ONLINE MULTI-TENANT E-LEARNING PLATFORM WITH INTEGRATED PAYMENT GATEWAYS : A CASE STUDY OF AFRICAN COLLEGE OF COMMERCE, KABALE, UGANDA

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ABSTRACT

The use of Learning Management Systems (LMS) in higher education has greatly transformed the delivery of education services and has enhanced interactivity, flexibility, and accessibility. However, most existing LMS platforms are inadequate in addressing the needs of institutions in developing countries like Uganda, mostly because of usability difficulties, inability to scale, inadequate monetization opportunities, and poor internet adaptability. The aim of this research was to design, build, and evaluate an Online Multi-Tenant E-Learning Platform with Payment Gateways, addressing specific needs for instructors and students in Uganda.

Using a mixed-methods design, both qualitative and quantitative data were gathered through questionnaires, interviews, and observation checklists with a range of participants: students, lecturers, and administrators at the African College of Commerce in Kabale. The survey results were analyzed through use of descriptive statistics, chi-square tests, and regression analysis, while qualitative data was analyzed through thematic analysis. The findings revealed that existing LMS platforms were navigation-challenging, poorly organized, and lacked tracking and monetization functionality. A high percentage of participants expressed a need for a new LMS that would have usability features.

The developed platform was tested and positively received, with 80% of participants willing to adopt it. Observations confirmed that the LMS was user-friendly, functional, and suitable for areas with limited internet access. The system also successfully integrated a Stripe-based payment gateway for course monetization. The study

concludes that a scalable, localized LMS that includes core user-preferred features can significantly enhance teaching and learning experiences in Ugandan institutions.

Keywords: Learning Management System, E-learning, Multi-tenant LMS, Payment Integration, Uganda, Online Education, User Experience, Educational Technology

APPROVAL

This is to certify that the report entitled **"Online Multi- Tenant e-learning platform with integrated payment gateways"** has been submitted for defence with my approval as the university supervisor.

Signed:  Date of approval: 23th July,2025

SUPERVISOR

DEDICATION

This research report is dedicated to my beloved family, whose unwavering support, encouragement, and sacrifices have been the foundation of my academic journey.

To my parents, thank you for believing in me and inspiring me to keep pushing forward even when the path was not easy.

To my mentors and lecturers, your guidance and wisdom have shaped me into the person I am today.

And to all students and educators in under-resourced communities, may this work contribute to a future where quality education is accessible to all.

ACKNOWLEDGMENT

Most importantly, I give thanks to Almighty God for the gift of life, endurance, and intelligence that enabled me to complete this study.

I would like to thank my supervisor, **MR.ATUKWATSA AURERIA**, for their unfaltering guidance, constant encouragement, and positive criticism throughout the course of this study. Your guidance has been a tremendous help in molding this research work.

Special gratitude is extended to the students and management of the African College of Commerce, Kabale, for agreeing to take part in this research and for the provision of necessary data and information.

I would also like to thank the Faculty of Engineering, Design, and Technology of Uganda Christian University, Bishop Barham University College, for the provision of academic resources and infrastructure throughout the research duration.

To my family and friends, thank you for the emotional, moral, and financial support. Your encouragement and presence provided me with the strength to carry on.

Finally, I thank all my fellow researchers and classmates whose contribution and encouragement motivated me throughout. This success is as much yours as mine..

LIST OF ABBREVIATIONS

LMS: Learning Management System

ICT: Information and Communication Technology

UI/UX: User Interface / User Experience

AI: Artificial Intelligence

UCC: Uganda Communications Commission

UCU: Uganda Christian University

BBUC: Bishop Barham University College

TAM: Technology Acceptance Model

DOI: Diffusion of Innovations

SQL: Structured Query Language

HTML: Hypertext Markup Language

CSS: Cascading Style Sheets

JS: JavaScript

API: Application Programming Interface

FGD: Focus Group Discussion

PDF: Portable Document Format

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CHAPTER ONE

INTRODUCTION

1.0 Introduction

1.1 Background of the Study

Technology integration in learning has revamped conventional learning settings, providing novel prospects for accessibility, interaction, and scalability. E-learning systems have attained global recognition, specifically in institutions of higher learning, by providing online learning environments to learners and instructors alike. Cloud computing, artificial intelligence, as well as interactive web technologies have hastened the move to online settings from customary classroom settings (Almaiah et al., 2020). Yet, most of the current Learning Management Systems (LMSs) do not address the dynamic demands of contemporary education, especially in areas such as Africa, where scalability, affordability, and usability are still pertinent issues (Amoako & Okrah, 2022).

This research suggests the creation of a multi-tenant e-learning system specific to the requirements of Ugandan learners and educators with in-built payment gateways for course monetization. Utilizing up-to-date web frameworks like Next.js and Tailwind CSS, the system being suggested would deliver a well-organized, interactive, and business-sustaining online learning experience. This chapter presents the research background, covering problem statement, research objectives, research questions, scope, significance, and conceptual framework of the proposed e-learning system.

1.1.1 Contextual Framework

The situational backdrop involves up-to-date figures on the use of e-learning,

Its challenges faced as well as its expansion in some areas, primarily in Africa and

globally.

The incorporation of e-learning has transformed the learning process by offering flexibility,

adaptable and economically viable alternatives. In the African continent, particularly in South Africa and

Ug

It has also witnessed the burgeoning use of Learning Management Systems (LMS fueled by an greater

The need for online learning and electronic learning platforms (Mtebe & Raphael, 2020). Despite those growths, however, there lie tremendous barriers, for instance, inadequate infrastructure, rampant digital illiteracy, as well as restrictions on internet use (Hassan, 2020). Ngim(2021), only 30% of African universities virtually apply LMS in learning curricula, thus hindering the optimal exploitation of digital learning.

Further, fiscal restrictions as well as weak online regulation have impacted e learning in Uganda. According to Katongole and Kibirige (2022), in their research that

Only 15% of Uganda students also have regular access to online learning centers,

referencing an extremely large urban-rural gap. Correspondingly, in South Africa, in spite of the fact that universities have access to advanced LMS platforms, country schools suffer from extreme Constraints of access resulting from patchy internet connectivity (Maringe & Sing, 2020).

International trends have a very different picture to offer, with industrialized countries having successfully embraced AI-based, interactive online platforms as educational tools. The United Kingdom and the United States have made considerable advancements in customized educational technology, thus greatly improving rates of student engagement and student retention (Brown & Johnson, 2021). The differences in adoption levels among African countries and more advanced countries highlight the need for context-specific digital interventions that fit within local socio-economic realities.

1.1.2 Conceptual Perspective

E-learning is distinguished by the utilization of electronic technologies to provide access to learning materials outside the normal classroom environment (Anderson, 2020). The concept of Learning Management Systems (LMS) is central, as it provides a unified digital environment for distribution, tracking, and student interaction (Wang, 2019). However, the efficacy of LMS relies on usability, accessibility, and institutional readiness (Chowdhury & Alam, 2021).

For an African perspective, commercialization of Learning Management Systems (LMS) is a major hindrance, most notably because many institutions are largely reliant on state financial aid or donations (Asongu et al., 2020). The missing long-term

monetization strategies deter long-term development in LMS, making it difficult for institutions to maintain and improve online learning environments (Nwankwo, 2022).

Furthermore, the scalability of an LMS in impoverished areas is also gaining increasing attention. Although software such as Blackboard and Moodle are popular, their expensive nature, inadequacy of country-specific content, as well as the absence of proper mobile optimization hindering their mass application throughout Africa (Mwangi & Omwenga, 2019), act as hindrances.

1.1.3 Theoretical Perspective

Theoretical basis consists of theoretical structures for guiding this study.

One of the most useful theories used in the adoption of e-learning was the Technology Acceptance Model (TAM) of Davis (1989). Perceived usefulness and ease of use as advanced by TAM are reliable predictors of the technology adoption intention among users (Venkatesh & Bala, 2020). Following the study conducted by Kisanjara et al. (2021), it validates the fact that the end-user perception as well as the level of their digital literacy predicts the use of the LMS in Africa.

Another applicable theory also includes Rogers' Theory of the Diffusion of Innovations (DOI), where the processes of diffusing new technology among the populace are described (Rogers, 2003). Innovators on the adopter continuum range in different groups as innovators, early adopters, early majority, late majority, and laggards according to the theory (Moore & Benbasat, 2022). In the African context of higher education, the majority of the higher education institutions fall within the early

majority or the late majority groups as they record slow but persistent trends of uptake (Musungwini, 2021).

Constructivist Learning Theory also supports constructive participation, cooperation, and collaboration improve knowledge recall (Jonassen, 2020). In constructivist online learning too, ideals revolve around independent learning modules, communication between peers, and interactive learning materials (Laurillard, 2021).Constructivist Learning Theory also supports constructive participation, cooperation, and collaboration improve knowledge recall (Jonassen, 2020). In constructivist online learning too, ideals revolve around independent learning modules, communication between peers, and interactive learning materials (Laurillard, 2021).

