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Original Study

An AI-powered personalised self-learning system at the University of Kisubi. A cross-sectional study.

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Abstract

Background:

Traditional learning approaches in higher education often fail to address the diverse learning needs of students due to limited personalised support, delayed feedback, and increasing class sizes. This study aimed to develop an AI-powered personalised self-learning system to improve learning experiences, increase student engagement, and enhance academic performance at the University of Kisubi.

Methodology:

A qualitative case study research design was adopted. The study was conducted at the University of Kisubi using a sample of 24 respondents comprising students, lecturers, administrators, and support staff selected through random sampling. Data were collected using questionnaires and analysed thematically to establish the functional and non-functional requirements of the proposed system. The identified requirements guided the design, development, implementation, testing, and validation of the AI-powered personalised self-learning system.

Results:

The study established that the existing learning system lacked personalised instruction, real-time feedback, adaptive learning pathways, and flexibility to accommodate diverse learner needs. Functional requirements identified included secure user registration and authentication, personalised learning paths, real-time feedback, interactive quizzes, content management, and performance analytics, while non-functional requirements emphasised usability, scalability, security, and system performance. The developed system was successfully implemented using HTML, CSS, JavaScript, PHP, and MySQL and incorporated AI-based adaptive learning features. System testing and user validation confirmed that all core functionalities operated as intended, enabling personalised content delivery, immediate feedback, efficient course management, learner progress tracking, and an intuitive user interface. The findings demonstrated the system's potential to improve student engagement, support self-paced learning, and enhance academic performance.

Conclusion:

The AI-powered personalised self-learning system successfully addressed the limitations of the existing learning approach by providing adaptive, learner-centred educational support.

Recommendations:

Educational institutions should adopt and integrate AI-powered personalised learning systems into their teaching and learning processes to promote individualised instruction and continuous assessment.

Keywords: *Artificial Intelligence, Personalised Learning, Intelligent Tutoring System, Self-learning system.*
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Background of the study

The journey of Artificial Intelligence (AI) powering online tutor systems is a rich material merged through periods of human development (Grzybowski et al., 2024; Yevstratov, 2025). The attraction of creating entities with the imprint of human intellect dates back to early civilisations and traditions (Chumakov, 2025), where stories of artificial beings capable of intelligence fired the imagination of societies.

The ancient Greeks, for instance, visualised automatons capable of limiting human actions. In their tradition, the skilled craftsman Hephaestus was said to have created mechanical servants. Traditional education often struggles to provide individualised attention to students (Saleem et al., 2025). Large class sizes and limited teacher resources can make it difficult for teachers to cater to each student's learning style and pace (Saleem et al., 2025). AI-powered personalised systems have the potential to bridge this gap by

offering a personalised learning experience that adapts to every student's needs (Abimbola et al., 2024). Institutions in the educational technology industry have developed Individual Adaptive Learning Systems that allow personalised learning, Aided Teaching Systems that assist classroom environment management, grading, evaluation, and second-language problems; and Institute Administration Systems that help with student enrolment and enquiries, etc. (Abimbola et al., 2024; Bhatia et al., 2024). As institutions proceed apace with AI-based innovation, issues arise, such as how to integrate AI-powered online tutor-based education systems with macro education institutions and micro education contexts, and the roles played by stakeholders in the AI-based education environment (Al-Omari et al., 2025). This study aimed to develop an AI-powered personalised self-learning system to improve learning experiences, increase student engagement, and enhance academic performance at the University of Kisubi.

Methodology

Study area

This study took place in the computer laboratory at the University of Kisubi, located 25 km along Kampala – Entebbe Road.

Study population and sampling

The target population for this study consisted of students, lecturers, non-teaching staff members, and administrators of the University of Kisubi, as simplified below.

Table 1: Sample structure and sample Size

Category	Targeted size	Sample size	Sampling techniques
Dean faculty	1	1	Random sampling
Lecturers	4	4	Random sampling
Other staffs	5	5	Random sampling
Students	15	14	Random sampling
Total population	25	24	Random sampling

Sampling Procedure and Sampling Space

The study employed random sampling by using lists of names of confined and odd names were selected. A sample of 24 respondents was used to provide the information required.

Data Collection

In order to explore the AI-Powered personalised system, data were collected using questionnaires from the respondents (students, lecturers, and Dean of Faculty). The questionnaires were designed to answer the research questions.

Data Presentation and Analysis

I used qualitative research methods to analyse data. Each question had its responses coded by assigning codes to responses for each item. The responses were categorised into themes based on the research questions and objectives. Categories like demographic information were analysed using descriptive statistics such as frequencies, percentages, and averages.

AI-Tutor system development method

Machine Learning Pipeline Algorithm: In machine learning, I first define a clear problem statement that I want to solve using ML. Once it's defined, I try to find or create the dataset for that problem statement. Data consists of input and true target variables for which machines try to find the mapping function. After finalising the dataset, I pick the appropriate machine learning algorithm to solve the problem statement. Now select ML algorithms to produce the desired output as a solution.

