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**A FRAMEWORK FOR ENHANCING TEACHING AND LEARNING MANAGEMENT  
WITHIN SECONDARY SCHOOLS**

**CASE STUDY: SELECTED SECONDARY SCHOOLS IN UGANDA**

A dissertation presented to

**FACULTY OF SCIENCE**

in partial fulfillment of the requirements for the award of the degree

**Master of Science in Information Systems**

Uganda **M**artyrs University  
*Making a Difference*

**UGANDA MARTYRS UNIVERSITY**

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**UGANDA MARTYRS UNIVERSITY**

**DIRECTORATE OF GRADUATE STUDIES, RESEARCH AND ENTERPRISE**

**Master's Dissertation**

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**Master's Dissertation**

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## DEDICATION

This thesis is dedicated to the countless individuals who have contributed to its completion, each playing a unique and invaluable role in this journey. First and foremost, I extend my deepest gratitude to the respondents who generously shared their time, insights, and experiences. Their willingness to participate and provide candid feedback was instrumental in shaping the research and bringing depth and authenticity to the findings. Without their contributions, this study would not have been possible, and their involvement underscores the collaborative spirit of academic inquiry.

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Lastly, this thesis is dedicated to the broader academic community and future researchers who strive to make meaningful contributions to their fields. May this work serve as a stepping stone for further exploration and innovation, inspiring others to pursue their academic passions with vigour and dedication. It is my hope that the insights and findings presented here will contribute to the ongoing dialogue and advancement of knowledge in our collective quest for understanding and improvement.

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## LIST OF ABBREVIATIONS

<b>TLM</b>	Teaching and Learning Management
<b>SMIS</b>	School Management Information Systems
<b>ICT</b>	Information Communication Technology
<b>MoES</b>	Ministry of Education and Sports
<b>API</b>	Application Programming Interface
<b>NEMIS</b>	National Education Management Information Systems
<b>SEMIS</b>	Smart Education Management Information Systems
<b>UDISE</b>	Unified District Information Systems for Education
<b>TAM</b>	Technology Acceptance Model
<b>DOI</b>	Diffusion of Innovations
<b>UTAUT</b>	Unified Theory of Acceptance and Use of Technology
<b>NDP</b>	National Development Plan
<b>DT</b>	Digital Transformation
<b>MINEDUC</b>	Ministry of Education Rwanda
<b>UNSA</b>	Uganda National Students' Association
<b>USSD</b>	Unstructured Supplementary Service Data
<b>SMS</b>	Short Message Service
<b>AES</b>	Advanced Encryption Standard
<b>UCC</b>	Uganda Communications Commission
<b>SPSS</b>	Statistical Package for the Social Sciences
<b>SEM</b>	Structural Equation Model
<b>ANOVA</b>	Analysis of Variance
<b>EFA</b>	Exploratory Factor Analysis
<b>OCED</b>	Organisation for Economic Co-operation and Development
<b>UNICEF</b>	United Nations International Children's Emergency Fund
<b>CSFs</b>	Critical Success Factors
<b>RBAC</b>	Role-Based Access Control
<b>HTTPS</b>	Hypertext Transfer Protocol Secure

## ABSTRACT

This thesis presents a comprehensive study focused on the design and validation of a Teaching and Learning Management (TLM) Framework tailored for secondary schools in Uganda, with an emphasis on enhancing the integration and utilization of Information and Communication Technology (ICT) in academic administration. The research employs a mixed-methods approach, combining both quantitative and qualitative analyses to evaluate the effectiveness of the proposed framework. By doing so, it aims to address the challenges faced by educational institutions in adopting ICT solutions, thereby improving administrative efficiency and educational outcomes.

The study reveals significant predictions between key framework components and teaching and learning management effectiveness. Notably, assessment and feedback predict the highest with a regression coefficient ( $\beta = 0.346$ ), followed by pedagogical support ( $\beta = 0.309$ ), technological integration ( $\beta = 0.271$ ) and institutional capacity ( $\beta = 0.215$ ). These components collectively explain teaching and learning management outcomes, as indicated by the regression model's  $R^2$  value. This statistical evidence underscores the critical role of a well-structured system design, robust infrastructure, and tangible benefits in driving the successful adoption of academic management systems.

The prototype evaluation of the TLM framework received overwhelmingly positive feedback from experts. Over 97% of respondents agreed on the framework's clarity, practicality, and effectiveness in managing academic processes. This high level of agreement highlights the framework's potential to streamline administrative tasks, enhance communication, and improve data management within educational settings. The positive reception of the prototype underscores its readiness for real-world application and its potential to address the specific needs of secondary schools in Uganda.

Furthermore, the study underscores the importance of robust technological infrastructure, comprehensive user training, and stringent security measures in facilitating successful ICT integration in educational settings. These elements are crucial for ensuring the framework's effectiveness and sustainability. By addressing these key areas, the TLM framework can significantly contribute to improving teaching and learning management in secondary schools.

# **CHAPTER ONE**

## **INTRODUCTION**

This chapter introduces the foundational aspects of this research study focused on designing a framework for enhancing teaching and learning management within secondary schools in Uganda's urban settings. It outlines the background, problem statement, objectives, research questions, scope, significance, justification, and key definitions, setting the stage for a comprehensive exploration of the integration of ICT in educational management.

### **1.1 Background of the Study**

Teaching and learning management remains one of the most critical determinants of educational quality and student outcomes in secondary schools. In Uganda's urban settings, particularly in cities such as Kampala, Jinja, Mbarara, and Gulu, secondary schools face persistent challenges that undermine effective instructional delivery, assessment, and the integration of technology into the learning process (Bingimlas, 2016). While academic management systems have historically evolved from simple record-keeping functions into comprehensive platforms that integrate student data, staff information, and academic performance tracking (Castañeda & Selwyn, 2018), their role in directly enhancing teaching and learning management has not been adequately harnessed in Uganda's urban schools. The absence of a robust framework that links ICT-enabled systems to pedagogical processes continues to limit their potential impact on instructional planning, classroom practices, and student achievement.

The theoretical foundation of this research is grounded in several established frameworks and models that have been instrumental in understanding the adoption and implementation of ICT in educational settings. The Technology Acceptance Model (TAM) posits that the acceptance and use of technology are influenced by perceived usefulness and perceived ease of use (Davis, 1989). This model has been widely applied in various contexts to explain user behaviour towards technology adoption. Similarly, the Unified Theory of Acceptance and Use of Technology (UTAUT) extends TAM by incorporating additional constructs such as social influence and facilitating conditions, providing a more comprehensive understanding of the factors that influence technology acceptance (Venkatesh et al., 2003). Additionally, the Diffusion of Innovations theory (Rogers et al., 2008) provides a useful lens for understanding how new technologies are adopted and diffused within organizations, highlighting the importance of communication channels, time, and social systems in the adoption process.