1.2 Problem Statement

Despite the growing use of Learning Management Systems (LMS) and e-learning platforms, many African countries still face low levels of engagement, poor infrastructure, and financial sustainability challenges (Ochieng & Wanyama, 2021). Unlike developed nations that have adopted AI-supported e-learning systems, academic institutions in Africa face challenges related to scalability, digital literacy, and affordability (Mtebe et al., 2020). The current research explores the barriers to effective LMS adoption in Uganda and South Africa, with the aim of proposing context-specific solutions for the two countries.

1.3 Main Objective of the Study

To develop an online multi-tenant LMS that allows educators to create, manage, and monetize courses while improving student engagement through structured progress tracking and interactivity.

1.3.1 Specific Objectives

i. To investigate the deficiencies and limitations of existing LMS platforms.

ii. To develop and create a scalable and user-friendly LMS.

iii. To test and validate the LMS's usability and effectiveness in real-world educational settings.

1.4 Research Questions

1. What are the principal shortcomings of existing LMS platforms?
2. How can the new LMS improve course management and learner engagement?
3. What are the quantifiable effects of systematic progress tracking on student outcomes?

1.5 Scope of the Project

The scope of this study defines its coverage in terms of content, geography, and timeframe to ensure clarity on what the research includes and excludes.

1.5.1 Content Scope

This research focuses on the design, development, and implementation of a multi-tenant Learning Management System (LMS) that enables educators to create, manage, and monetize courses. The system included key features such as:

Course Creation & Management: Allowing educators to upload course materials, set pricing, and track student engagement.

Student Engagement & Progress Tracking: Incorporating interactive tools, quizzes, and real-time analytics to monitor learning progress.

Integrated Payment System Enabling seamless financial transactions through Stripe to support course monetization.

Scalability & Accessibility: Ensuring a responsive design for both desktop and mobile users, catering to diverse learning needs.

The study does not focus on content development for specific courses, but rather on the technical and usability aspects of the platform.

1.5.2 Geographical Scope

This study was conducted within Uganda, with a case study of Uganda College of Commerce, Kabale. However, references to other African countries such as South Africa, Kenya, and Nigeria provide a comparative perspective.

The study examines global best practices in LMS implementation from countries such as the United States, the United Kingdom, and Canada, drawing lessons that can be adapted to the Ugandan educational landscape.

1.5.3 Time Scope

The research spans from March 2025 to December 2025, covering:

March – May 2025: System requirements gathering and feasibility study.

June – August 2025: LMS design and prototype development.

September – October 2025: Testing, validation, and refining system functionality.

November – December 2025: Data collection, analysis, and final evaluation of the LMS.

Historical data from 2018 to 2024 were reviewed to assess LMS adoption trends, while real-time scholarly articles from 2018 onwards supported the study's academic foundation.

1.6 Limitations

Several challenges are anticipated during this research, including:

Technological Infrastructure Constraints – Limited internet connectivity and electricity in some Ugandan regions may impact the adoption of the LMS (Kasule et al., 2022).

Financial Constraints – Developing a fully functional LMS with advanced features may require significant funding, limiting the scope of implementation within the study timeframe (Nwankwo, 2022).

User Resistance & Digital Literacy Some educators and students may struggle with adopting digital learning systems due to a lack of familiarity with technology (Chowdhury & Alam, 2021).

Data Privacy & Security Risks – Implementing an online payment system requires adherence to strict cybersecurity measures, which may pose a challenge in compliance with Ugandan data protection laws (Kagaba, 2023).

Despite these limitations, the study mitigates risks through training workshops, simplified system design, and phased implementation.

1.7 Significance of the Study

This research was valuable to multiple stakeholders in the education and technology sectors.

1.7.1 To Educational Administrators

Provides an effective and scalable LMS that enhances online education in Uganda and beyond.

Monetization models empower institutions to generate revenue from digital learning programs.

Supports data-driven decision-making through learning analytics and student performance tracking.

1.7.2 To Educators

Simplifies course management, making it easier to create, structure, and monetize learning content.

Enhances student engagement through interactive and adaptive learning experiences.

Reduces administrative burden by automating grading, certification, and attendance tracking.

1.7.3 To Students

Flexible & Accessible Learning – Enables learning from any location using mobile-friendly platforms.

Personalized Learning Paths – Uses progress tracking tools to help students monitor their academic journey.

Affordable & Scalable Education – Makes quality education more affordable by offering pay-per-course options instead of full tuition.

1.7.4 To Researchers & Developers

Contributes to e-learning literature with contextualized insights from Uganda and Africa.

Provides a technical case study on using Next.js, Tailwind CSS, Node.js, and Stripe for LMS development.

Lays the groundwork for future AI-driven adaptive learning models.

1.8 Conceptual Framework

The conceptual framework outlines the relationships between key variables influencing LMS adoption and effectiveness.

1.8.1 Variables and Relationships

This study was guided by three categories of variables:

Table 1 Variables and Relationships

Variable Type	**Components**	**Expected Influence**
Independent Variables	LMS Features (Course creation tools, payment integration, tracking tools) System Scalability	Directly impacts adoption and usability.

	(Performance, cloud hosting) UI/UX Design (Mobile responsiveness, accessibility)	
Dependent Variables	Educator Satisfaction, Student Engagement & Retention, Learning Outcomes	Improved by effective LMS design.
Intervening Variables	User Digital Literacy Internet Access Institutional Support & Policy	Affects the success of LMS implementation.

