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DEVELOPMENT OF A LEARNING MANAGEMENT SYSTEM FOR THE DEPARTMENT OF COMPUTER SCIENCE, AKWA IBOM STATE POLYTECHNIC, IKOT OSURUA

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ABSTRACT

The rapid evolution of technology has necessitaed the development of efficient Learning Management System (LMS) in academic institutions. This paper presents the design, implemetation and evaluation of a bespoke LMS for the Department of Computer Science. The system integrates core functionalities such as course management, assignment handling, grade tracking, and collaborative tools, taloired to meet the specific needs of students and facculty. Developed using the MERN STACK, The was designed using a user-centererd approach, focusing on specific needs of Computre Science Department. The system architecture follows a modular structure, leveraging the MERN. LMS emphasizes user experience, scalability, and seamless integration with existing university testing indicate significant improvements in academic workflow efficiency and student engagement. The LMS serves as a model for institutions seeking to modernize their educational frameworks. Results suggest the LMS enhances learning experiences and academic processes, serving as a viable model for other departments.

KEYWORDS: Learning Management System, higher education, system development, educational technology

INTRODUCTION

In the evolving landscape of higher education, Learning Management Systems (LMSs) have become indispensable tools for facilitating teaching and learning, particularly in resource-constrained environments such as developing countries (Pham *et al.*, 2022). These platforms enable the delivery of course content, student assessments, and administrative oversight in a digital format, promoting accessibility and efficiency (Sanchez & Penarreta, 2024). In Nigeria, where educational institutions face challenges such as large class sizes, limited infrastructure, and inconsistent power supply, the adoption of LMS can significantly improve pedagogical outcomes (Yakubu & Ugbe, 2025; Iliya & Benjamin, 2025).

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Akwa Ibom State Polytechnic, located in Ikot Osurua, is a pivotal institution that offers technical education in southern Nigeria. The Department of Computer Science, with its focus on practical computing skills, identified a need for a customized LMS to streamline workflows for lecturers, students, and administrators. Traditional methods, reliant on physical handouts and manual grading, often lead to inefficiencies and reduced student engagement (Aldheleai, H. *et al.*, 2023). This project, seeks to develop a secure, scalable LMS tailored to departmental needs.

The objective is to create a system that supports course delivery, assignment submission, grading, announcements, user management (including roles for students, lecturers, and HOD), and basic analytics for performance monitoring (Umoh, 2025). This aligns with broader goals of digital transformation in African higher education, where LMS adoption has been shown to enhance student retention and learning flexibility (Maluleke & Maake, 2025).

Evolution and Benefits of LMS in Higher Education

Learning Management Systems have advanced significantly since the mid-2010s, evolving from bare content repositories to comprehensive platforms with analytics and mobile access (Abid, A., 2024). Benefits include centralized resource management, improved collaboration, and data-driven insights into student performance (Movchan, S., 2025). In polytechnics, where hands-on training is emphasized, LMS facilitates blended learning, allowing students to access materials at any time, which is crucial in areas with limited campus facilities. Studies show LMS usage can increase engagement by 35% and retention by 25% in universities (Astria Learning, 2025).

In Nigeria, LMS implementation has grown, particularly post-COVID-19, with platforms like Moodle and Google Classroom adopted in institutions (Academic Motivation and Use, 2025). A potent tool for transforming Nigerian education, LMS addresses inequities by enabling remote access in underserved regions (Sa'ad & Isa, 2025). For instance, in federal colleges, LMS enhances teaching efficacy and student interaction (Iliya & Benjamin, 2025).

Challenges in LMS Development and Adoption in Developing Countries

Developing LMS in low-resource settings presents unique hurdles. Key challenges include infrastructure deficits, such as unreliable internet and power, which hinder deployment and usage (Aung & Khaing, 2016; Saxena, R., 2023). In developing countries, adoption barriers encompass ICT skill gaps, high costs, and resistance to change (Pham *et al.*, 2022; Mbewe, S., 2025). Nigerian studies highlight similar issues: poor network infrastructure, limited developer availability, and budget constraints (Utilization of Learning Management System, 2025; Yakubu & Ugbe, 2025).