Regionally, the National Education Management Information System (NEMIS) in Kenya serves as a notable success story since it has been instrumental in streamlining administrative processes, enhancing data management, and improving decision-making in Kenyan schools (Kasimiri et al., 2021). The system's success can be attributed to its comprehensive design, which addresses various aspects of school management, including student enrollment, staff information, and financial data. Similarly, Rwanda's Smart Education Management System has demonstrated the potential of ICT to transform educational administration by integrating various management functions into a cohesive platform (Habyarimana et al., 2022). The success of these systems underscores the importance of a holistic approach that considers the unique challenges faced by educational institutions (Tondeur et al., 2017).

Contextually, Uganda's urban secondary schools operate in a rapidly evolving environment marked by population growth, resource constraints, and escalating administrative demands. Kampala, hosting over 300 secondary schools, faces unique challenges: overcrowded classrooms, inadequate infrastructure, frequent teacher transfers, and pressure to comply with national reporting standards (Mukwaya et al., 2025). A 2023 survey of 50 schools in the city found that only 28% had fully digitized academic records, while 72% relied on hybrid paper-digital systems, leading to data discrepancies during Uganda National Examinations Board (UNEB) submissions (Mukhula et al., 2021). These inefficiencies are compounded by infrastructural gaps; while 89% of Kampala schools have internet access, connectivity remains unstable, with 65% experiencing daily outages (UCC, 2023).

Furthermore, schools in low-income areas often struggle with unreliable internet connectivity and a lack of access to modern computing devices, which are essential for the effective operation of academic management systems. Additionally, the limited technical expertise among school administrators and teachers further exacerbates these challenges, as many lack the necessary skills to effectively utilize ICT tools (Kahangirwe, 2012). These contextual factors highlight the need for a comprehensive ICT framework that addresses the unique challenges and barriers faced by secondary schools in Kampala. The successful implementation of such a framework requires a holistic approach that considers the social, cultural, and organizational factors that influence technology adoption (Ertmer et al., 2012). Additionally, the role of leadership and organizational culture in facilitating technology adoption cannot be overlooked, as effective leadership is essential for creating a supportive environment for ICT integration (Fullan, 2014).

Globally, advancements in academic management offer valuable lessons. In India, the Unified District Information System for Education (UDISE), launched in 2014, unified disparate datasets across 1.5 million schools using cloud-based architecture, reducing reporting errors by 70% (Kaushik et al., 2024). Similarly, Brazil's Educacenso integrated biometric attendance tracking, cutting dropout rates by 12% in urban centers (Nogueira, 2017). However, these systems often assume high technical capacity and stable infrastructure—conditions unmet in Uganda, where 55% of school IT staff lack formal training (Steketee, 2005). This disparity necessitates a framework blending global best practices such as offline-first design and modular scalability.

Uganda's urban education landscape is further shaped by rapid urbanization and policy shifts. The National Development Plan III (NDP III) prioritizes ICT integration in secondary schools, yet implementation lags due to budgetary shortfalls, with only 8% of the education sector's 2022–2023 budget allocated to digital infrastructure (MoES, 2022). Meanwhile, private schools like Gayaza High School and Nabisunsa Girls' School have pioneered in-house academic management tools, such as AI-driven attendance algorithms, but these remain inaccessible to underfunded public institutions (Nyakito et al., 2021). In light of these challenges, there is a pressing need to design a comprehensive framework for enhancing teaching and learning management in Uganda's urban secondary schools. Such a framework should integrate global best practices with local contextual realities, ensuring that ICT is not only adopted but also embedded within instructional planning, assessment, feedback mechanisms, and student engagement processes.

## **1.2 Statement of the Problem**

Despite significant policy commitments by the Ugandan government, such as the ICT in Education Policy (2002) and the National Development Plan III (NDP III), teaching and learning management in urban secondary schools remains weak, fragmented, and inefficient. Many schools in Kampala and other urban centers continue to rely on hybrid systems of paper-based and partially digitized records, which create discrepancies in lesson planning, assessment tracking (UCC, 2023), and reporting to national agencies like the Uganda National Examinations Board (UNEB) (Mukhula et al., 2021).

While global models such as India's UDISE (Kaushik et al., 2024) and Kenya's NEMIS (Kasimiri et al., 2021) demonstrate how integrated ICT systems can enhance teaching quality and accountability, Ugandan schools struggle with inadequate infrastructure, unstable internet

connectivity (Ertmer et al., 2012), and limited technical expertise among teachers and administrators (Kahangirwe, 2012). Theoretical insights from the Technology Acceptance Model (Davis, 1989), UTAUT (Venkatesh et al., 2003), and Diffusion of Innovations Theory (Rogers et al., 2008) suggest that adoption barriers are not only technological but also cultural and organizational—highlighting why existing frameworks remain underutilized in Uganda’s urban education system.

The consequence of these inefficiencies is significant. Poorly managed teaching and learning processes manifest in overcrowded classrooms, limited teacher preparedness, delayed or inconsistent feedback to learners (Fullan, 2014), and weak student engagement—all of which directly undermine learning outcomes (Tondeur et al., 2017). Furthermore, the absence of real-time monitoring and evaluation tools prevents school leaders from making data-driven decisions to improve instructional quality, leading to inequities between private schools with advanced systems and underfunded public schools still constrained by resource shortages.

There is therefore an urgent need for a contextually grounded framework that enhances teaching and learning management in Uganda’s urban secondary schools. Unlike generic academic management systems, this proposed framework will directly link ICT adoption to pedagogical processes such as instructional planning, assessment, feedback, and student engagement, while embedding enabling factors like leadership support, teacher professional development, and infrastructure scalability.

### **1.3 Objectives of the Study**

#### **1.3.1 Major Objective**

To design a framework for enhancing teaching and learning management within secondary schools in Uganda’s urban settings. A case study of Kampala district.

#### **1.3.2 Specific Objectives**

1. To review the existing frameworks for teaching and learning management.
2. To design a framework that leverages pedagogical and ICT integration to enhance teaching and learning management within secondary schools in Uganda’s urban settings.
3. To validate the framework that leverages pedagogical and ICT integration to enhance teaching and learning management within secondary schools in Uganda.