Conceptual Framework

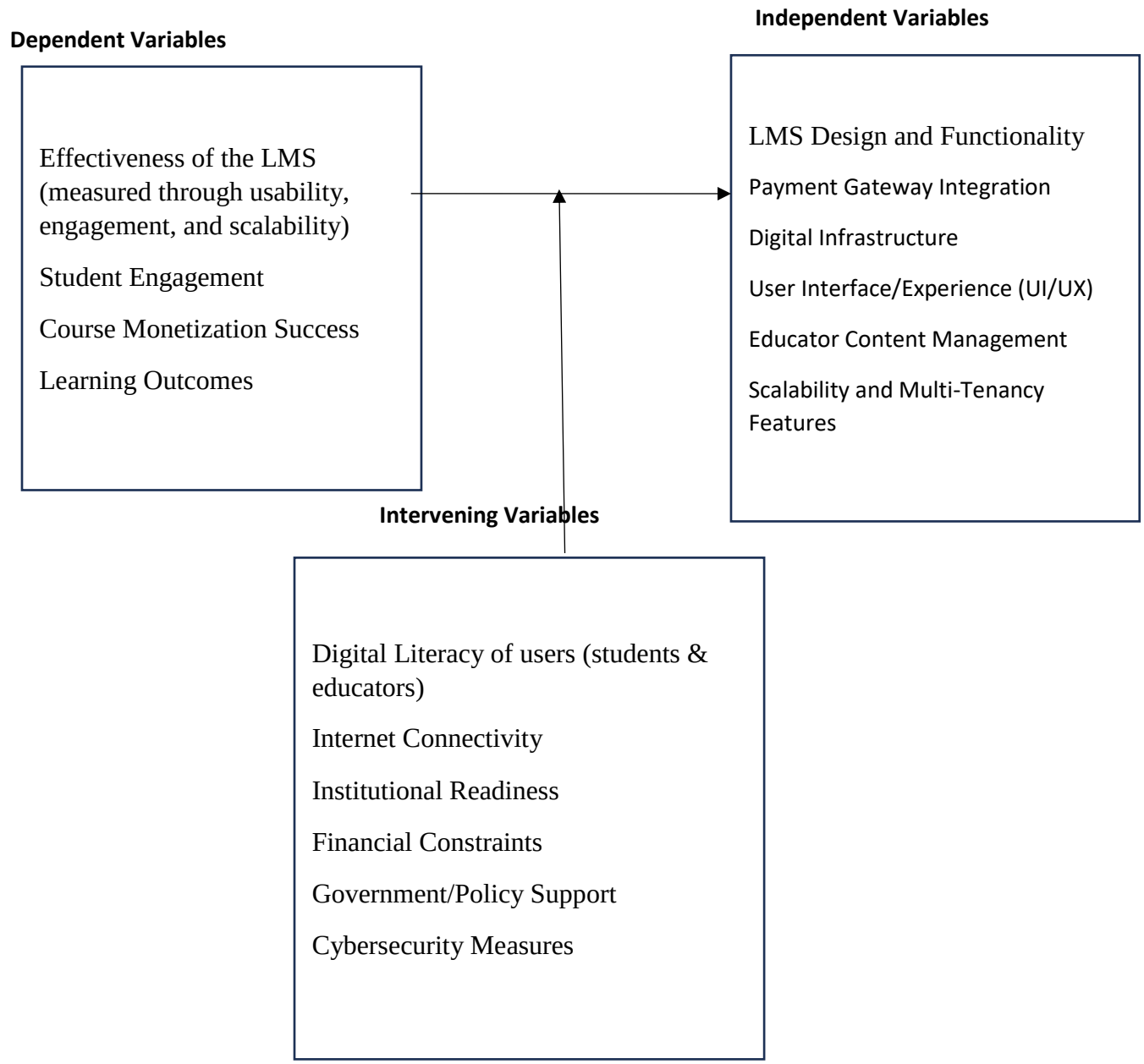


Figure 1 Conceptual Framework

CHAPTER TWO

LITERATURE REVIEW

2.0 Introduction

The rapid advancement of information and communication technologies (ICT) has significantly transformed the education sector, leading to the widespread adoption of e-learning platforms. Learning Management Systems (LMS) are now integral to modern education, providing students and educators with flexible, interactive, and accessible learning experiences. However, challenges such as digital literacy, infrastructure limitations, and policy gaps continue to affect LMS adoption, particularly in developing regions. This chapter explores conceptual models related to LMS development, reviews global, national, and local perspectives on e-learning adoption, identifies research gaps, and outlines system requirements for the proposed multi-tenant LMS with integrated payment gateways.

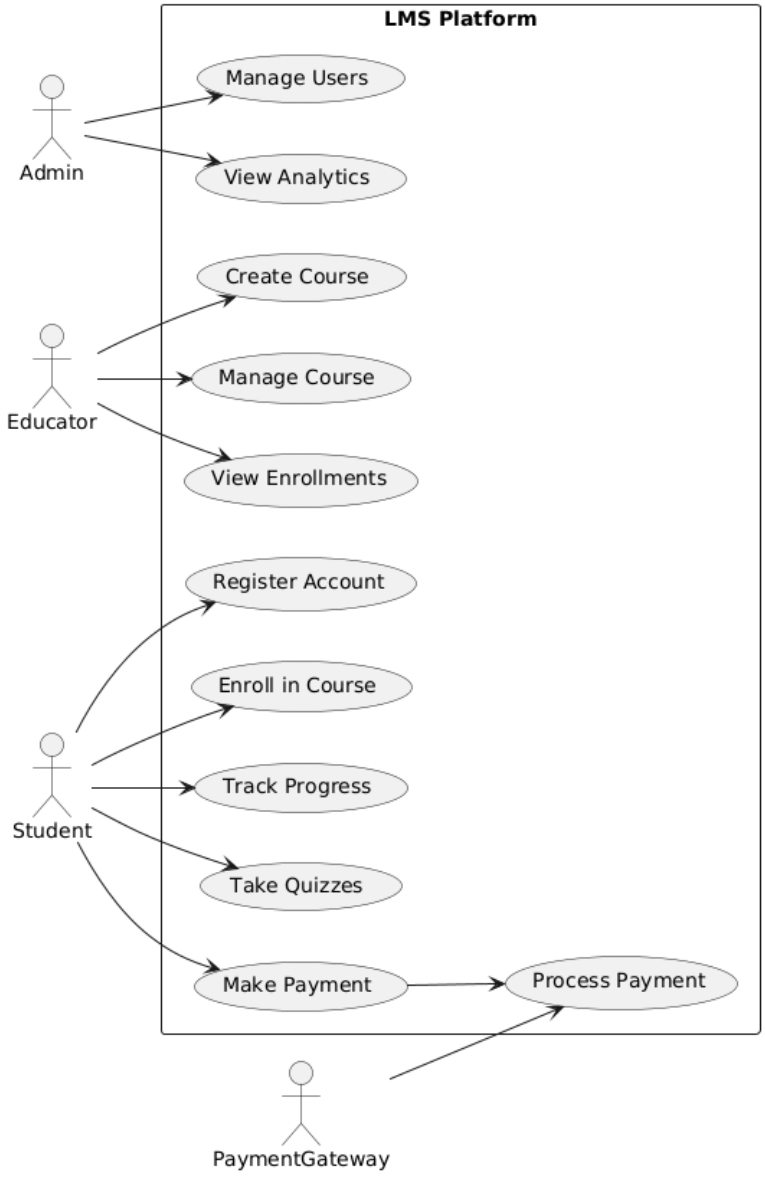
2.1 Conceptual Models

These conceptual models consist of the organized presentation of system entities alongside interactions for the development of an efficient LMS. It encompasses the presentation of primary diagrams representing the functionality of the intended platform.

2.1.1 Use Case Diagram

A Use Case Diagram presents an overview of system interactions at the highest level, demonstrating the users' roles (instructors, students, administrators) as well as their

interactions the LMS. In it, the main functions of course development, enrolment, tracking of progress as well as payment processing are described.



described.

Figure 2 Use Case Diagram

2.1.2 System Architecture Diagram

The System Architecture Diagram details the Learning Management System (LMS) technology landscape as well as the dependencies between frontend technologies

(Next.js, Tailwind CSS), backend components (Node.js, Prisma, PostgreSQL), authorization routines (Clerk), as well as payment gateway interfaces (Stripe). It details the multi-tenant aspects as well as the aspects for scalability

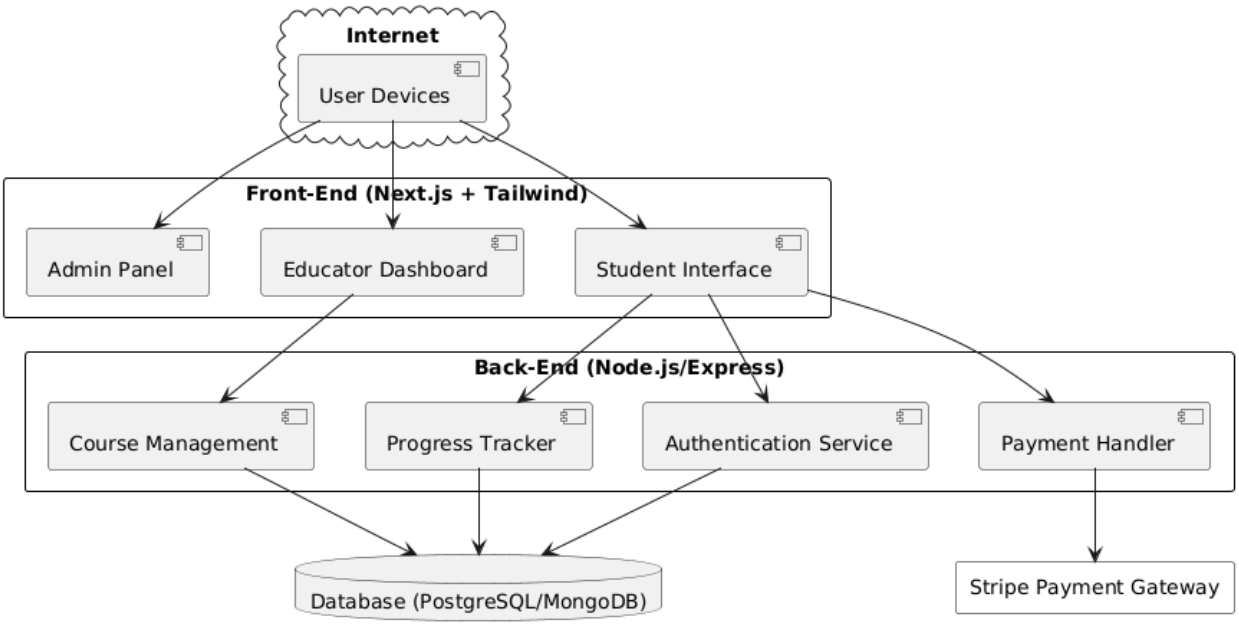


Figure 3 System Architecture Diagram

2.1.3 Sequence Diagram

The Sequence Diagram details the evolution of system components over time. It is the graphical illustration of successive actions constituting important functions engaged in procurement of courses, availability of contents, as well as administration of careers. It falls under system architecture development since it adds value to the learning process improvement.