Data analysis

Qualitative Data

Qualitative data from interviews and focus groups was analysed using thematic analysis. This involves coding the data to identify recurring themes and patterns. The qualitative insights complemented the quantitative findings, offering a deeper understanding of user experiences and expectations.

Research design

I adopted a Qualitative research method that focused on numerical data and statistics. Qualitative research is more descriptive and interpretive, aiming to provide a comprehensive understanding of the research problem. According to Plano Clark (2017), qualitative research is particularly effective for exploring complexities within their contexts. It allows researchers to collect rich, detailed data that can reveal the nuances of human experiences and social processes. machine learning algorithm to solve the problem statement. Now select ML algorithms that produce the desired output as a solution.

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Machine Learning Pipeline Algorithm Methodology

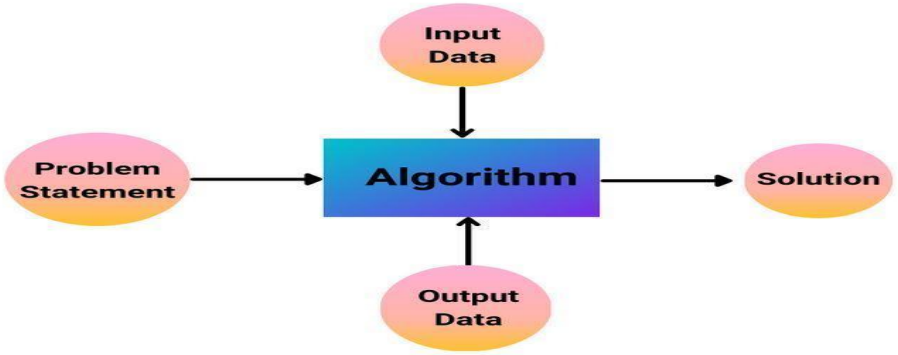

Figure 1: https://www.enjoyalgorithms.com/blog/classification-of-machine-learning-models

Implementation Plan

The Target Audience and Learning Objectives was in this way**:** Who will the AI online tutoring cater to? What subjects will it focus on? Clearly defining these aspects guided development.

Content and the Knowledge Base were developed by compiling high-quality, relevant content for the chosen subject area. This formed the foundation of the AI online tutor's knowledge.

Then the User Interface (UI) was designed, which was a user-friendly and engaging interface that facilitates communication with the AI tutor. Study elements like a conversational interface, progress tracking dashboards, and clear navigation tools

Core Components were developed, that is, the student model, pedagogical engine, and NLP functionalities using suitable tools and frameworks.

External Resources were integrated by connecting the AI online tutor with relevant external learning materials to enhance the learning experience.

Lastly, Testing and Modification: A thoroughly tested AI online tutoring system was developed to identify and address any bugs or limitations, and this was done to gather user feedback and repeat based on their experiences.

Ethical Consideration

Informed consent was considered such that the person who participated in the evaluation was fully informed about the evaluation being conducted, and Participants were alerted about the purpose of the research study. Confidentiality was also considered such that any identifying information was not made available to, or accessed by, anyone but the program coordinator.

Field study and system design

The Nature of the Current System

The institution currently employs a manual system for managing records and student information, relying heavily on pen and paper. All data entries, including student information, are manually recorded and stored in allocated box files, which are considered the safest storage method. This system does not support data integration or sharing among users, as every task is executed manually.

Strengths of the Current System

Despite its limitations, the current manual system has several strengths:

Compatibility with Daily Tasks**:** The system is compatible with the daily operations of the institution. The records entered manually can still be used to generate reports that aid in decision-making.

Cost-Effective in Training**:** There are no costs associated with training staff to use this system. The simplicity of the manual system negates the need for extensive training programs.

Weaknesses of the current system

The current system for the AI-powered online tutor has several critical weaknesses. It lacks accessibility and flexibility, confining students to physical classrooms and fixed schedules, without accommodating different learning styles or needs for personalised instruction.

System requirements

The system requirements consist of the functional requirements that state what the system will do and non-functional requirements that state the usability or the behaviour of the system, all derived from the problems of the current system.

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Functional Requirements

User Registration and Authentication: The system should allow users (students and faculty) to register and authenticate securely.
Personalised Learning Paths: The AI engine should analyse student performance data and generate personalised learning paths.
Real-time Feedback: The system should provide instant feedback on student progress and performance.
Interactive Learning Modules: The system should include interactive elements such as quizzes, simulations, and exercises.
Content Management: Faculty should be able to upload and manage learning content.
Analytics Dashboard: The system should provide detailed analytics on student performance and engagement for faculty.

Non-Functional Requirements

Scalability: The system should be able to handle a growing number of users and data.
Security: The system should ensure data privacy and secure access to sensitive information.
Usability: The user interface should be intuitive and user-friendly.
Performance: The system should perform efficiently with minimal latency.