Content development weaknesses and integration with existing systems further complicate projects (Exploring the Critical Challenges, 2020). Institutional support is often inadequate, leading to underutilization (An Assessment of Learning Management System Use, 2024). Despite these challenges, strategies such as cloud hosting and offline features can mitigate risks (Budiman, A. *et al.*, 2024).

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Case Studies and Comparative Analysis

Comparative reviews of LMS platforms reveal that open-source options, such as Moodle, excel in customization for higher education, scoring high in features and scalability (Sanchez & Penarreta, 2024). Case studies from Africa demonstrate that successful integrations can improve academic motivation (Aldheleai, H. *et al.*, 2023). In Singapore polytechnics, the adoption of Blackboard demonstrated benefits in communication but faced initial resistance. Nigerian examples, such as those in Imo State tertiary institutions, underscore the role of LMS in business education, but note underutilization due to training gaps (Odia, J. *et al.*, 2025).

This project builds on these insights, opting for a custom-built solution to address local needs, similar to developments in Saudi Arabia, where barriers such as ICT competencies were overcome through stakeholder involvement (Gamdi & Samarji, 2016).

Methodology

Agile project management methodology which is a flexible and iterative approach that enables teams to quickly adapt to changing project requirements and deliver high-quality results within shorter timeframes was employed. Agile methodologies are about teamwork, customer satisfaction, constant refinement, and breaking big projects into bite-sized pieces. The AGILE methodology with project management life cycle consists of 5 distinct phases including initiation, planning, execution, monitoring, and closure that combine to turn a project idea into a working product.

Project Initiation

The project initiation phase is the first stage of turning an abstract idea into a meaningful goal. In this stage, Defining project goals and objectives are defined, stakeholders and their needs were identified, feasibility analysis was conducted and project scope and boundaries were established. Finally project charter was created.

Requirements Analysis and Specification

A Functional Requirements Document (FRD) was produced, detailing user roles, course management, and security needs. Non-functional requirements included performance targets (e.g., 99% uptime), security (HTTPS/SSL), and accessibility. Use cases and data flow diagrams were prepared and validated through sessions (Umoh, 2025). This phase drew on agile methodologies, allowing for iterative feedback (Smith, S., 2025).

System Architecture and Design

A web-based client-server architecture was selected, featuring React for the frontend, Django (or an equivalent framework) for the backend, and PostgreSQL for the database management system. Schema design covered tables for users, courses, modules, assignments, submissions, grades, and logs. Security plans incorporated password hashing, role-based access control, and input validation (Umoh, 2025). UI/UX mockups, both low- and high-fidelity, were reviewed, incorporating accessibility features like readable fonts (Development of a Learning Management System, 2024).