## **1.4 Research Questions**

1. What are the key requirements for designing a framework that aims to enhance teaching and learning management in Uganda's urban settings?
2. How can a framework that leverages pedagogical and ICT integration to enhance teaching and learning management within secondary schools be designed?
3. How effective is the framework that leverages pedagogical and ICT integration in enhancing teaching and learning management within secondary schools?

## **1.5 Scope of the Study**

### **1.5.1 Geographical Scope**

This study focuses on four selected secondary schools in Kampala, Uganda: Bishop Cipriano Kihangire Secondary School, St. Joseph's Girls Secondary School, Nsambya, Kampala Secondary School, and Kawempe Muslim Secondary School. These schools were chosen due to their diverse student populations and varying levels of ICT integration, providing a comprehensive representation of the challenges and opportunities in enhancing teaching and learning management in urban settings (Newby et al., 2013).

### **1.5.2 Time Scope**

The research was conducted over a one-year period, allowing for an in-depth assessment of the current state of teaching and learning management, designing the ICT framework, and the evaluation of its potential impact. This timeframe ensured a thorough exploration of the implementation process and its outcomes within a manageable period (Businge et al., 2022).

### **1.5.3 Content Scope**

The study encompasses various aspects of teaching and learning management, including institutional planning and delivery, learning assessment and evaluation, and pedagogical and ICT integration. The Teaching and Learning Management (TLM) framework aims to address the integration of these components into a cohesive and efficient system, tailored to the specific needs and contextual factors of secondary schools in Kampala (Voogt et al., 2015).

## **1.6 Significance of the Study**

The significance of this study lies in its potential to enhance the efficiency and effectiveness of teaching and learning management in secondary schools in Uganda's urban settings, benefiting a wide range of stakeholders. Policymakers will gain valuable insights into the challenges and

opportunities of ICT integration in education, enabling them to formulate more informed and effective policies that support digital transformation in schools (Castañeda & Selwyn, 2018). Local schools, particularly those involved in the study, will benefit from improved administrative processes and educational outcomes, as the TLM framework aims to streamline data management and decision-making (Newby et al., 2013). Education experts will find the research useful for understanding the practical implications of ICT frameworks in educational settings, providing a model for enhancing teaching and learning management in similar contexts (Voogt et al., 2015). Academia will benefit from the theoretical and empirical contributions of the study, as it addresses gaps in the literature on ICT integration in school management, offering a foundation for further research (Businge et al., 2022).

### **1.7 Justification of the Study**

This is rooted in the growing recognition of the importance of ICT in education and the urgent need for robust frameworks to support the effective implementation and utilization of teaching and learning management. The study is timely and relevant, given the increasing emphasis on digital transformation in the educational sector and the need for data-driven decision-making (Castañeda & Selwyn, 2018). The potential benefits of this research are significant, as it offers a model for other schools and educational institutions seeking to enhance their management information systems through the integration of ICT, thereby contributing to the broader goal of improving educational quality and outcomes in Uganda (Newby et al., 2013).

Despite the recognized benefits of ICT in education, many secondary schools in Kampala continue to face significant challenges in effectively implementing and utilizing teaching and learning management, such as inadequate infrastructure, limited technical expertise, and insufficient funding (Businge et al., 2022). These challenges lead to inefficiencies, errors, and delays in administrative tasks, ultimately impacting the overall performance of the schools. The need for this study is further underscored by the growing demand for data-driven decision-making and the increasing complexity of educational management, which requires a tailored approach to integrating ICT into school management processes (Voogt et al., 2015).

### **1.8 Definition of Key Terms**

#### **Academic Management**

This refers to the systematic process of planning, organizing, directing, and controlling the academic activities and resources within educational institutions. This includes managing

student records, staff information, curriculum development, and academic performance tracking to ensure the effective delivery of educational services (Bingimlas, 2016).

### **Teaching and Learning Management**

This refers to the systematic planning, coordination, and evaluation of instructional processes within schools, encompassing lesson preparation, delivery, assessment, feedback, and the integration of technology to optimize student engagement and achievement. It is a critical subset of academic management that ensures alignment between curriculum objectives, pedagogical practices (Fullan, 2014), and learning outcomes, while also leveraging ICT to improve efficiency, accountability, and data-driven decision-making (Tondeur et al., 2017).

### **Digital Transformation**

The integration of digital technology into all areas of an organization, fundamentally changing how it operates and delivers value. In education, digital transformation involves the adoption of digital tools and technologies to improve administrative efficiency, teaching, and learning outcomes (MoES, 2014).

### **Stakeholder Engagement**

It involves all relevant stakeholders, such as students, teachers, parents, and community members, in the decision-making and implementation processes of educational initiatives. Effective stakeholder engagement ensures that the diverse needs and perspectives of the school community are considered, leading to more inclusive and sustainable outcomes (Fullan, 2014).

### **Information and Communication Technology (ICT)**

This encompasses the technologies and tools used to handle information and aid communication. In the context of education, ICT includes hardware, software, networks, and digital platforms that facilitate the management, delivery, and enhancement of educational processes (Castañeda & Selwyn, 2018).

## **CHAPTER TWO**

### **LITERATURE REVIEW**

This chapter reviews the existing literature on teaching and learning management, focusing on its core components. Additionally, it explores existing frameworks that have been instrumental in the successful implementation of teaching and learning management in various contexts. The review aims to provide a comprehensive understanding of the current state of teaching and learning management, the challenges faced in implementation, and the TLM framework tailored to secondary schools in Uganda's urban settings.

#### **2.1 Teaching and Learning Management within Secondary Schools**

##### **2.1.1 Overview of TLM in Secondary Schools in Kampala**

The current state of teaching and learning management systems within secondary schools in Kampala, a subset of academic management that mostly focuses institutional planning and delivery, learning and assessment evaluation, and pedagogical and ICT integration, reflects a landscape marked by both progress and persistent challenges. In Kampala, schools such as Bishop Cipriano Kihangire Secondary School and St. Joseph's Girls Secondary School, Nsambya, have made strides in integrating ICT into their management systems, demonstrating the potential benefits of a well-designed academic management system and its role in improving teaching and learning (Mukhula et al., 2021).