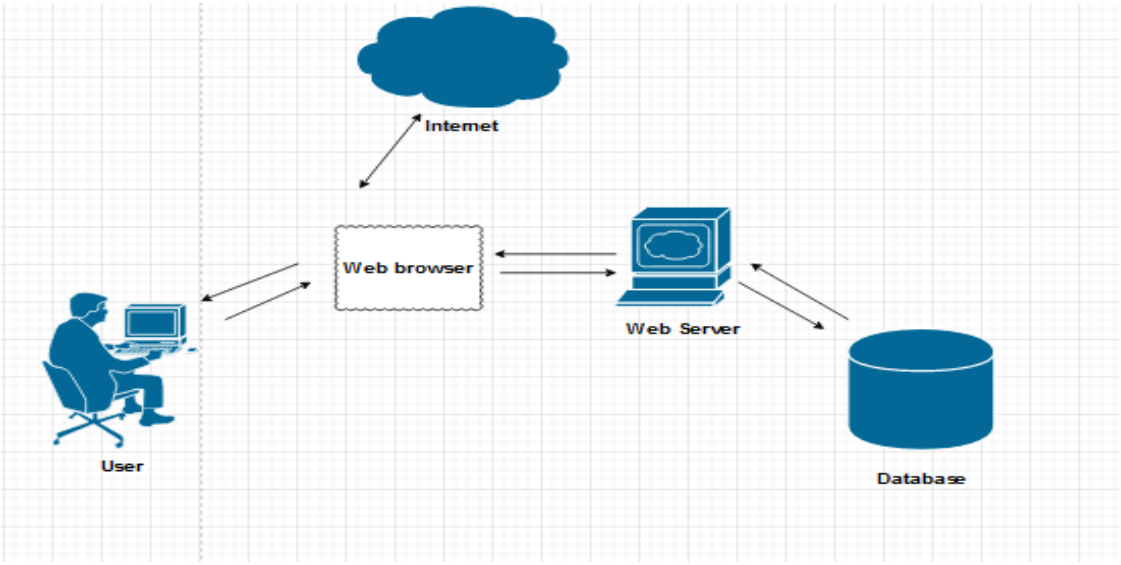
System Design

The system was designed using Architectural design, Context flow diagram, Data Flow diagram, and Entity Relationship Diagram.

Architectural Design

The system architecture is designed to integrate several components, including the user interface, AI engine, content management system, and analytics module. The architecture follows a modular design to ensure scalability and maintainability.

Figure 2: Architectural Design



The context flow diagram

A context diagram, sometimes called a level 0 data-flow diagram, is drawn to define and clarify the boundaries of the software system. It identifies the flows of information between the system and external entities.

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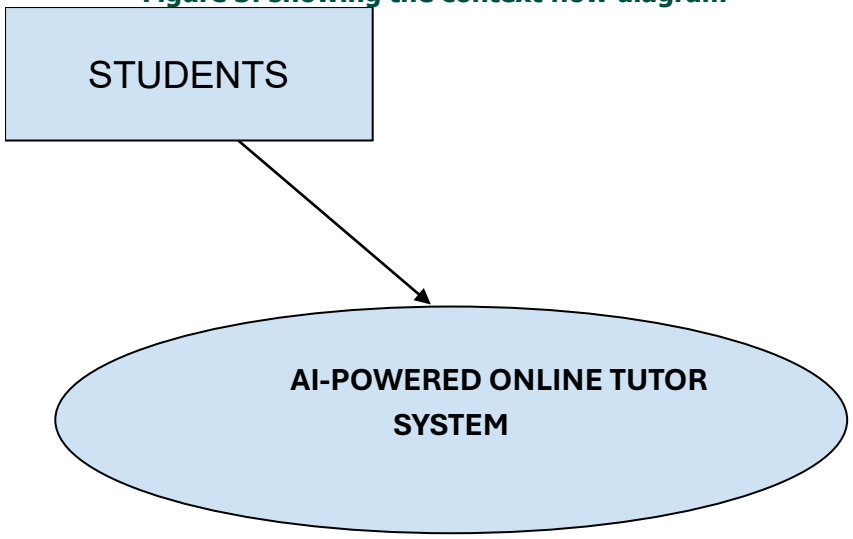
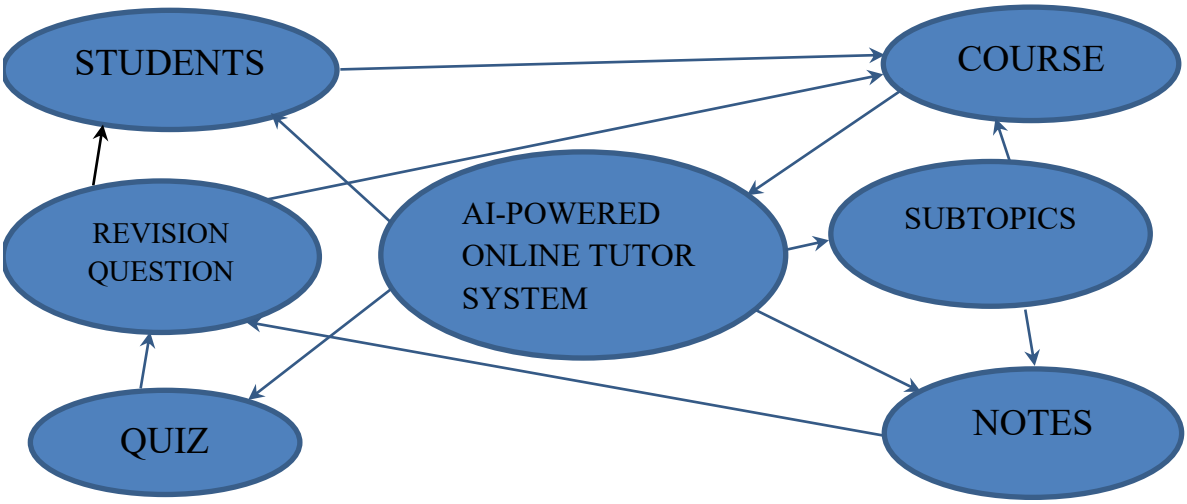
Figure 3: showing the context flow diagram