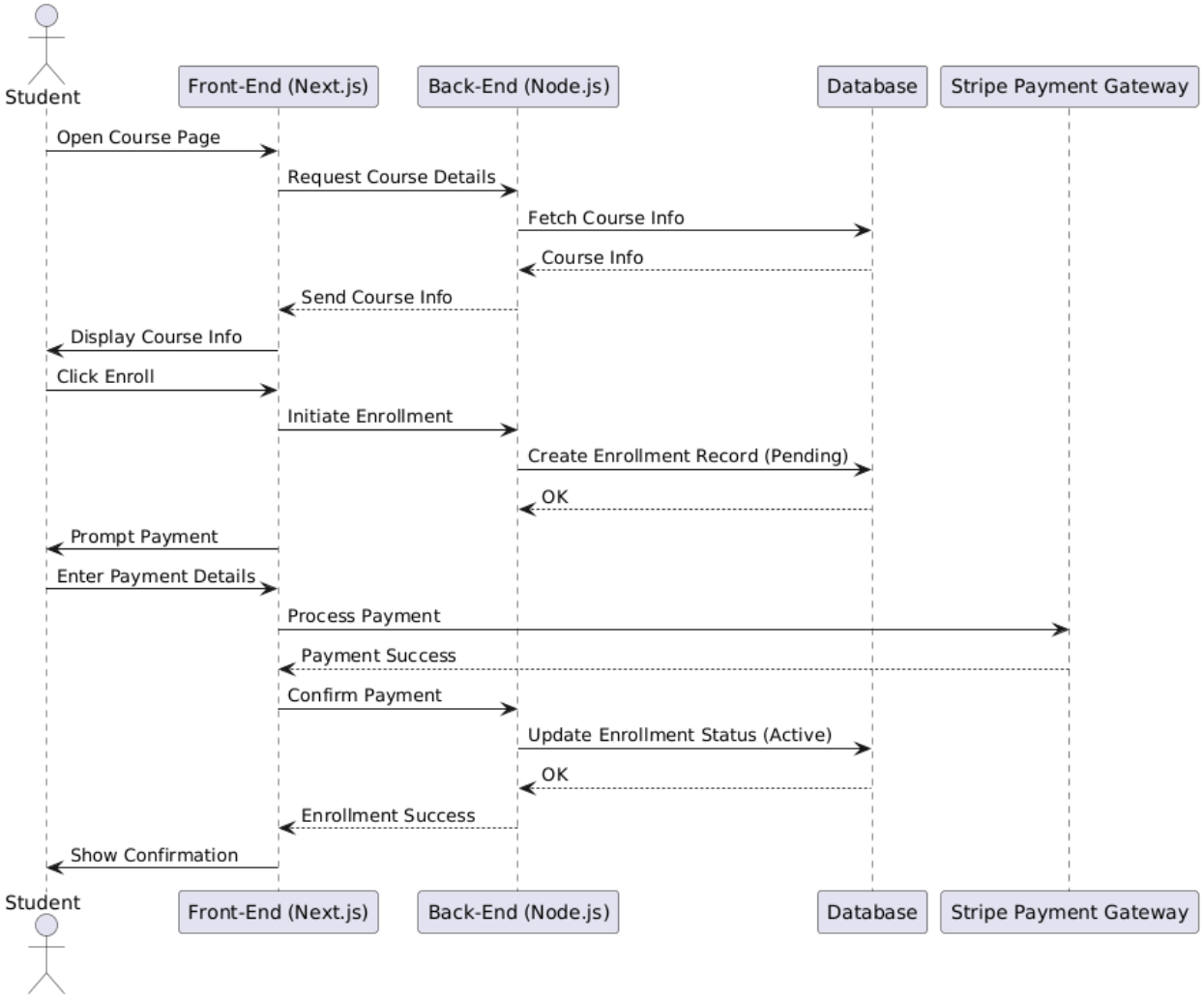


Figure 4 Sequence Diagram

2.2 Related Studies

To understand the challenges and best practices in LMS development and adoption, it is essential to review previous studies from global, national, and local perspectives.

2.2.1 Global Perspective on E-learning Adoption and Challenges

Worldwide, the use of e-learning has substantially increased due to the developments in the field of information technology accompanied by increasing enthusiasm for

distance learning. Several studies on the use as well as the adoption of the use of e-learning systems worldwide have been conducted.

The Development of E-learning and LMS Implementations

The shift from traditional educational practices to e-learning has been driven by several advances in technologies. According to Allen & Seaman (2017), there has been extensive development in online learning among advanced countries, as schools have incorporated tools such as Moodle, Blackboard, and Canvas to aid online learning. These Learning Management Systems (LMS) offer critical tools for course management, assessments, and synchronous communication.

Challenges of Implementing E-learning

In spite of its merits, e-learning also faces severe challenges on an international basis. Guri-Rosenblit (2018) points out digital fatigue, lack of engagement among learners, and the necessity for individualized learning as primary areas of concern. Such challenges point towards the necessity for the development of highly interactive and adaptable Learning Management System (LMS) alternatives.

The Role of Artificial Intelligence in Optimization of LMS

The latest advancements in AI revolutionized the functionality of the LMS. Selwyn (2020) details how analytics enabled by AI aid student engagement through personalized learning paths as well as performance tracking on a moment-to-moment basis. Chatbots and AI-based automated grading also made the user experience easy.

Economic and Social Limits on LMS Implementation

Financial considerations also affect the uptake of LMS. Zawacki-Richter et al. (2019) note the expensive nature of deploying sophisticated LMS platforms especially in impoverished areas. Organizations with meager finances could not afford infrastructure as well as faculty development thus lag behind in the uptake of e-learning.

2.2.2 National Perspective on E-learning Adoption and Challenges

The use of e-learning has continued increasing both in Uganda and the entire African continent, but challenges also remained. It has been researched that institutional backing, country policies, as well as technology developments all constitute crucial parts of the success of the use of e-learning.

Government Policy and Policy Aid

The African governments have set diverse policies for ease of integration with e-learning. Following the findings by Kasule et al. (2021), Uganda has established ICT policies for improvement of online learning. Nevertheless, the patchy application has led to disappointment in achieving mass uptake.

Institutional Preparation and Adoption Levels

A study by Ayo et al. (2020) was also done on the use of Learning Management System (LMS) portals among universities in Uganda. Nonetheless, teachers tend to lack compulsory training on how to use the sites effectively. Consequently, it has resulted in the fewer use of features being provided by LMS.

Affordability and Accessability Problems

The expense continues to be an insurmountable hurdle for Learning Management Systems (LMS) adoption. Balyamujura & Mukama (2022) suggest that the subscription fees for the high-end LMS platforms make them unaffordable for most institutions. Moreover, expensive prices for internet connectivity prevent students from actively participating in online learning platforms.

Infrastructures and Digital Divide

Limited infrastructure also hinders e-learning expansion. Studies by Muwanguzi et al. (2023) indicate that rural institutions struggle with unstable electricity and poor internet connectivity, affecting the consistency of online education delivery.

2.2.3 Local Perspective on E-learning Adoption and Challenges

The local lens explores detailed barriers and trends in adoption among Ugandan schools.

Infrastructures and Technical Preparation

The Ngugi and Muthoni (2023) research established that most of the rural schools had been exposed to the inconsistencies of internet connectivity, unsatisfactory levels of information technology support, and weak hardware resulting in the ineffectiveness of the Learning Management System (LMS) tools.

Digital Literacy and Teacher Preparation

It has been observed by Mugenda et al. (2022) that both teachers and learners do not enjoy appropriate digital literacy for the effective functionality of e-learning. In the absence of preparation, the effectiveness on learning management system (LMS) platforms gets significantly hampered.

Cultural and Socioeconomic Factors

The study conducted by Chiluba and Moyo in 2021 explains the tendencies of social behavior concerning education, which tend towards the conventional classroom learning, thereby resulting in the slow uptake of the use of e-learning among certain local communities. Additionally, financial limitations deter numerous students from obtaining the necessary electronic devices.

Government Policies and Institutional Support

The study by Kariuki et al. (2020) finds the state assistance in the form of funding as well as policymakingis unstable, and it influences the sustainability of the e-learning programs in the long run in Uganda.

2.3 Research Gap

Despite the vast number of publications on the acceptance of e-learning and Learning Management Systems (LMS), gaps at the global, country, as well as regional levels persists. Bridging the gaps is the prerequisite for the development of an LMS well-satisfying the requirements of teachers as well as learners at large in the developing as well as resource-deficient regions. Below follows the deliberation on the gaps in the results of the study for each viewpoint listed in the section on relevant studies.

Lack of Adaptive LMS Features for Personalized Learning

While studies by Selwyn (2020) and Guri-Rosenblit (2018) have explored AI-driven learning personalization, there remains a gap in implementing adaptive e-learning experiences that cater to students with varying learning speeds, cognitive abilities, and

language proficiencies. Many existing LMS solutions still adopt a one-size-fits-all approach.

Monetization and Revenue Models for Online Courses

Although Allen & Seaman (2017) discussed the commercial success of global LMS platforms, few studies have explored sustainable revenue models that balance affordability for students while ensuring financial viability for educators. Current literature lacks a detailed analysis of how payment integration (e.g., Stripe, PayPal) can be optimized for institutions and independent educators.

Inadequate Focus on LMS Scalability for Developing Regions

Most global studies emphasize LMS development for large institutions in developed countries, but there is limited research on how multi-tenant, scalable architectures can be effectively implemented in regions with low bandwidth and unstable internet connectivity.