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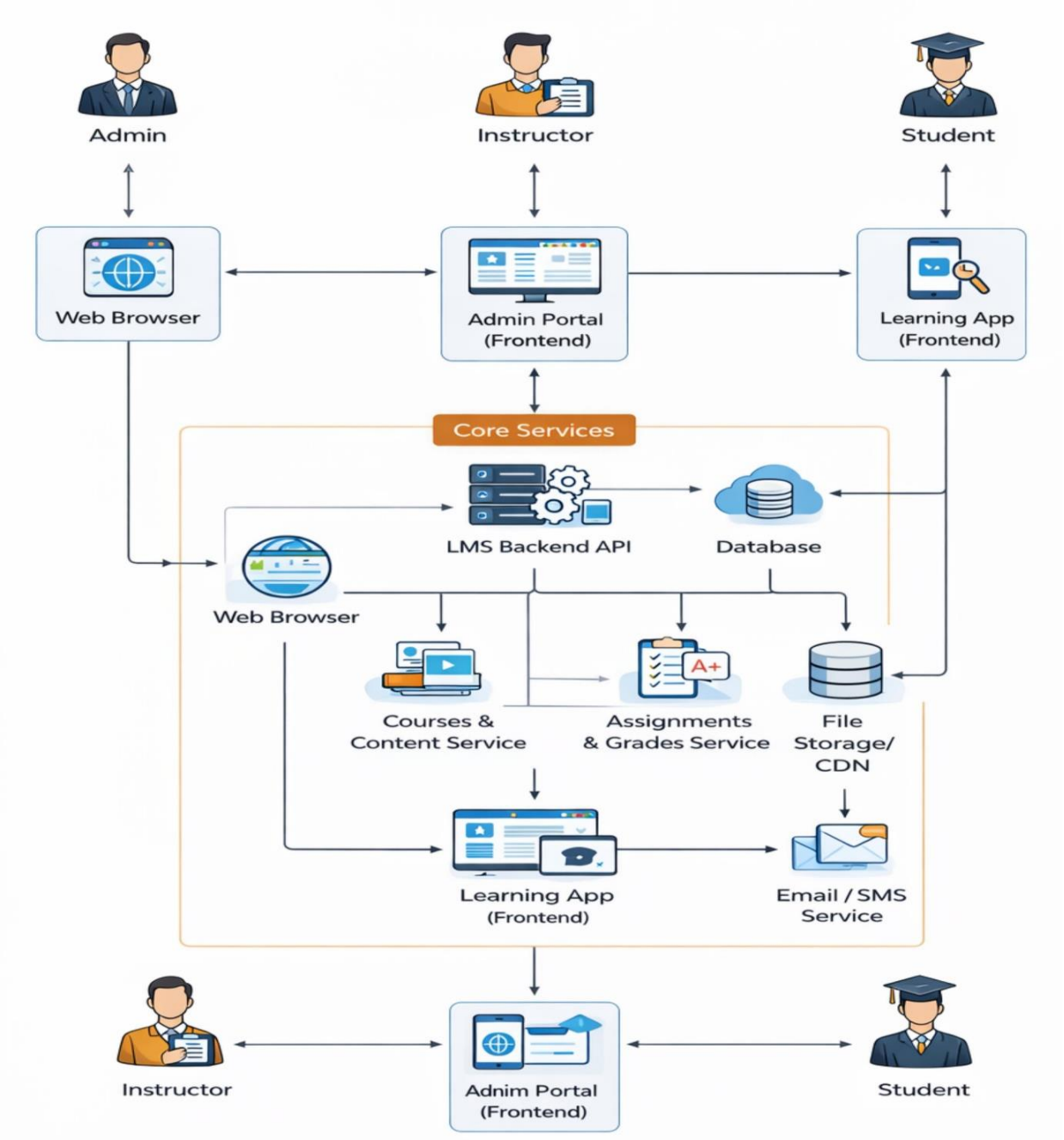

Figure 1: System Architecture

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Procurement and Infrastructure Setup

A test/staging server (cloud VPS) was provisioned, with production procurement ongoing. Networking, backups, and power options were sourced to address local instabilities (Umoh, 2025). Cloud alternatives are considered for reliability (Approval to Proceed, 2025).

Development and Testing

Core development uses Git for version control, with branching and CI outlines. Completed modules include authentication, course creation, resource uploads, and announcements. In progress: assignments (80%), grading (60%), dashboards (60-70%). Unit tests cover APIs. A test plan for functional, usability, and load testing has been drafted (Umoh, 2025). Documentation includes installation guides and user manuals.