Data Flow Diagram

The Data flow diagram illustrates the interaction between users and the system. It shows how data flows from the user interface to the AI engine and back to the user, highlighting key processes such as user registration, content delivery, and feedback generation.

Figure 4: Showing Data Flow Diagram



The Use Case Diagram

The use case diagram for the AI-powered online tutor system illustrates the interactions between the student and the system. It identifies the main functionalities of the system and shows how the student engages with these features. This diagram serves as a blueprint for understanding the system's requirements and the scope of the interaction.

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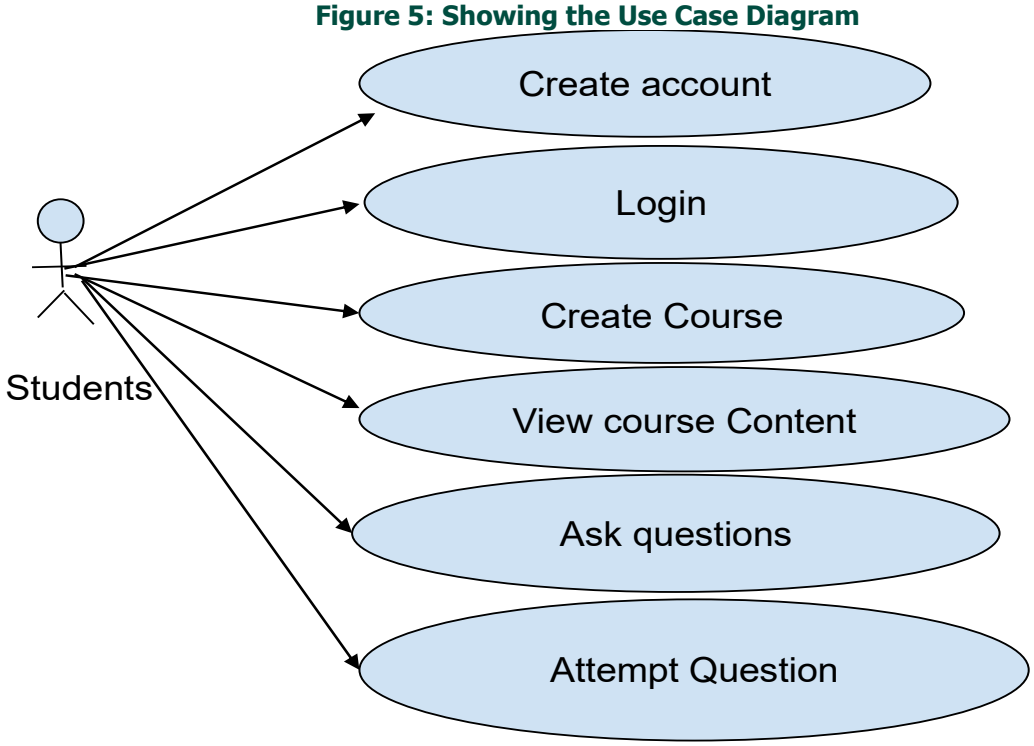
Figure 5: Showing the Use Case Diagram



Entity Relationship Diagram

The entity relationship diagram (ERD) outlines the database structure, depicting the relationships between different entities such as users, courses, learning materials, and performance data. The ERD helps in organising and managing data efficiently.