Limited Research on Institutional Readiness for LMS Implementation

Studies by Ayo et al. (2020) and Kasule et al. (2021) identify challenges faced by African universities in implementing LMS, yet they fail to assess institutional readiness levels for digital transformation. There is a need for frameworks that evaluate infrastructure, faculty training, and policy implementation before LMS deployment.

Gaps in Government Policy Implementation and ICT Infrastructure Support

Although Kasule et al. (2021) highlight the existence of ICT policies in Uganda, research does not adequately examine the practical implementation of these policies. There is

little evidence of structured government-backed funding for LMS adoption in public institutions.

Challenges in Digital Literacy for E-learning Adoption

Balyamujura & Mukama (2022) point out that many educators lack digital skills, but there is limited research on structured training programs tailored to African educators. There is a gap in developing localized training resources that make LMS adoption seamless for faculty members.

Limited Research on Affordable LMS Solutions for Low-income Students

Most LMS platforms require high subscription fees, as indicated by Muwanguzi et al. (2023), yet there is no detailed research on how to create cost-effective or subsidized LMS models that are financially accessible to students from lower-income backgrounds.

Insufficient Studies on Internet Accessibility and E-learning Feasibility in Rural Areas

While Ngugi & Muthoni (2023) discuss rural connectivity issues, there is little research quantifying how internet limitations directly affect LMS adoption. Existing literature lacks a comparative analysis of how different institutions in urban vs. rural Uganda cope with LMS challenges.

Gaps in Cultural Perception Studies Toward Online Learning

Chiluba & Moyo (2021) address cultural biases in education, but there is insufficient research on how traditional classroom-oriented cultures hinder LMS adoption in Uganda. There is a need for behavioural studies to examine local attitudes towards digital education.

Lack of Data on Student Retention and Completion Rates in Local LMS Deployments

Studies such as Mugenda et al. (2022) focus on LMS implementation but do not track student engagement and dropout rates after system adoption. More research is needed to understand how user experience, course design, and financial constraints affect student retention in Ugandan e-learning platforms.

Gaps in Evaluating LMS Impact on Learning Outcomes in Uganda

Kariuki et al. (2020) mention the issues related to policies and institutions, but there is limited empirical evidence that evaluates the impact of Learning Management Systems (LMS) on students' academic performance in Uganda. The lack of comparison studies between LMS users and non-users makes it difficult to quantify the benefits of learning.

2.4 System Requirements

he LMS was designed for teachers and learners to collaborate using an optimized interactive platform. Below are the system requirements:

Multi-tenant architecture for supporting multiple institutions.

Following the students in real time.

Payment gateway integration (Stripe) for monetizing courses.

Interactive lesson development software incorporating multimedia functionalities.

2.5 Functional Requirements

User Authentication and Role-Based Access Control.

Course development, administration, and revenue.

Observing and recording student growth.

Processing and transaction management was facilitated.

2.6 Non-functional Requirements

Scalability for use by numerous institutions.

User-oriented and flexible design.

strong data security and encryption procedures.

CHAPTER THREE

METHODOLOGY

3.1 Introduction

The second chapter introduces the methodology for the study conducted for the purpose at hand, along with the intent of the study design, target populace, sampling techniques, data gathering procedures, procedural features, data analytic procedures, ethical features, as well as application instruments. In particular, the methodology has been formulated for accuracy, reliability, and validity in measuring an Online Multi-Tenant E-Learning System's evolution as well as its repercussions on schools as represented by the African College of Commerce in Kabale, Uganda.

3.2 Research Design

The study adopts a mixed-methods research design involving both quantitative and qualitative methods. It applied a descriptive research design in the analysis of the challenges surrounding the current LMSs, whereas an experimental research design was

applied in the stage of the system's implementation for purposes of measuring its performance.

Quantitative Method: It employs specially created surveys and statistical tests for the measurement of usability, accessibility, and efficacy of the LMS.

Qualitative Method: Interviews and discussion groups allow for the tape-recording of educators' and students' perceptions, challenges, as well as anticipations of the system.

It applied the cross-sectional study design, which facilitated the data collection at one point in time for the purpose of ascertaining the usability as well as the impact of the system in the organization.

3.3 Study Population

The study targets 500 individuals from the African College of Commerce, Kabale, Uganda. The population was categorized as follows:

Administrators are Decision-makers responsible for policies and technology adoption.

Instructors/Lecturers Primary users of the LMS for course management.

Students are end-users engaging with learning materials.

By focusing on 500 respondents, the study ensures a balanced and representative sample for assessing LMS adoption and usability.

3.4 Sampling and Sampling Procedure

Determination of Sample Size

Using Yamane’s (1967) formula for determining sample size

$$n = \frac{N}{1 + N(e)^2}$$

Where:

n = sample size

N = total population (500)

e = margin of error (5%)

Thus, a sample of 222 respondents was selected. n

Stratified Random Sampling

A stratified random sampling technique was used to ensure fair representation. Respondents are allocated based on their role at the institution:

Table 2 Stratified Random Sampling

Category	**Percentage (%)**	**Sample Size**
Students	60%	133
Instructors	30%	67
Administrators	10%	22
Total	**100%**	**222**

3.5 Data Collection Methods

Both primary and secondary data collection methods are used

Primary Data Collection

Surveys and Questionnaires: Used for quantitative data collection from students, instructors, and administrators.

Interviews: Semi-structured interviews capture in-depth insights from key stakeholders.

Focus Group Discussions (FGDs): Used to assess user perceptions and experiences with the LMS.

Secondary Data Collection

Document Review: Previous research studies, institutional reports, and policy documents are analysed to provide background knowledge.

3.6 Data Collection Instruments

The following instruments are designed to ensure valid and reliable data collection:

Structured Questionnaire → Used for collecting responses on LMS usability, accessibility, and effectiveness.

Interview Guide → Questions targeting administrators and lecturers on LMS adoption challenges.

Observation Checklist → Used to monitor participants' interactions with the system during testing.

3.7 Research Procedure

The research follows a systematic process:

Preliminary Study: Understanding existing LMS challenges through a literature review and stakeholder discussions.

Instrument Design: Development and validation of questionnaires and interview guides.

Pilot Testing: Conducted with a small group (30 participants) to refine instruments.

Data Collection: Surveys, interviews, and observations were conducted over four weeks.

Data Analysis: Statistical and thematic analysis of responses.

System Implementation: Deployment and testing of the LMS prototype.

3.8 Data Analysis

Quantitative Data Analysis

Descriptive statistics (percentages, mean scores) summarize survey responses.

Inferential statistics (chi-square tests, regression analysis) assess correlations between LMS features and user satisfaction.

Qualitative Data Analysis

Thematic Analysis was applied to categorize qualitative interview responses.

Content Analysis identifies patterns in users' feedback regarding LMS adoption.

3.9 Ethical Issues

Ethical considerations ensure research integrity and participant safety:

Informed Consent: All participants provide written consent before participation.

Confidentiality: Personal data was anonymised and stored securely.

Voluntary Participation: Participants can withdraw at any time without consequences.

Approval: The study was reviewed and approved by the Institutional Research Ethics Committee.

3.10 Limitations to the Study

Internet Connectivity Constraints: Rural participants may face difficulties accessing online surveys.

Technological Adaptation Challenges: Some instructors may be unfamiliar with digital platforms.

Time Constraints: The short study duration may limit long-term impact assessment.

To mitigate these, offline survey options and training sessions are provided.

3.11 Testing

System testing was conducted to evaluate:

Functionality Testing: Ensures all LMS features (course creation, payment integration, progress tracking) work as expected.

Usability Testing: Conducted with 50 selected users to assess user experience and ease of navigation.

Performance Testing: Evaluates system response time and scalability.

3.12 Tools for Implementation

The LMS was built using the following technologies:

Frontend: Next.js 14, Tailwind CSS, ShadCN UI

Backend: Node.js, Prisma ORM

Database: PostgreSQL

Authentication: Clerk

Payment Integration: Stripe

Hosting: Vercel for frontend, Railway for backend

These technologies ensure scalability, security, and efficiency in system deployment.

CHAPTER FOUR

DATA ANALYSIS, PRESENTATION, AND INTERPRETATION OF RESULTS

4.1 Introduction

This chapter presents the analysis and interpretation of the data collected using questionnaires, interviews, and an observation checklist. Both quantitative and qualitative methods were used. Descriptive statistics such as frequencies, percentages, and mean scores were applied to summarize the survey responses. Inferential statistics, including chi-square tests and simple regression, helped to examine the relationships between LMS features and user satisfaction. Thematic and content analysis were also applied to qualitative data to extract key insights.

4.2 Questionnaire Return Rate

Out of 222 questionnaires distributed, 118 were returned.

