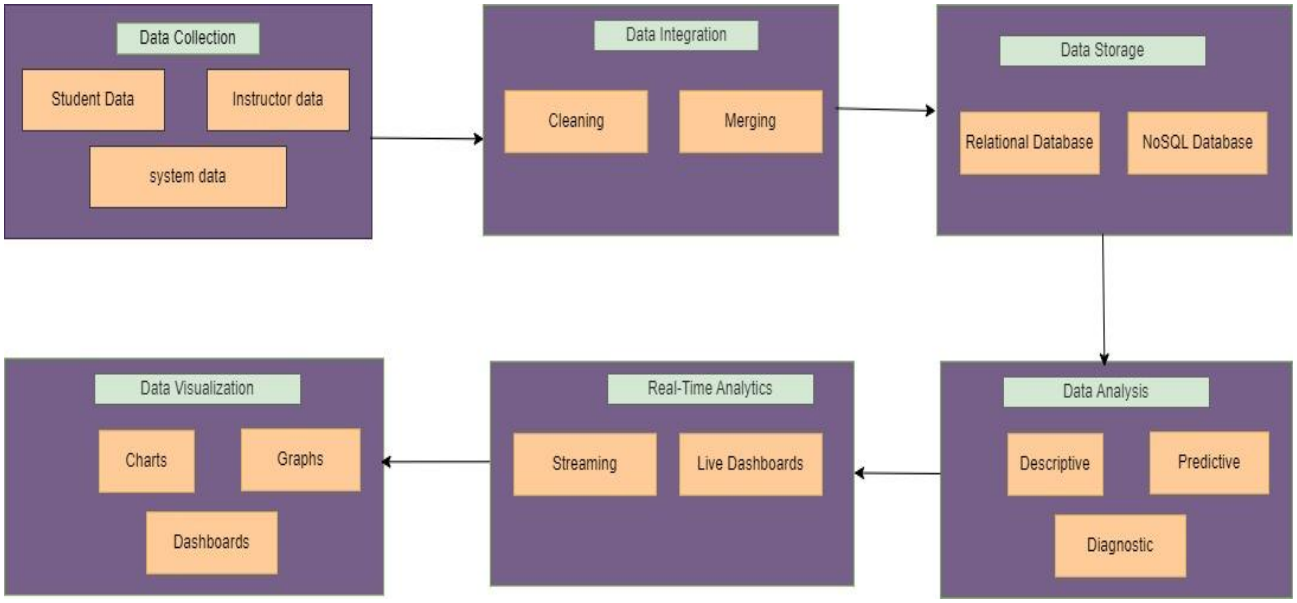
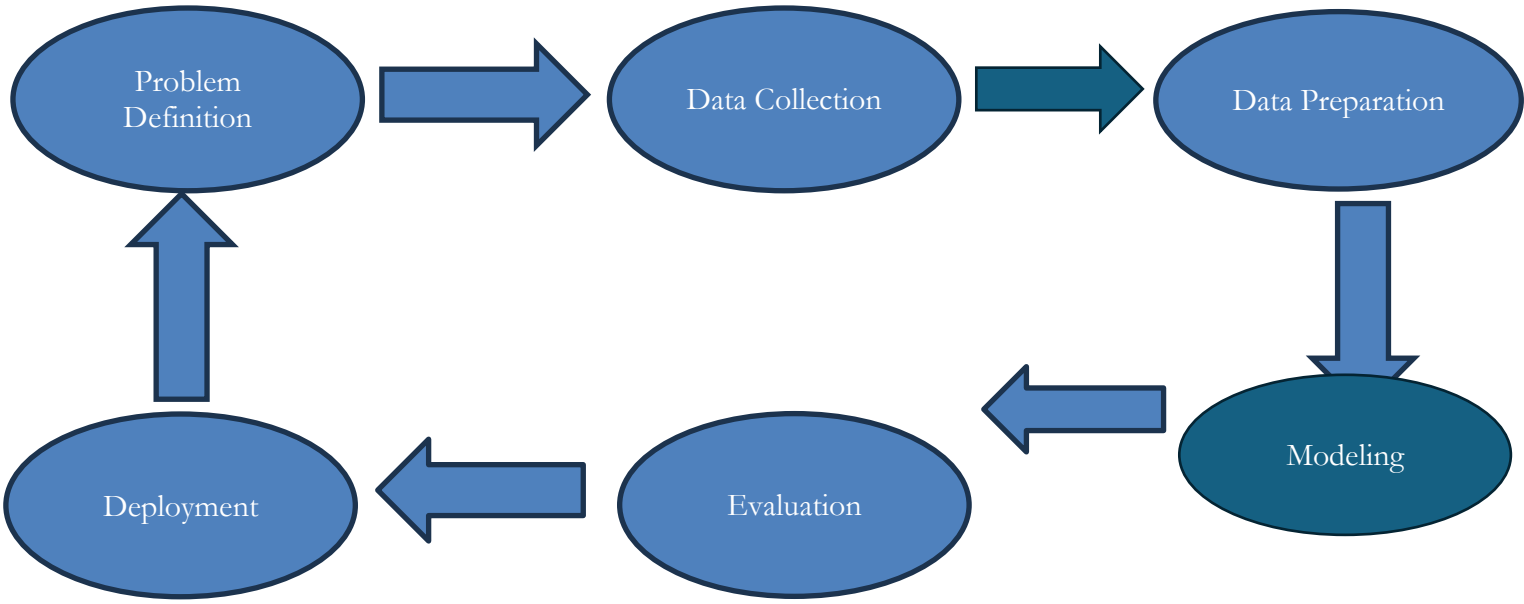


Figure 8: Analytical Steps Diagram

6.2 Deployment

After evaluating the models and analytic tools, they should be put into use in a live e-learning platform. Continuous review assures that the system is working appropriately adding more advancements in it after wards.



References

[1] VICTORIA STATE GOVERNMENT(DEPARTMENT OF EDUCATION), "Feedback and reporting," VICTORIA, 2022.
[2] ScienceDirect, "Artificial intelligence in education: A systematic literature review," 2024.
[3] V. E. Riordan Alfredo, "Human-centred learning analytics and AI in education: A systematic literature review," ELSEVIER, 2024.

Appendices

Appendix I: Industry Client Details

Project Title: E-learning Platform for Courses with Real-Time Analytics

Name of Industry Placement Agent

Agent Name: Arif Systems

Contact Name: Dr. Arif Jubaer

Contact number: 0411215302

Emailid: **info@arifsystems.org**

Industry Client Details :

Company Name: Skill Sync

ABN: 12670804592

Company address: Level 7 / 276 Flinders Street, Melbourne, VIC, 3000

Company Profile: Helping businesses source exceptionally skilled professionals across diverse sectors. Through the company's remote recruitment solutions, businesses can enhance their resilience, competitiveness, and profitability, all while reaping the benefits of reduced labour expenditures. Our refined methodology guarantees a smooth end-to-end journey, ensuring a frictionless encounter.

Website: https://skillsync.com.au/

Industry Professional (Contact) Name: Tanvir Iqbal

Client emailid: iqbaltanvir@outlook.com

Brief Bio of the industry professional: Tanvir is a tech lead at Skill Sync.