Figure 6: Showing the Entity Relationship Diagram

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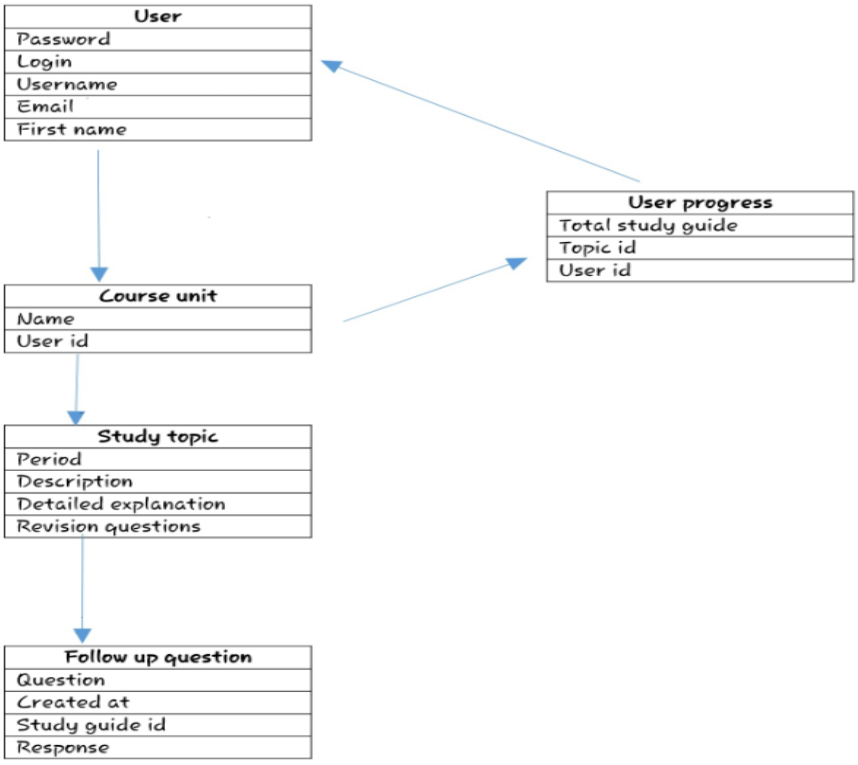

System Implementation

The implementation phase involves developing the AI-powered online tutor system based on the design specifications. The following technologies are used:

User Interface: Designed with HTML, CSS, and JavaScript to ensure an intuitive and responsive interface.

Backend Development: Implemented using PHP for server-side logic and MySQL for database management.

Content Management System: Allows faculty to upload and manage learning content easily.

Testing and Validation

System testing involves multiple stages, including unit testing, integration testing, and user acceptance testing (UAT). Each stage ensures that the system functions correctly, meets user requirements, and performs efficiently.

Implementation and testing

Interface screenshots

The following are the screenshots of interfaces for the developed system;

The Sign-in page

The user registration page allows new users to create accounts. This includes fields for personal information and security credentials. The interface is designed to be smooth, with clear instructions and error handling to ensure a smooth registration process.

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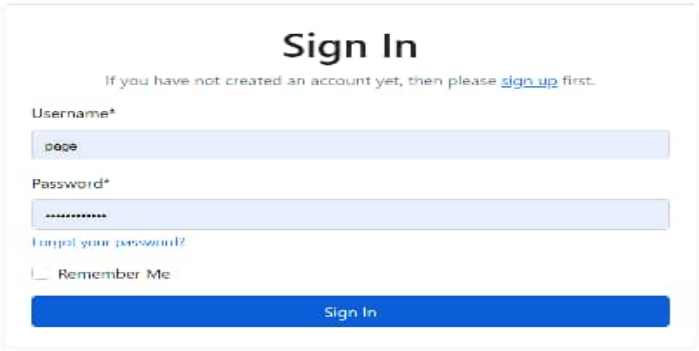
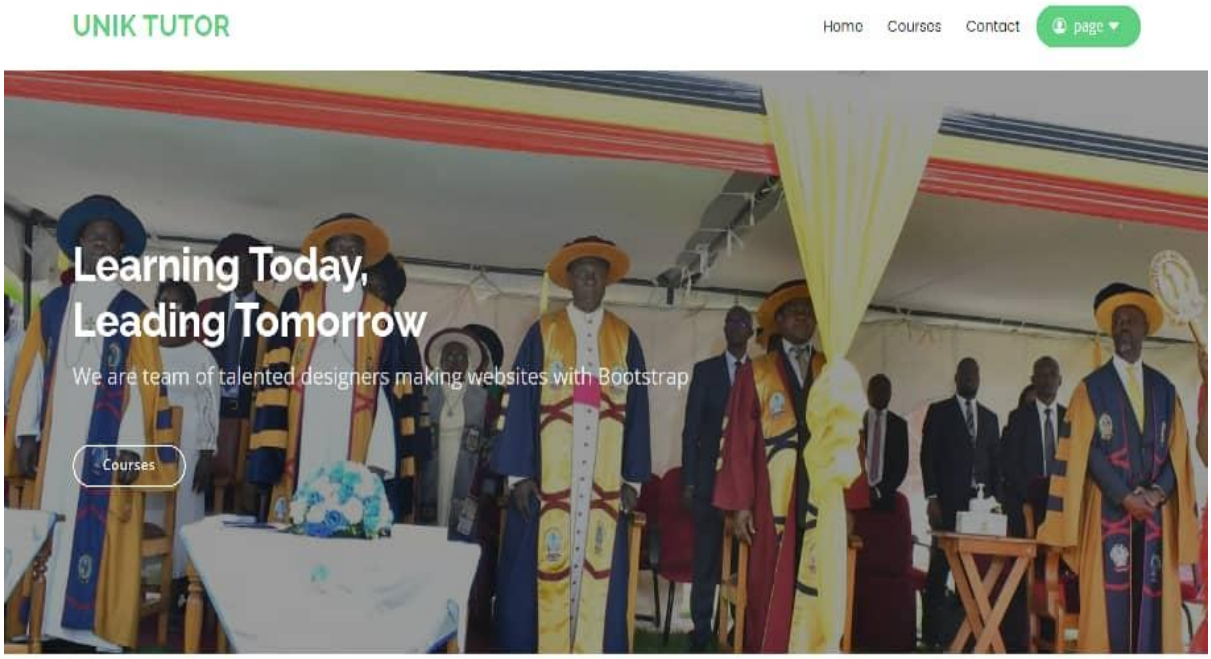