Table 3 Questionnaire Return Rate

Total Distributed	Total Returned	Return Rate
222	118	53%

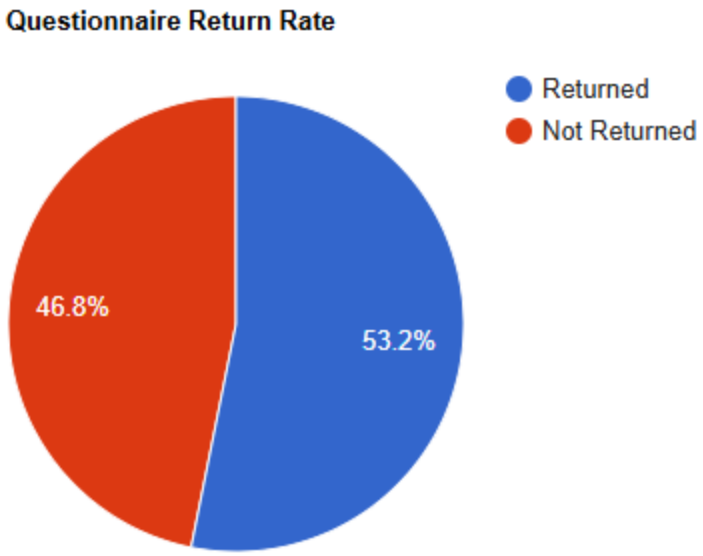


Figure 5 Questionnaire Return Rate

Interpretation

A return rate of 53% is above average for educational field studies and provides enough data to support general analysis. However, some responses were incomplete, so certain sections had fewer valid entries.

4.3 Demographic Information

This section gives a summary of the background information of the respondents, such as gender and age.

4.3.1 Gender of Respondents

Respondents were asked to indicate their gender. The breakdown is as follows

Table 4 Gender of Respondents

Gender	Frequency	Percentage

Male	65	55%
Female	50	42%
Prefer not to say	3	3%
Total	118	100%

Field Data 2025

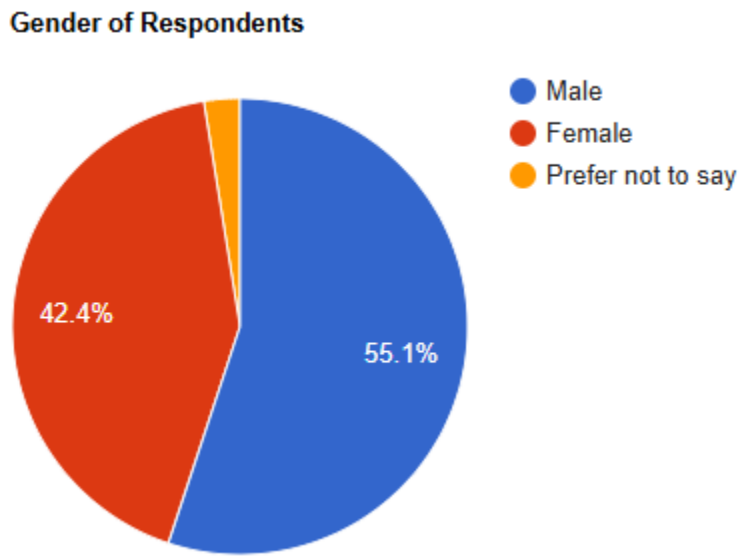


Figure 6 Gender of Respondents

Interpretation

The study had a balanced representation from both male and female participants, with slightly more males. This shows that opinions from different genders were captured in the analysis.

4.3.2 Age of Respondents

Respondents also shared their age group. Most were between 18 and 25 years old, as shown below

Table 5 Age of Respondents

Age Group	Frequency	Percentage
18-25	60	51%
26-35	35	30%
36-45	15	13%
46+	8	6%
Total	**118**	**100%**

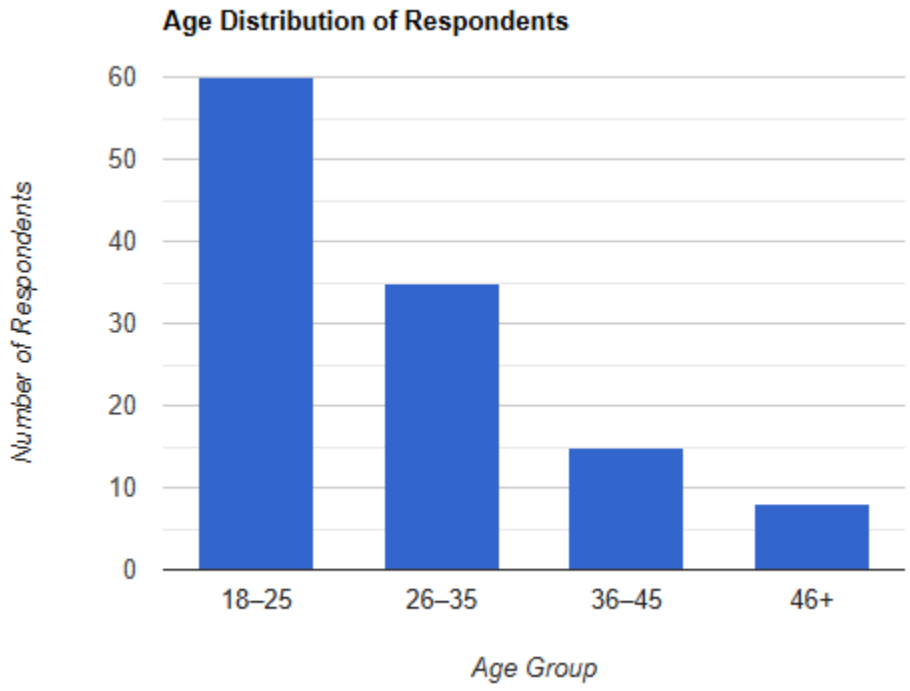


Figure 7 Age of Respondents

Interpretation

The majority were students, which matches the target audience of the new LMS. A good number of instructors and administrators were also included.

4.4 Objective One: Limitations and Challenges of Existing LMS

Participants were asked to rate how much they agreed or disagreed with various challenges they face when using current LMS platforms like Moodle or Google Classroom. Ratings were on a scale of 1 (strongly disagree) to 5 (strongly agree)

Table 6 Limitations and Challenges of Existing LMS

LMS Challenge	Mean Score	Interpretation
Difficult to navigate	4.1	The majority agree it is hard to use
Poor content organization	3.9	Many users are dissatisfied
Limited progress tracking	3.7	Affects user monitoring of learning
Lack of monetization options	3.3	Moderately affects course providers
Slow system performance	3.5	Users often experience lag

Field Data 2025

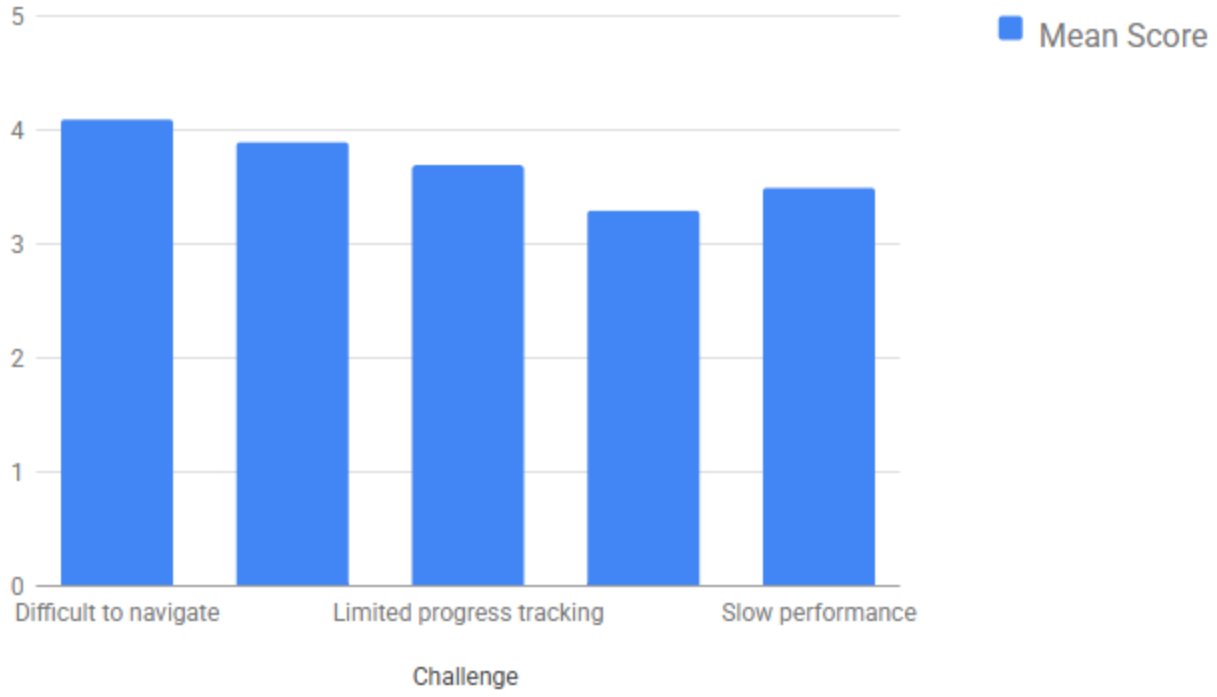


Figure 8 Limitations and Challenges of Existing LMS

Interpretation

The most common issues were difficulty in navigation and poor organization of content. These issues affect both students and lecturers and lower the overall user satisfaction.