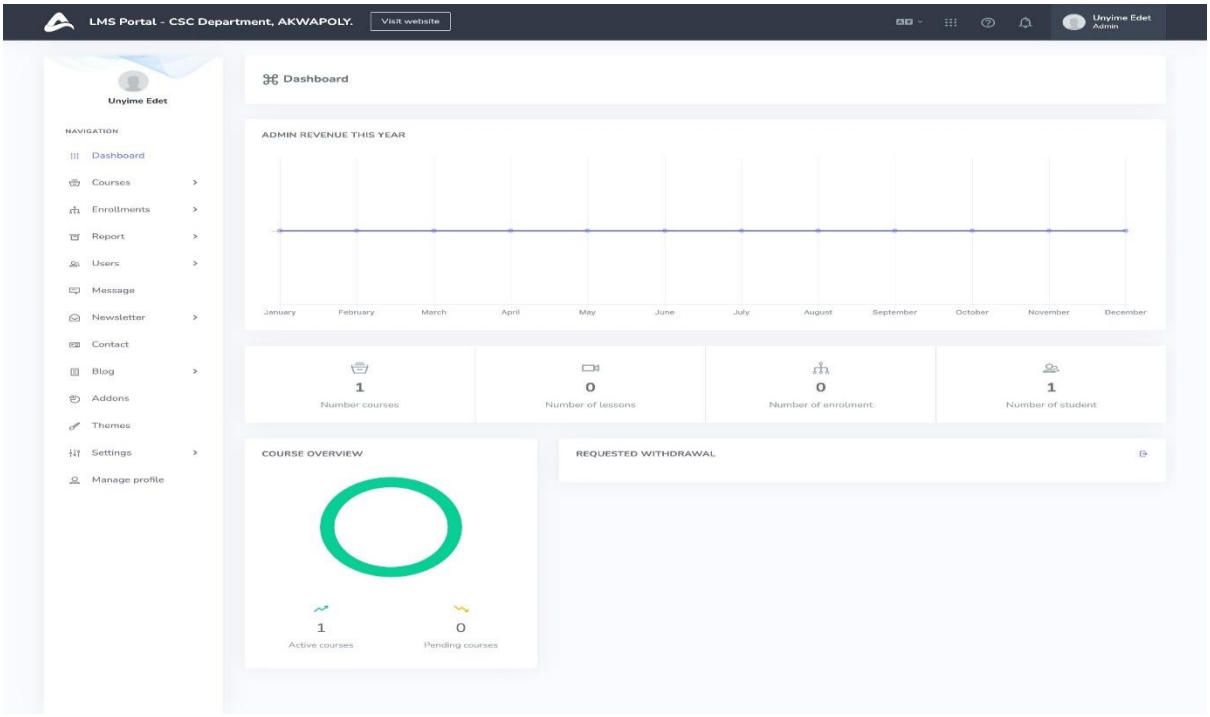

Figure 2: TheDashboard

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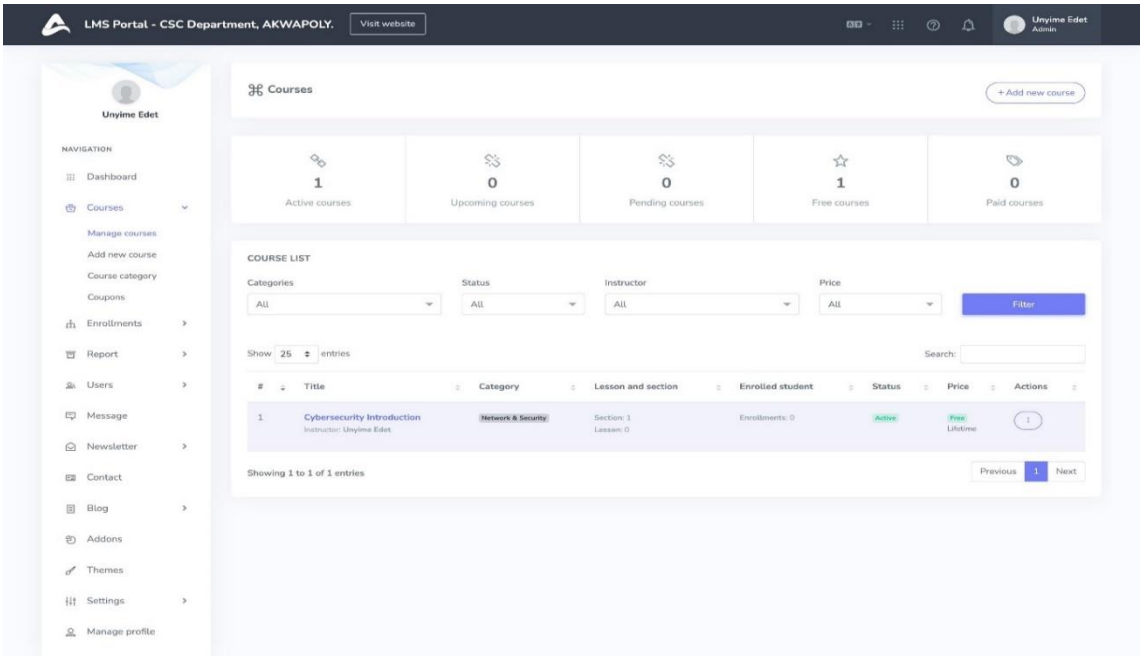