Dashboard Overview

The main dashboard provides an overview of the student's progress, upcoming assignments, and personalised recommendations. The dashboard is designed to be the central hub for students, giving them quick access to essential information and tools.



The Study Courses Unit

This screenshot displays the course units that the student has engaged with. The design and functionality are optimised for easy navigation and efficient study management.

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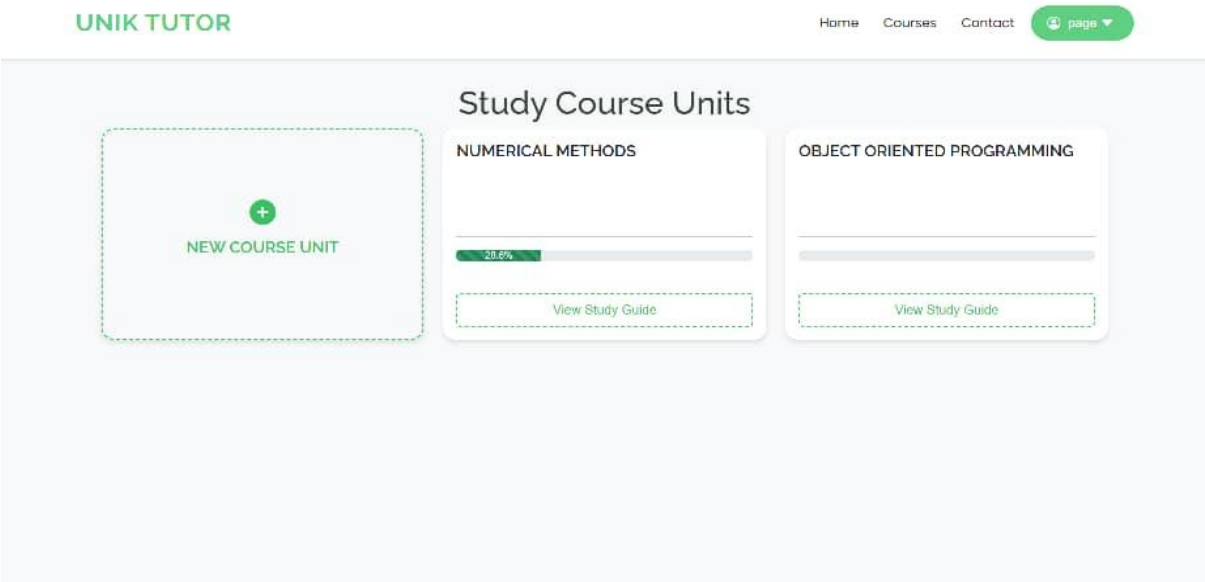
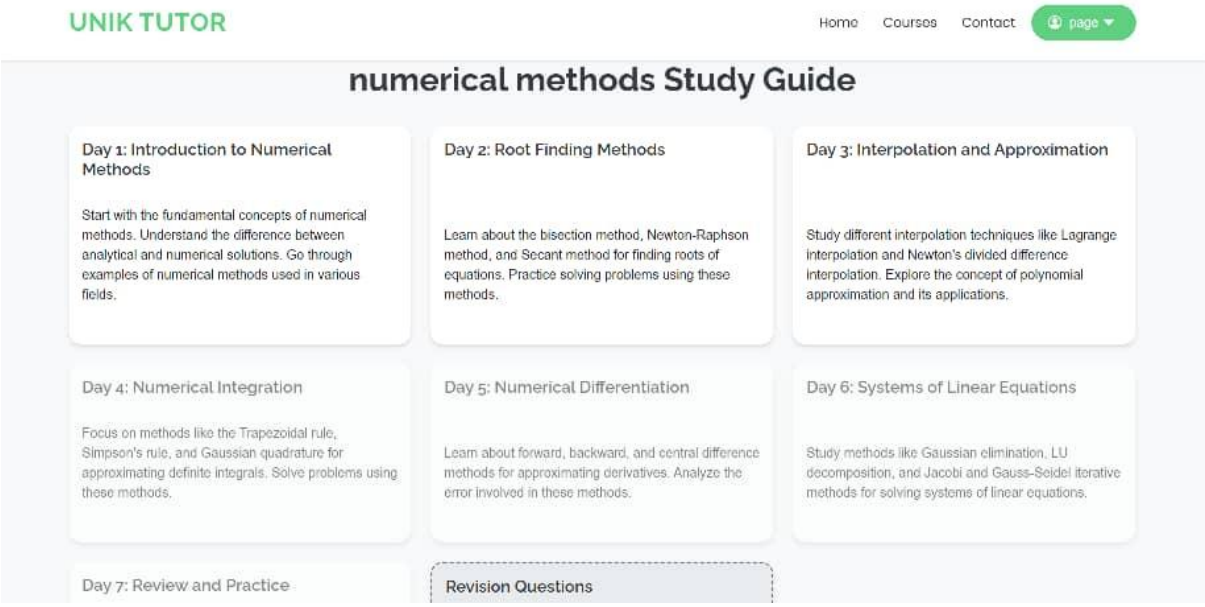