Bishop Cipriano Kihangire SS, for instance, has implemented advanced technological tools such as smartboards and security cameras, which have significantly enhanced classroom engagement and campus security, respectively. These institutions have adopted digital platforms for student records, attendance tracking, and academic performance monitoring, which have significantly streamlined administrative processes and improved data accuracy (Newby et al., 2013). However, these examples are exceptions rather than the norm, as many schools in Kampala continue to struggle with the effective implementation and utilization of ICT in their management processes (Bingimlas, 2016).

In comparison to other regions of Uganda, Kampala's secondary schools generally have better access to technological infrastructure and resources. For instance, schools in rural areas such as those in the Luweero and Masaka districts often face more pronounced challenges, including unreliable internet connectivity and limited access to modern computing devices (Businge et al., 2022). These rural schools frequently rely on manual record-keeping systems, which are

prone to errors and inefficiencies, highlighting a stark contrast with the relatively more advanced academic management system implementations seen in some Kampala schools.

Within the region, Uganda's progress in academic management system adoption lags behind nations like Kenya and Rwanda. Kenya's NEMIS has been instrumental in streamlining administrative processes, enhancing data management, and improving decision-making in Kenyan schools (Kasimiri et al., 2021). Its comprehensive design addresses various aspects of school management, including student enrollment, staff information, and financial data, setting a benchmark for the region. Similarly, Rwanda's SEMS has demonstrated the potential of ICT to transform educational administration by integrating various management functions into a cohesive platform (Habyarimana et al., 2022). Its success underscores the importance of a holistic approach that considers the unique challenges faced by educational institutions.

Despite these regional advancements, many secondary schools in Kampala still grapple with significant challenges in effectively implementing and utilizing ICT. Issues such as inadequate infrastructure, limited technical expertise, and insufficient funding hinder the optimal performance of these systems (Nyakito et al., 2021). For example, schools in low-income areas of Kampala often struggle with unreliable internet connectivity and a lack of access to modern computing devices, which are essential for the effective operation. Additionally, the limited technical expertise among school administrators and teachers further exacerbates these challenges, as many lack the necessary skills to effectively utilize ICT tools.

### **2.1.2 Types of TLM Used within Secondary Schools**

Teaching and learning management in secondary schools can be categorized into traditional, technology-assisted, and blended models, each reflecting different levels of integration of pedagogy, assessment, and ICT in the instructional process.

Traditional management focuses on teacher-centred approaches, with lesson planning, delivery, and evaluation relying largely on manual processes such as chalk-and-talk teaching, paper-based assessments, and manual grade books. While this approach remains dominant in many Ugandan secondary schools, especially those in low-resource settings, it has been criticized for limiting student engagement, constraining feedback mechanisms (Fullan, 2014), and offering little scope for personalized learning (Bingimlas, 2016). Despite its accessibility and low cost, traditional teaching and learning management has struggled to meet the demands of modern education systems that emphasize innovation, efficiency, and accountability.

A second type is technology-assisted teaching and learning management, where ICT tools are integrated into certain aspects of the instructional process. This includes the use of electronic grade books, online assessment platforms, digital attendance registers, and classroom technologies such as projectors and smartboards. In Kampala, schools such as Bishop Cipriano Kihangire and Gayaza High School have piloted these tools to improve classroom delivery and record management (Mukhula et al., 2021). However, the effectiveness of technology-assisted management often depends on infrastructure availability, reliable internet access, and teacher capacity—challenges that persist in many Ugandan urban schools where 65% report daily internet outages and limited ICT skills among staff (UCC, 2023).

A third type is blended teaching and learning management, which combines traditional classroom practices with digital tools to enhance both instruction and student engagement. This approach allows teachers to leverage ICT for lesson preparation, formative assessment, and real-time feedback while maintaining face-to-face interactions that support contextualized learning. Blended systems have been found to improve student motivation and knowledge retention, especially when integrated into subjects like science and mathematics (Tondeur et al., 2017). In Uganda, a pilot project in Mukono District using Raspberry Pi-based learning platforms reduced report generation times and enhanced monitoring of student progress, demonstrating the potential of low-cost blended approaches (Stiles et al., 2021).

Finally, emerging models of data-driven teaching and learning management are beginning to shape modern education systems, though they are still rare in Uganda. These systems emphasize the collection and analysis of real-time data on student performance, attendance, and engagement to inform instructional decision-making. Internationally, Brazil's *Educacenso* (Nogueira, 2017) and India's UDISE (Kaushik et al., 2024) have shown that data-driven systems can reduce dropout rates and enhance accountability in secondary education. In Uganda, however, weak monitoring and evaluation structures, coupled with fragmented data management systems, have slowed the adoption of such models (MoES, 2022).

### **2.1.3 Challenges in Enhancing TLM within Secondary Schools**

The enhancement of teaching and learning management system in secondary schools faces several challenges that hinder their effective implementation and utilization. Majorly is inadequate infrastructure, including unreliable internet connectivity and limited access to modern computing devices, which are essential for the effective operation (Castañeda & Selwyn, 2018). Schools in low-income areas often struggle with these infrastructural

limitations, which can lead to inefficiencies and errors in administrative tasks (Businge et al., 2022). Additionally, the limited technical expertise among school administrators and teachers further exacerbates these challenges, as many lack the necessary skills to effectively utilize and operate ICT machinery (Voogt et al., 2015).

Another significant challenge is the insufficient funding and resource allocation for the implementation and maintenance of these systems. Many secondary schools, particularly those in low-income areas, face budgetary constraints that limit their ability to invest in the necessary technological infrastructure and resources (Newby et al., 2013). This lack of funding can hinder the effective implementation and utilization of ICT tools, leading to suboptimal administrative efficiency and educational outcomes (Bingimlas, 2016). Additionally, the limited technical expertise among administrators and teachers can further exacerbate these challenges, as users with limited technical skills may struggle to effectively utilize the systems (Voogt et al., 2015).

There are also challenges related to the alignment of the systems with the specific needs and contextual factors of the schools. For instance, the integration of teaching and learning management systems with existing administrative processes and educational practices can be complex and time-consuming, requiring significant effort and resources (Castañeda & Selwyn, 2018). Additionally, the limited technical expertise among school administrators and teachers can further exacerbate these challenges, as users with limited technical skills may struggle to effectively utilize the systems which hinders operations (Businge et al., 2022).