Figure 3: The course upload page

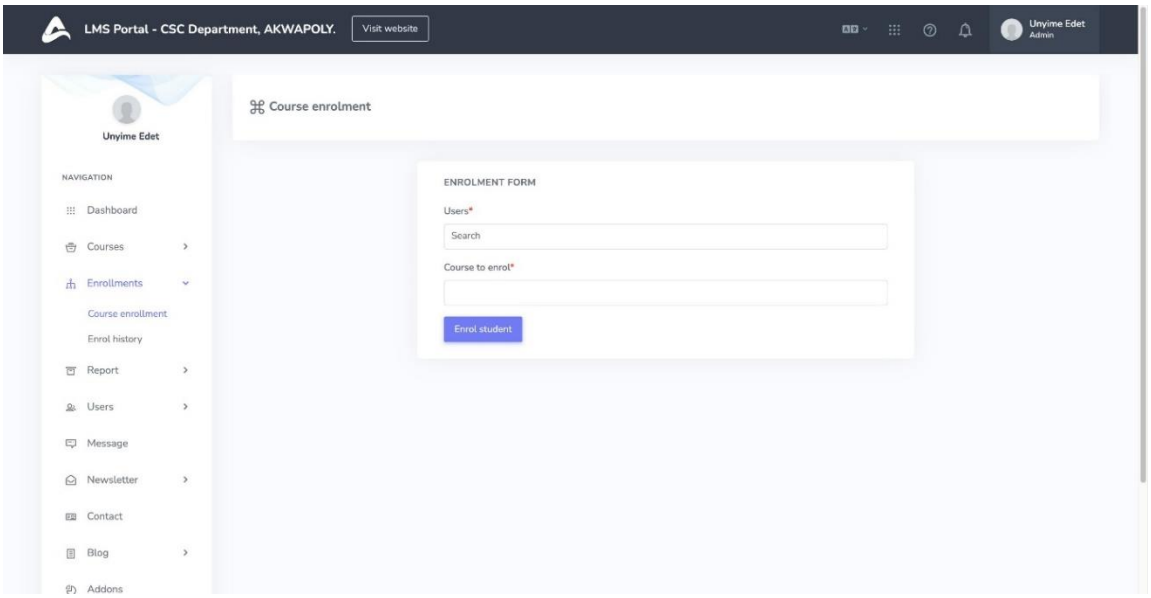

Figure 4: Course Enrollment Page

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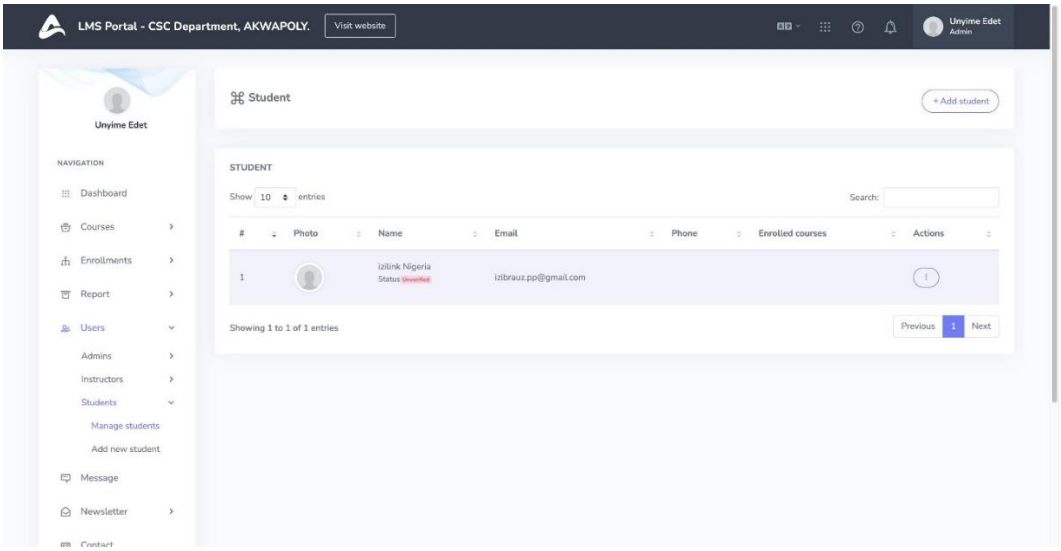