The Course Study Guide

This screenshot displays the detailed study guide for the "Numerical Methods" course unit. The study guide is structured to provide a clear and organised roadmap for students to follow.



Interactive Quiz Module

The interactive learning module includes quizzes, simulations, and exercises tailored to individual learning paths. This module aims to enhance engagement and retention by providing interactive and personalised content. The design incorporates elements of gamification to motivate students and make learning more enjoyable.

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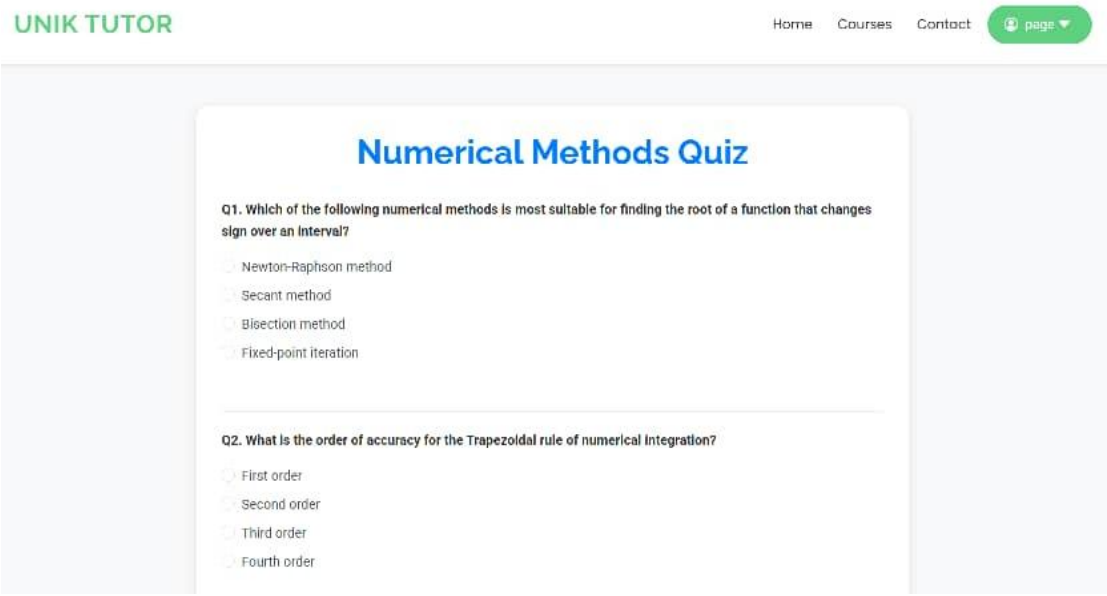
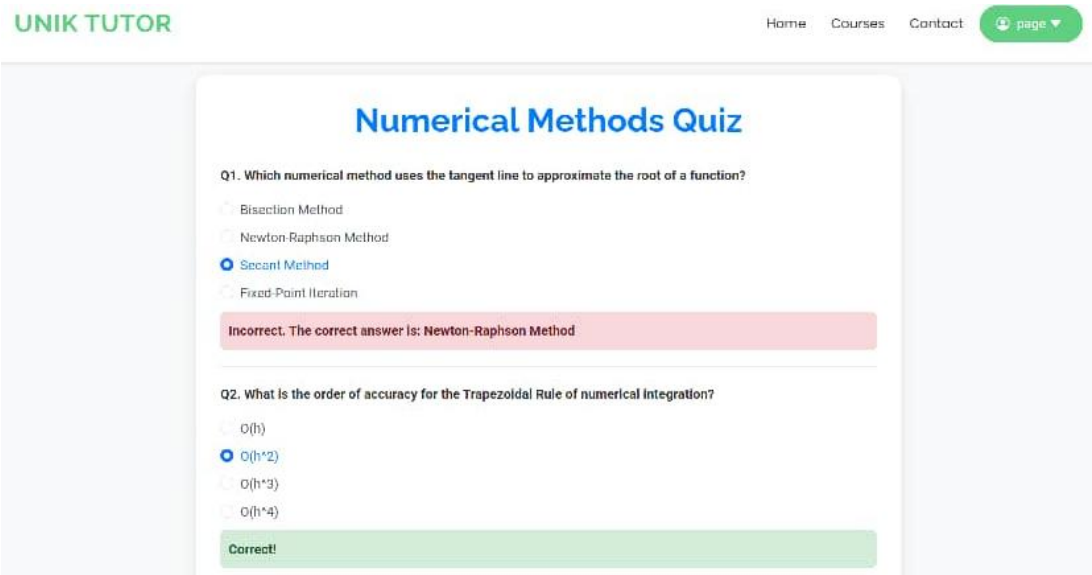


Feedback Mechanism

The feedback mechanism provides real-time feedback to students on their performance, highlighting areas for improvement and offering resources for further learning. This feature is essential for adaptive learning, allowing the system to adjust the difficulty and focus of the content based on the student's progress.