## **2.2 Components of the Teaching and Learning Management Framework**

### **2.2.1 Institutional Planning and Delivery**

Institutional Planning and Delivery is a core component of the TLM Framework, chosen because it provides the structural foundation upon which effective teaching and learning processes are built. It operates through three elements: curriculum alignment, resource allocation, and timetable management. Curriculum alignment ensures that instructional activities are directly linked to national and institutional goals, promoting consistency and relevance in learning. Resource allocation guarantees that teaching materials, ICT tools, and human resources are effectively distributed, reducing disparities and supporting equitable learning opportunities. Timetable management provides the organizational backbone that structures the delivery of lessons, ensuring optimal use of time and balanced workloads for both teachers and students. Together, these elements create the necessary groundwork for systematic and efficient learning environments in secondary schools.

This component feeds into the overall framework by enabling accurate instructional planning, improving the flow of data capture and reporting, and ensuring that ICT-supported teaching practices can be effectively implemented. When curriculum is aligned, resources are well allocated, and time is efficiently managed, the subsequent layers of the framework—assessment, ICT integration, and teacher practices—operate more smoothly. Ultimately, this leads to the enhanced Teaching and Learning Management, as teachers are better prepared, students engage more effectively, and learning outcomes improve. Institutional Planning and Delivery was chosen as a pillar because without strong foundational organization, ICT adoption and assessment strategies cannot achieve their intended impact, making it indispensable in transforming urban secondary school education.

### **2.2.2 Learning Assessment and Evaluation**

Learning Assessment and Evaluation is a central pillar of the TLM Framework because it provides the mechanisms through which student progress is measured, instructional effectiveness is monitored, and feedback is generated to improve teaching practices. It operates through three interconnected elements: formative assessment, which supports continuous monitoring of student learning during instruction; summative assessment, which evaluates overall achievement at the end of a learning period; and feedback mechanisms, which close the learning loop by providing timely insights to both teachers and learners. These elements ensure that teaching is not only delivered but also measured against expected outcomes, making it possible to identify gaps, adjust pedagogy, and enhance student learning experiences.

This component drives the framework toward the final output by ensuring that instructional delivery is evidence-based and responsive to learner needs. Through formative assessment, teachers adapt lesson delivery in real time, while summative evaluation provides structured evidence of achievement that informs decision-making at school and policy levels. Feedback mechanisms empower students by keeping them engaged and aware of their progress, fostering accountability and motivation. By embedding these processes into the framework, this component ensures that data-driven decisions and continuous improvement feed directly into enhanced Teaching and Learning Management, resulting in improved instructional quality, stronger student engagement, and better learning outcomes. This component was chosen because without effective assessment and evaluation systems, the integration of ICT and instructional planning cannot achieve measurable and sustainable impact.

### **2.2.3 Pedagogical and ICT Integration**

Pedagogical and ICT Integration is a vital component of the TLM Framework because it bridges traditional teaching practices with modern technological innovations, ensuring that instruction is both effective and relevant in today's digital learning environment. It functions through three elements: digital tools usage, which involves the deployment of ICT resources such as smartboards, e-learning platforms, and digital content; teacher ICT capacity, which focuses on equipping educators with the skills and confidence to integrate technology into lesson delivery; and blended learning practices, which combine face-to-face teaching with digital methodologies to create more flexible and engaging learning experiences. Collectively, these support a dynamic instructional process that goes beyond conventional teaching, making learning more interactive, accessible, and aligned with global educational standards.

This component directly contributes to the dependent variable by transforming the classroom into a learner-centred environment where technology enhances engagement, assessment, and feedback. The use of digital tools makes instructional delivery more efficient, while teacher ICT capacity ensures sustainability by embedding these practices into daily routines. Blended learning further amplifies impact by allowing personalized learning pathways, thus catering to diverse student needs and promoting inclusivity. Pedagogical and ICT Integration was chosen as a core pillar because, without embedding technology into pedagogy, the benefits of planning and assessment remain limited. By integrating ICT into instructional practice, this component ensures that the framework achieves its ultimate outcome, characterized by improved instructional quality, increased student engagement, and stronger learning outcomes.

## **2.3 Existing Frameworks for Academic Management Systems**

### **2.3.1 EF1: National Education Management Information System (NEMIS)**

This framework has been instrumental in streamlining administrative processes, enhancing data management, and improving decision-making in Kenyan schools (Kasimiri et al., 2021). Its success can be attributed to its holistic approach, which considers the unique challenges faced by educational institutions (Tondeur et al., 2017).

#### **Strengths:**

- a) It addresses multiple aspects of school management, providing a holistic solution that enhances administrative efficiency and data accuracy (Kasimiri et al., 2021).

- b) The system integrates various data sources, facilitating seamless data sharing and reducing duplication efforts (Tondeur et al., 2017).
- c) NEMIS aligns with national educational policies and standards, ensuring compliance and supporting broader educational goals (Kasimiri et al., 2021).

**Weaknesses:**

- a) The effectiveness of NEMIS is contingent on robust technological infrastructure, which may not be available in all educational settings (Tondeur et al., 2017).
- b) The system requires a high level of technical expertise for effective implementation and utilization, which may be a barrier in some contexts (Kasimiri et al., 2021).
- c) Its comprehensive nature demands significant resources for implementation and maintenance, which may be challenging for underfunded institutions (Tondeur et al., 2017).

### **2.3.2 EF2: Smart Education Management System (SEMS)**

It has demonstrated the potential of ICT to transform educational administration by integrating various management functions into a cohesive platform (Habyarimana et al., 2022). Its success underscores the importance of a holistic approach that considers the unique challenges faced by educational institutions, providing valuable lessons for Uganda.

**Strengths:**

- a) SEMS integrates various management functions, providing a unified platform that enhances data consistency and administrative efficiency (Habyarimana et al., 2022).
- b) The system is designed with a focus on user experience, ensuring accessibility and ease of use for stakeholders with varying technical proficiency (MINEDUC, 2019).
- c) SEMS is scalable, allowing for incremental upgrades and expansion to meet the growing needs of educational institutions (Habyarimana et al., 2022).

**Weaknesses:**

- a) The integration of multiple management functions can be complex, requiring significant effort and resources for effective implementation (MINEDUC, 2019).
- b) The user-centric design of SEMS necessitates comprehensive training programs to ensure that all users can effectively utilize the system (Habyarimana et al., 2022).
- c) The effectiveness of SEMS is dependent on reliable technological infrastructure, which may not be available in all educational settings (MINEDUC, 2019).

### **2.3.3 EF3: Unified Theory of Acceptance and Use of Technology (UTAUT)**

This extends the Technology Acceptance Model (TAM) by incorporating additional constructs such as social influence and facilitating conditions, providing a more comprehensive understanding of the factors that influence technology acceptance (Venkatesh et al., 2003). UTAUT offers valuable insights into the factors that may influence the successful implementation of teaching and learning management systems in secondary schools.