Figure 5: Student enrollment Page

5. Results

Measurable outputs: Functional prototype with login, course creation, uploads, and announcements; configured staging environment; approved FRD, architecture document, mockups, and test plan; three stakeholder sessions with feedback (Umoh, 2025)

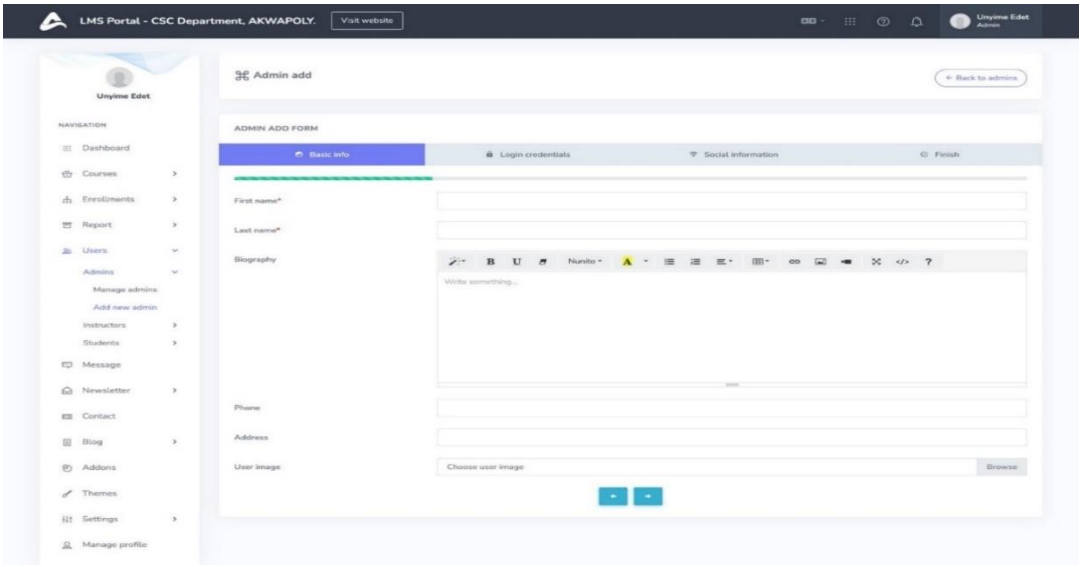

Figure 6: Admin page

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Discussion

The prototype demonstrates core functionalities, addressing gaps in departmental processes. Stakeholder involvement has ensured relevance, echoing the success of African LMS implementations (Maluleke & Maake, 2025). Analytics features will enable performance monitoring, a benefit highlighted in polytechnic studies (Benefits of LMS, 2025).

Challenges and Mitigation

Power and network instability delayed testing, a common issue in Nigeria (Mbewe, S., 2025). Procurement lags and developer availability constrained progress, while integration required scope adjustments (Umoh, 2025). Budget pacing is tight. Solutions include cloud hosting, optimized resources for low-bandwidth applications. (Recommendations, 2025). These align with strategies for developing countries (Saxena, R., 2023).

Recommendations

This LMS could serve as a model for other departments, promoting digital equity (Sa'ad & Isa, 2025). It addresses underutilization by incorporating training, which may boost adoption (An Assessment, 2024).

Conclusion

The development of this LMS represents a step toward modernizing education at the Department of Computer, Akwa Ibom State Polytechnic It holds a significant importance for academic institutions, particularly in developing countires like Nigeria, where e- learning infrsturcture is still evolving. It addressses specific needs and enhances efficiency, accessibiity, and student engagement. This initiative underscores the potential of localized LMS in enhancing teaching in resource-limited settings (Pham et al., 2022).

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