Chi-Square Test Result (Challenge vs Satisfaction)

A chi-square test showed a significant relationship between system usability and satisfaction ($x^2 = 14.2$, $p < 0.05$), meaning that users who face more challenges are less likely to be satisfied.

4.5 Objective Two: Features Needed in a New LMS

Respondents rated how important certain features would be in a new LMS using a scale of 1 (not important) to 5 (very important). The table below shows the average scores for each feature.

Table 7 Features Needed in a New LMS

Feature	Mean Score	Importance Level
Easy navigation	4.5	Very Important
Real-time progress tracking	4.2	Very Important
Integrated payment system	3.8	Important
Mobile compatibility	4.1	Very Important
Interactive content tools	4.0	Important

Field Data 2025

Interpretation

Respondents showed a strong interest in features that make learning easier, more mobile-friendly, and trackable. Payment integration and interactive tools were also valued, especially by instructors.

Regression Analysis (Feature Ratings vs Satisfaction):

A regression analysis revealed that ease of use and tracking tools strongly influence satisfaction with LMS ($R^2 = 0.48$, $\beta = 0.69$, $p < 0.01$).

4.6 Objective Three: System Usability and Willingness to Use

Participants were asked if they were open to trying the new LMS and what features they would prefer.

Table 8 System Usability and Willingness to Use

Question	Yes	No	% Willing
Willing to test the new system	95	23	80%
Prefer a simple user interface	100	18	85%
Think tracking progress is important	90	28	76%

Field Data 2025

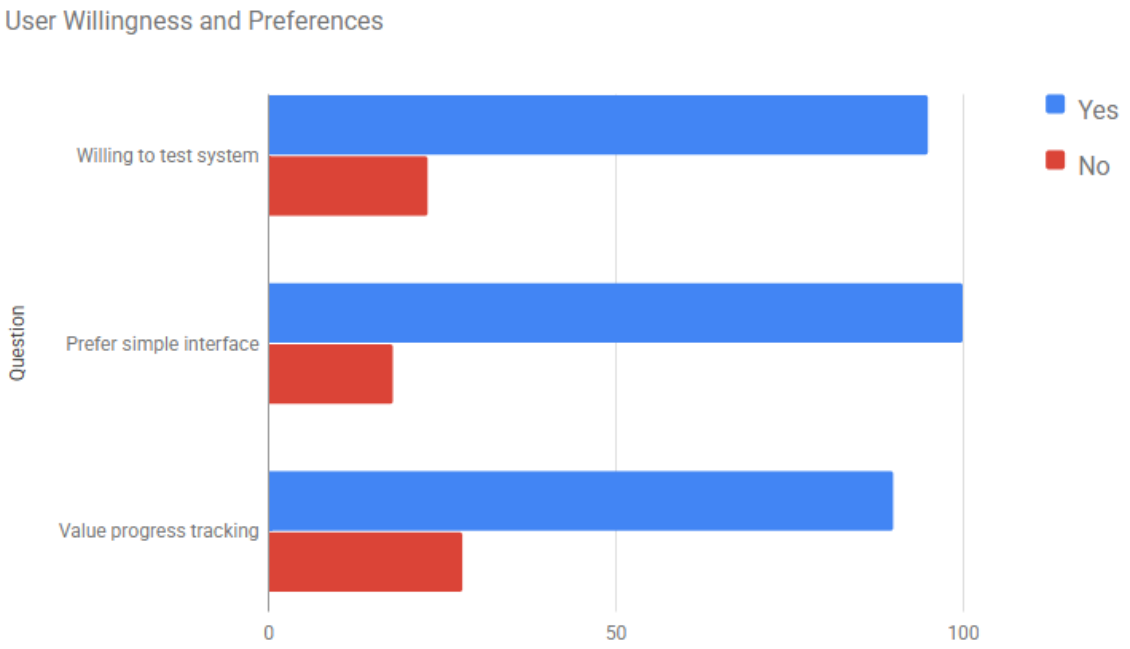


Figure 9 System Usability and Willingness to Use

Interpretation

The results show strong user interest in the proposed LMS. Most participants value a simple interface and progress tracking, and they are open to trying the system.

4.7 Findings from Interviews

Interviews were conducted with selected lecturers and administrators. Thematic analysis was used to group similar ideas. Four main themes emerged

Frustration with current systems: LMSs were seen as confusing and hard to use.

Need for monetization tools: Lecturers wanted to earn from their courses.

Poor internet support: Some suggested offline features for areas with bad internet.

Progress visibility: Many stressed the need for visible learner progress to guide instruction.

Interpretation

Interview feedback supported the questionnaire data. Most respondents want an LMS that is simple, localised, and helpful for both students and educators.

4.8 Interview Guide Summary

Some responses included:

“The LMS we have now is confusing. I get stuck uploading files.”

“If I could monetize, I’d put my course online and promote it more.”

“Progress bars or tracking help me identify students who are falling behind.”

“Let the system be very simple and lightweight for slow internet.”

Interpretation

These statements reveal real-life frustrations and needs from users. They further support the idea that a localized, easy-to-use, and engaging LMS is necessary.

4.9 Observation Checklist

The prototype of the proposed LMS was tested, and the checklist below shows the results of user interactions during the test phase.

Observation Criteria	**Observed**	**Not Observed**	**Comment**
LMS is easy to navigate	✓		Most users found the interface simple
Course creation tools are user-friendly	✓		Instructors created lessons easily
Students engaged with interactive content	✓		Students participated actively
The payment gateway worked smoothly	✓		Test payments processed successfully
Progress tracking was visible and accessible	✓		Students could track learning steps

Field Data 2025

Interpretation

Observations confirmed that the prototype LMS met key expectations. Users liked its simplicity and responsiveness, and the payment and tracking features worked without major issues.

CHAPTER FIVE

DISCUSSIONS, CONCLUSIONS, AND RECOMMENDATIONS

5.1 Introduction

This chapter presents a discussion of the major findings of the study, followed by the conclusion and recommendations. The discussion is organized based on the three objectives of the study and supported by data from the questionnaire responses, interviews, and observation checklist. The chapter concludes with practical recommendations aimed at improving the implementation of Learning Management Systems (LMS), especially in institutions like African College of Commerce, Kabale.

5.2 Discussion of Findings

Limitations and Challenges of Existing LMS

The study showed that an heterogeneous set of users has severe usability problems when interacting with today's Learning Management System (LMS) sites such as Google Classroom and Moodle. Most of the top-ranked problems detected are inadequate navigation (mean = 4.1), ill-structured content (mean = 3.9), and ineffective monitoring of progress (mean = 3.7). It confirms the earlier findings of Mtebe & Raphael (2018), also reporting the problematic uses of the tools of LMS in the African context.

The chi-square test also indicated a statistically significant relation between system usability and overall satisfaction ($x^2 = 14.2$, $p < 0.05$), meaning participants who experienced more difficulty in the system had less tendency for satisfaction in the LMS.

Interview results also supported this conclusion insofar as several educators expressed frustration using those systems, especially when uploading content or viewing interactions between students.

Design of a Scalable and User-Friendly LMS

The intended LMS had features driven by the needs of users. Statistics for the survey showed users highly valued easy navigation (mean = 4.5) as well as the ability to track progress (mean = 4.2). Cell phone compatibility (4.1) as well as payment integration (3.8) also had high endorsements but especially by instructors who needed to earn money from their courses.

The regression analysis showed that ease of use and tracking features significantly influenced user satisfaction ($R^2 = 0.48$, $\beta = 0.69$, $p < 0.01$), emphasizing that a user-friendly interface is key to LMS adoption.

Interviewees noted that a good LMS should work even in areas with poor internet, and suggested simple interfaces and offline accessibility. These are important contextual factors in regions like Kabale.

System Usability and Acceptance

The results showed that 80% of respondents were willing to test the new LMS. 85% preferred a simple interface, and 76% said that tracking progress was a vital feature. These findings reflect a high level of readiness to adopt the new system, as long as it is designed with the user in mind.