#### **Strengths:**

- a) UTAUT provides a holistic understanding of technology acceptance, considering multiple factors that influence user behaviour (Venkatesh et al., 2003).
- b) It is applicable to various contexts, offering insights into the specific factors that may influence the adoption of teaching and learning management (Venkatesh et al., 2003).
- c) It has strong predictive power, enabling the identification of key factors that may facilitate or hinder the successful implementation of academic management (Venkatesh et al., 2003).

#### **Weaknesses:**

- a) The comprehensive nature of UTAUT can be complex, requiring significant effort and resources for effective application (Venkatesh et al., 2003).
- b) The theory may not fully account for the unique challenges and barriers faced by educational institutions in specific contexts (Venkatesh et al., 2003).
- c) The application of UTAUT demands significant resources for implementation and analysis, which may be challenging for underfunded institutions (Venkatesh et al., 2003).

### **2.3.4 EF4: Technology Acceptance Model (TAM)**

The TAM posits that the acceptance and use of technology are influenced by perceived usefulness and perceived ease of use (Davis, 1989). TAM has been widely applied in various contexts to explain user behaviour towards technology adoption. In the context of teaching and learning management, TAM provides valuable insights into the factors that influence the successful implementation of these systems in secondary schools.

#### **Strengths:**

- a) TAM is a straightforward and easy-to-understand model, focusing on key factors that influence technology acceptance (Davis, 1989).
- b) The model has strong predictive power, enabling the identification of key factors that may facilitate or hinder the successful implementation of SMIS (Davis, 1989).

- c) TAM is applicable to various contexts, offering insights into the specific factors that may influence the usage of teaching and learning management systems in schools (Davis, 1989).

**Weaknesses:**

- a) The simplicity of TAM may limit its ability to fully account for the complex and multifaceted nature of technology acceptance (Davis, 1989).
- b) The model may not fully account for the unique challenges and barriers faced by educational institutions in specific contexts (Davis, 1989).
- c) The application of TAM demands significant resources for implementation and analysis, which may be challenging for underfunded institutions (Davis, 1989).

**2.4 Comparative Analysis of Existing Frameworks and the TLM Framework**

The Table 2.1 presents a comparative analysis of various frameworks relevant to enhancing teaching and learning management systems in secondary schools and the TLM framework. The frameworks evaluated include the National Education Management Information System (NEMIS) from Kenya, the Smart Education Management System (SEMS) from Rwanda, the Unified Theory of Acceptance and Use of Technology (UTAUT), the Technology Acceptance Model (TAM), against the Teaching and Learning Management Framework.

**Table 2. 1: Comparative Analysis of Existing Frameworks and TLM Framework**

<b>Variables</b>	<b>EF1: NEMIS</b>	<b>EF2: SEMS</b>	<b>EF3: UTAUT</b>	<b>EF5: TAM</b>	<b>TLM Framework</b>
Flexibility & Scalability	Moderate	High	Moderate	Low	High
Learning Assessment	Moderate	Moderate	Low	Low	High
Technical Infrastructure	Moderate	High	Low	Low	High
User Training and Support	Low	Moderate	Moderate	Low	High
Security and Compliance	Moderate	High	Low	Low	High
Institutional Planning	High	High	Moderate	Low	High
Pedagogical integration	Low	Moderate	Moderate	Low	High

The comparative analysis reveals that NEMIS and SEMS have made significant progress in strengthening institutional planning, data management, and administrative efficiency, with SEMS standing out for its scalability, user experience, and security. However, both frameworks remain less effective in supporting learning assessment and pedagogical integration, as their designs were primarily administrative rather than instructional. Similarly, theoretical models such as UTAUT and TAM provide valuable insights into technology acceptance and user

behaviour, but they are limited in practical applicability since they do not address infrastructural realities, classroom-level processes, or policy compliance in secondary schools.

The Teaching and Learning Management (TLM) framework addresses these shortcomings by emphasizing ICT integration into instructional planning, continuous assessment, and feedback while embedding enabling factors such as teacher professional development, infrastructure scalability, and leadership support. By blending global best practices with Uganda's contextual realities, the TLM framework ensures flexibility, inclusivity, and sustainability, offering a comprehensive solution that not only strengthens administrative processes but also directly enhances the quality of teaching and learning in urban secondary schools.

## **2.5 Research Conceptualization**

### **2.5.1 Dependent Variable**

The dependent variable in this study is Enhanced Teaching and Learning Management, which refers to the improved efficiency, effectiveness, and quality of instructional processes in secondary schools. It encompasses better lesson planning, continuous assessment, timely feedback, and increased student engagement (Tondeur et al., 2017), all of which directly contribute to improved learning outcomes (Fullan, 2014). This variable reflects the ultimate goal of integrating ICT into school management—ensuring that technology adoption translates into tangible improvements in teaching and learning practices.