Discussion

System requirements

The requirements for developing the system were determined from two sources, namely library research and field study. The study presented the requirements of the system in two ways, namely functional and non- functional requirements.

Functional requirements were used to build the interactive part of the system, and non-functional requirements were used to build what is admired about the system as required by the software development process.

In this study, the requirements are presented in Chapter 4,

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which were then used to design the system. Therefore, system requirements were achieved as in Objective 1 in Chapter One.

System design.

The design of the system in this study was presented in chapter four, which involved architectural designs, activity diagrams, context diagram, use case diagram, and finally the back-end design, which is the database in the form of an Entity Relationship Diagram. The design was used for the proposed system implementation; therefore, the design was achieved as stated in chapter one objective 2.

Implementation of the system

The system was implemented using various software technologies used for the front end and back end, such as:
HTML as the scripting language that was used in the front end for creating and structuring sections, paragraphs, headings, links, and block quotes for web pages and applications. CSS is a language that was used to style HTML documents, describe how it is displayed, and control the layout of multiple web pages (Mazinanian et al 2014, November).
PHP, as a server-side scripting language, was used for integrating the database of MySQL and to deal with forms such as saving, adding, deleting, and modifying elements within the database. MySQL is used in the back end for storing data and displaying categorised and searchable information to the web user with the help of scripting languages such as PHP.

System Testing and Validation

The system was subjected to testing by inputting data and observing the output observed (system reaction observed). The system was also validated with some specific users from whom data were collected so as to ensure user acceptance of the system.
For system testing, the outputs are shown as screenshots. So the testing and validation were done successfully.

Limitations

However, there were some limitations of the study which are recommended for future work. The system does not support any payment modes, such as credit/debit card transactions, mobile money payment services, or other electronic payment methods. This limitation poses a challenge for institutions that may want to integrate payment for courses, materials, or other educational services directly through the system.

Conclusion

Based on the collected data and the comprehensive analysis conducted during this study, it is evident that the proposed AI-powered tutor system is a robust solution. The findings demonstrate a strong inclination among the respondents towards embracing an AI-driven educational tool, reflecting the growing acceptance and integration of advanced technologies in the academic environment.

Recommendation

The system has been developed; therefore, the AI-powered online tutor system should be implemented across educational institutions to transmit and provide students and educators with essential information. The system should be fully integrated into the curriculum to assist in the learning and teaching process, offering personalised tutoring and real-time feedback.
The academicians are recommended to study the developed system to make further advancements.

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Thanks be to God who always gives me guidance from the beginning and victory till now in all things; I give him thanks. I also wish to salute all the authors and authorities whose valuable works I have referred to in this book. I would like to thank all my lecturers who have offered and done their work of enriching me with knowledge; special regards to Dr Angole Richard for the guidance and advice at all stages of my research project. Despite his other duties, he took time to meet me and supervise plus guided me on how the research project ought to be. His encouragement, discussions, and fruitful suggestions have made the entire work reach this far.
Special thanks to my colleagues in the profession, comrades in the subject (project presentation), and all those who have appreciated my work. I would like to say thank you for the encouragement.
Lastly, my beloved friends within the Kisubi University vicinity and outside, I appreciate your support when I need your helping hand.

List of abbreviations

ML- Machine Learning.
AI- Artificial Intelligence.

PMS	Property Management System
DSS	Decision Support Systems
ESS	Executive Support Systems
KMS	Knowledge Management Systems
TPS	Transaction Processing Systems
OAS	Office Automation Systems
EIS	Enterprise Information Systems
MIS	Management Information Systems
ERD	Entity Relationship Diagram
EDRMS	Electronic Document and Record Management System

Data availability
Data is available upon request from the corresponding author.

Informed consent
Written informed consent was obtained from all participants before their inclusion in the study. Participants were informed about the purpose of the study, procedures involved, potential risks and benefits, and their right to withdraw at any time without penalty.

Source of funding
The study did not receive any external funding.

Conflict of interest
The author did not declare any conflict of interest.

Author contributions
Jovan Mulindwa and Hillary Tumwesigye conceptualised the study, developed the proposal, collected and analysed the data, interpreted the findings, and prepared the final research report.
Richard Angole and Aloyzious Ssenteza supervised the whole research process.

Author Biography
Jovan Mulindwa and Hillary Tumwesigye are students pursuing a Bachelor of Science degree in Computer Science in the Faculty of Business and ICT, University of Kisubi.
Aloyzious Ssenteza and Richard Angole are Lecturers in the Faculty of Business and ICT, University of Kisubi.

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