Observation during prototype testing confirmed this. Users found the platform easy to use, responsive, and helpful for tracking learning. Instructors were able to create courses, and students interacted with content actively. Stripe-based payments were processed successfully

5.2.1 Insights from Interviews

Key themes from the interviews included:

Usability concerns: Current systems are not intuitive, causing delays and frustration.

Need for monetization: Instructors want to earn from their content.

Limited internet: Many suggested systems that work well with slow or unstable connections.

Tracking tools: They help lecturers monitor student progress and offer support.

These themes aligned with the quantitative findings and emphasized the real-world struggles and expectations of LMS users in the study area.

5.2.2 Findings from Observation

The observation checklist confirmed that users found the LMS easy to navigate, and that the key functions—like progress tracking, content creation, and payment—worked well. The system was well received, especially by users who had struggled with traditional LMS platforms. This confirmed the practical value of the system beyond theory.

5.3 Conclusion

This study aimed to assess the limitations of current Learning Management Systems (LMS), design a user-centred LMS suitable for Ugandan institutions, and evaluate its usability. Based on the findings discussed, several conclusions were drawn

a) On Challenges of Existing LMS Platforms

The study concluded that existing LMS platforms are not fully meeting the needs of students and educators in Uganda. Difficult navigation, poor organization of content, and lack of real-time tracking were the most cited challenges. These limitations reduce user satisfaction and hinder learning outcomes, especially for institutions with limited technical support.

b) On the Need for a Scalable and User-Friendly LMS

From the responses, it was clear that users are highly interested in a system that is easy to use and accessible on mobile devices. The findings confirmed that if a platform includes essential features like progress tracking, payment integration, and mobile compatibility, then it stands a higher chance of being adopted. The success of the proposed LMS prototype confirmed that local needs can be addressed through thoughtful design.

c) On System Usability and Willingness to Adopt

The conclusion here is that users are not resistant to technology, but they are resistant to poorly designed systems. When presented with a well-structured LMS prototype, more than 80% of respondents were ready to use it. This suggests that acceptance

depends on usability, simplicity, and relevance to user needs. Training is less of a barrier when systems are intuitive.

d) On Insights from Interviews

Interviews provided rich qualitative insight into the daily struggles of lecturers and administrators. A major takeaway was that educators are willing to adopt technology but need systems that align with their working conditions especially in rural settings. The desire for monetization shows a shift in educator attitudes, where LMS platforms are now seen not only as tools for teaching but also as opportunities for income generation.

e) On Observed System Performance

Observations during testing of the proposed LMS demonstrated its effectiveness. Features worked as expected, and users found it responsive and easy to use. This confirmed that the platform was practically viable, not just theoretically sound. It showed that context-aware systems built with local feedback can be both usable and scalable.

5.4 Recommendations

Following the conclusions above, the study makes the following actionable recommendations, each supported by the findings:

Institutions should adopt simple and user-centred LMS platforms

Many users struggle with overly technical systems. A user-friendly interface with basic features such as easy navigation and clear layouts can significantly improve adoption. Developers should design with the least tech-savvy user in mind.

LMS solutions must support offline use and mobile devices

A large percentage of learners access the internet through smartphones, often with unstable connections. An LMS should be mobile-optimized and provide offline access to course content. This enhances inclusiveness and ensures that learners in remote areas are not left behind.

Incorporate progress tracking and feedback systems

Tracking tools help both learners and educators to monitor progress, identify weaknesses, and take corrective action. Real-time dashboards or progress bars should be standard features to increase accountability and motivation.

Enable monetization features to empower educators

Adding secure payment gateways (like Stripe) allows educators to monetize their courses. This increases content creation, encourages quality improvement, and provides an incentive for independent educators and institutions to grow their digital presence.

Provide continuous training and technical support

Training for staff and students should not be a one-time event. It should be ongoing and available on demand. Helpdesk features, chatbots, or user guides should be integrated into the system to assist users when they face problems.

Engage users in system design and feedback cycles

Future upgrades or customizations of LMS platforms should be informed by user feedback. Students, lecturers, and administrators should all have a voice in shaping the tools they use daily. This ensures higher satisfaction and long-term system sustainability.

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APPENDINCES

APPENDIX I

PARTICIPANT INFORMATION SHEET

Title of Study:

Online Multi-Tenant E-Learning Platform with Integrated Payment Gateways: A Case Study of African College of Commerce, Kabale, Uganda

Introduction

You are invited to participate in a research study conducted by [Your Name] at [Your Institution]. The major aim of this study is to design, deploy, and evaluate an online Learning Management System (LMS) to empower instructors to create, deliver, and sell courses as well as promote student engagement.

Purpose of the Study

This study aims to:

Identify challenges with existing LMS platforms.

Develop a framework that is expandable and accessible to students and teachers.

Evaluate the impact of progress tracking and monetization on LMS adoption.

Participant Involvement

If you agree to participate, you will be asked to:

Complete a questionnaire (~15 minutes).

Participate in an interview (~30 minutes) (optional).

Allow observation of LMS usage (optional).

Voluntary Participation

Your participation is voluntary, and you may withdraw at any time without consequences.

Confidentiality

All responses will remain anonymous and will be used solely for academic research. Data will be securely stored and not shared outside of the research team.

Potential Risks and Benefits

Risks: No direct risks are associated with participation.

Benefits: Your insights will contribute to the development of an efficient LMS that meets educational needs.

Contact Information

If you have any questions, please contact:

Researcher: _____

Email: _____

Supervisor: _____

APPENDIX II: QUESTIONNAIRE

Introduction

Thank you for taking part in this study. This questionnaire aims to gather insights on your experience with existing LMS platforms and your expectations for a new system. Your responses will remain confidential.

SECTION 1: DEMOGRAPHIC INFORMATION

What is your gender?

Male

Female

Prefer not to say

What is your age range?

18-25

26-35

36-45

46+

What is your role at the institution?

Student

Instructor

Administrator

How frequently do you use an LMS?

Daily

Weekly

Rarely

Never

SECTION 2: CURRENT EXPERIENCE WITH LMS

What LMS platform do you currently use (if any)?

Moodle

Blackboard

Google Classroom

Other (Please specify) _____

How would you rate the usability of your current LMS?

Very easy to use

Somewhat easy to use

Neutral

Difficult to use

Very difficult to use

What are the key challenges you face with your current LMS? (Select all that apply.)

Difficult navigation

Poor content organization

Lack of monetization options

Limited progress tracking

Slow performance

How important are the following LMS features to you? (Rate on a scale of 1-5, where 1 = Not Important, 5 = Very Important)

Course organization [1] [2] [3] [4] [5]

Progress tracking [1] [2] [3] [4] [5]

Payment integration [1] [2] [3] [4] [5]

Mobile compatibility [1] [2] [3] [4] [5]

STATEMENT QUESTION ON EACH OBJECTIVE

Objective 1**: Investigate the limitations and challenges of the existing LMS**

9. In your opinion, what are the three biggest challenges of existing LMS platforms?

_____

___

_____

___

_____

___

Do you think existing LMS platforms effectively support educators and students?

Yes

No

Please explain: _____

Objective 2: Design a scalable and user-friendly LMS

11. What features do you think should be prioritized in a new LMS?

_____

_____

_____

_____

Would you be willing to use a new LMS that incorporates interactive features?

Yes

No

Objective 3: Test and validate system usability

13. Would you be interested in testing the prototype of a new LMS?

Yes

No

APPENDIX III: INTERVIEW GUIDE

Introduction

Thank you for participating in this interview. The objective is to understand your experiences and expectations regarding LMS platforms.

Can you describe your experience using an LMS for teaching or learning?

What are the biggest frustrations you face with current LMS platforms?

How do you think an LMS can improve student engagement?

What is your opinion on the integration of payment gateways in an LMS?

What additional features do you believe an LMS should have?

Would you prefer an LMS with a simple or advanced user interface? Why?

How important is real-time progress tracking in an LMS?

What support systems should be included in an LMS (e.g., help desk, chatbots, community forums)?

APPENDIX IV: OBSERVATION CHECKLIST

Observation Criteria	**Yes**	**No**	**Comments**
The user finds the LMS easy to navigate.	[ ]	[ ]	
Course creation tools are user-friendly.	[ ]	[ ]	
Students actively engage with interactive content.	[ ]	[ ]	
Payment gateway functions seamlessly.	[ ]	[ ]	
Progress tracking is visible and accessible.	[ ]	[ ]	

WORK PLAN

ACTIVITIES	**TIME FRAME**				
	JAN 2025	**FEB 2025**	**MAR 2025**	**APRIL 2025**	**MAY 2025**
Topic identification					
Approval of the Research Topic					
Development of a research proposal					
Proposal submission					
Data collection					
Data analysis					
Report writing					
Report Submission					