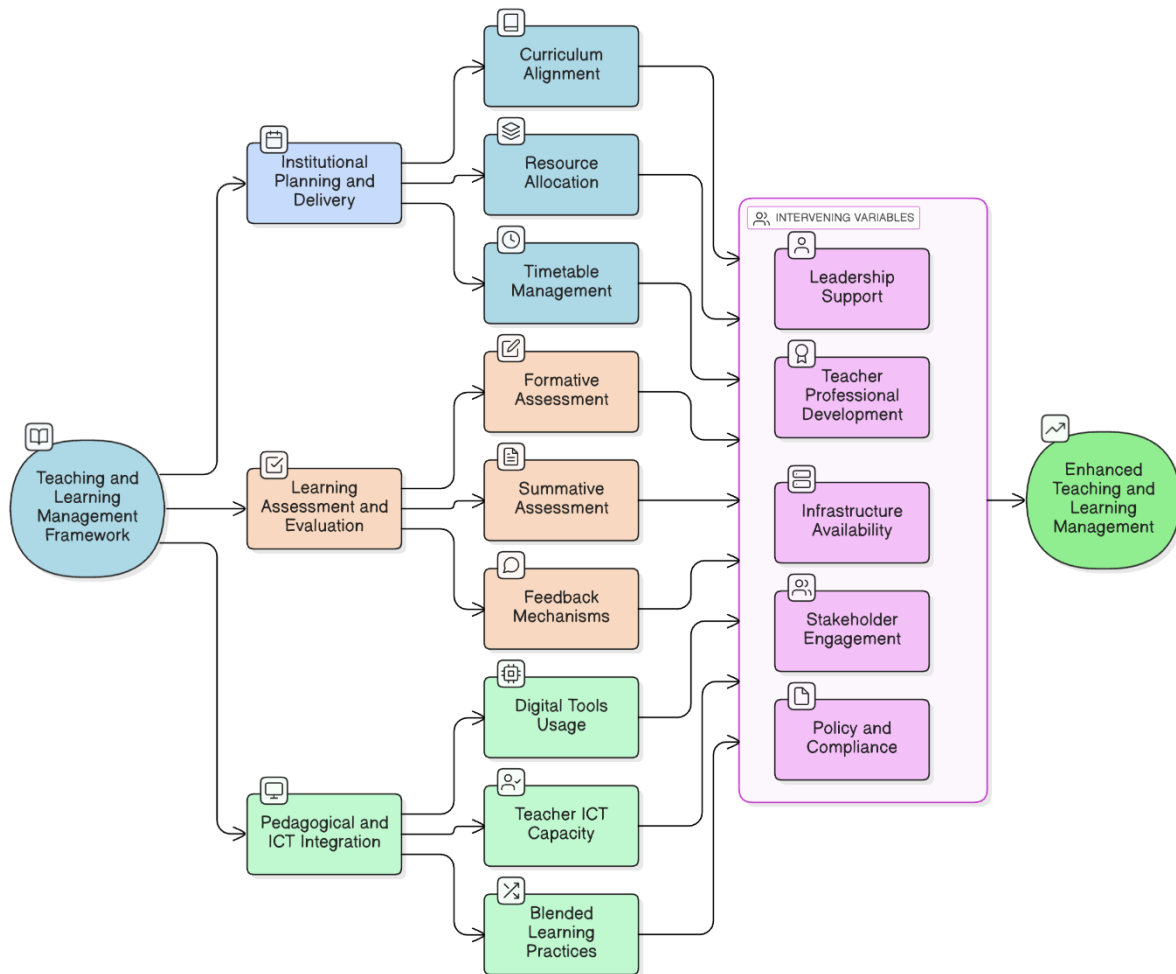
### **2.5.2 Independent Variable**

The independent variable is the Teaching and Learning Management (TLM) Framework, designed to strengthen institutional planning and delivery, learning assessment and evaluation, and pedagogical and ICT integration. This framework provides the structural and operational mechanisms through which ICT can be harnessed to support instructional processes, aligning administrative efficiency with classroom practices (Castañeda & Selwyn, 2018). By linking ICT-enabled management systems directly to pedagogical outcomes, the TLM framework seeks to bridge the gap between policy commitments and classroom realities.

### **2.5.3 Conceptual Framework of the study**

This provides a structured representation of how the Teaching and Learning Management Framework influences the enhancement of teaching and learning management in Uganda's urban secondary schools. It was used because it clearly links the independent variable—the

TLM framework, with its components of institutional planning and delivery, learning assessment and evaluation, and pedagogical and ICT integration—to the dependent variable.



**Figure 2. 1: Conceptual Framework of the Study**

Figure 2.1 is operationalized through three key components: Institutional Planning and Delivery (curriculum alignment, resource allocation, and timetable management), Learning Assessment and Evaluation (formative assessment, summative assessment, and feedback mechanisms), and Pedagogical and ICT Integration (digital tools usage, teacher ICT capacity, and blended learning practices). These components interact with critical intervening variables such as leadership support, teacher professional development, infrastructure availability, stakeholder engagement (Fullan, 2014), and policy compliance, which are essential for mediating the effectiveness of ICT adoption in education (Ertmer et al., 2012). The framework demonstrates that, when effectively implemented, these elements collectively contribute to the dependent variable—enhanced teaching and learning management, thereby aligning with global best practices (Kaushik et al., 2024) while being responsive to Uganda’s contextual realities (Mukwaya et al., 2025).

#### **2.5.4 Intervening Variables**

The study recognizes intervening variables—including leadership support, teacher professional development, infrastructure availability, stakeholder engagement, and policy compliance—that mediate the relationship between the TLM framework and enhanced teaching and learning management. These factors determine the extent to which ICT adoption can be effectively implemented and sustained in schools (Ertmer et al., 2012). Without strong institutional leadership, adequate resources, and capacity-building initiatives, the potential of the TLM framework to improve learning outcomes may remain unrealized.

#### **2.5.5 Hypothesis of the Study**

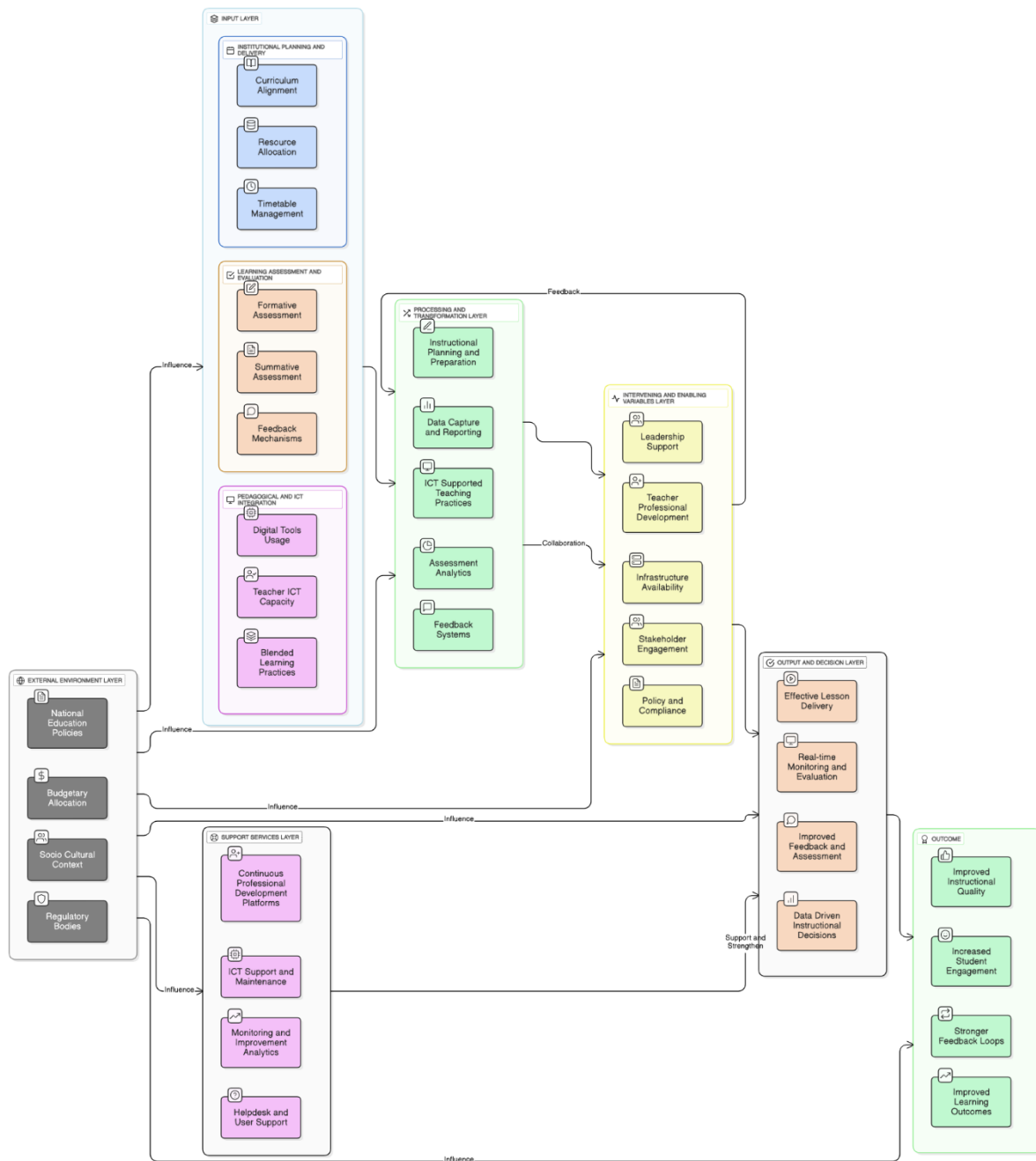
**H<sub>1</sub>:** There is a significant relationship between institutional planning and delivery and enhancement of teaching and learning management within urban secondary schools.

**H<sub>2</sub>:** There is a significant relationship between learning assessment and evaluation and enhancement of teaching and learning management within urban secondary schools.

**H<sub>3</sub>:** There is a significant relationship between pedagogical and ICT integration and enhancement of teaching and learning management within urban secondary schools.

### **2.6 The Teaching and Learning Management Framework**

This framework was designed as the final product of the study to provide a comprehensive, robust, and contextually grounded model that directly links ICT integration with enhanced teaching and learning management in Uganda’s urban secondary schools. Unlike the conceptual framework, which primarily illustrated hypothetical relationships, this final framework synthesizes empirical insights, theoretical foundations, and contextual realities to propose a practical and sustainable approach. It captures the complexity of teaching and learning management by showing how multiple layers of inputs, processes, enablers, and outputs interact to deliver improved educational outcomes.



**Figure 2. 2: Teaching and Learning Management (TLM) Framework**

As shown in Figure 2.2, the framework begins with the Input Layer, which represents the foundational components. These include Institutional Planning and Delivery, operationalized through curriculum alignment, resource allocation, and timetable management; Learning Assessment and Evaluation, which encompasses formative assessment, summative assessment, and feedback mechanisms; and Pedagogical and ICT Integration, comprising digital tools usage, teacher ICT capacity, and blended learning practices. These inputs form the starting point of the system by ensuring that planning, assessment, and pedagogy are systematically integrated with ICT support.

The inputs then feed into the Processing and Transformation Layer, where they are translated into practical functions that drive day-to-day teaching and learning. This layer emphasizes instructional planning and preparation, data capture and reporting, ICT-supported teaching practices, assessment analytics, and feedback systems. It represents the stage where abstract plans and tools are converted into actionable processes, ensuring that the data and resources generated at the input level are effectively utilized to improve instructional quality.

The effectiveness of this processing stage is further shaped by the Intervening and Enabling Variables Layer, which acknowledges the critical conditions required for the framework to operate successfully. Leadership support provides direction and commitment, teacher professional development ensures capacity-building, infrastructure availability addresses resource constraints, stakeholder engagement builds inclusivity, and policy and compliance establish regulatory alignment. These variables act as enablers, ensuring that inputs and processes are not only implemented but also sustained and aligned with institutional and national priorities.

The results of these interactions emerge in the Output and Decision Layer, where tangible benefits of the framework are realized. These include effective lesson delivery, real-time monitoring and evaluation, improved feedback and assessment, and data-driven instructional decisions. This layer highlights how the integration of ICT into planning, assessment, and pedagogy contributes directly to more efficient and evidence-based teaching and learning practices, enabling school leaders and teachers to respond to challenges with precision.

To sustain these outputs, the framework incorporates a Support Services Layer, which provides continuous reinforcement through professional development platforms, ICT support and maintenance, monitoring and improvement analytics, and helpdesk or user support. This ensures that the framework is not a one-off intervention but a dynamic, evolving system that adapts to challenges, builds teacher capacity, and maintains technological reliability over time.

Additionally, the External Environment Layer influences every stage of the framework, reflecting the reality that schools do not operate in isolation. National education policies, budgetary allocations, socio-cultural contexts, and regulatory bodies shape the availability of resources, the feasibility of implementation, and the sustainability of ICT integration in teaching and learning. By acknowledging these external forces, the framework situates itself within Uganda's broader educational landscape and policy environment.

Ultimately, these interconnected layers converge to produce the Outcome Layer, which represents the dependent variable—Enhanced Teaching and Learning Management. This outcome is reflected in improved instructional quality, increased student engagement, stronger feedback loops, and improved learning outcomes. By linking global best practices with Uganda’s contextual realities, this final framework demonstrates a holistic, inclusive, and sustainable model that strengthens both administrative efficiency and pedagogical effectiveness, positioning ICT as a driver of educational transformation in secondary schools.

## **2.7 Gaps in the Literature**

Although existing studies highlight the importance of ICT in educational management and showcase successful models such as NEMIS and SEMS, there remains a significant gap in frameworks that directly link ICT integration to teaching and learning management rather than focusing primarily on administrative efficiency. Much of the literature emphasizes adoption models and infrastructural challenges but gives limited attention to how institutional planning, assessment practices, and pedagogy interact with enabling conditions like leadership, teacher professional development, and policy compliance to improve learning outcomes. Furthermore, little has been done to contextualize global best practices within Uganda’s urban secondary schools, where socio-cultural dynamics, resource constraints, and technical capacity present unique challenges. This study addresses these gaps by designing a TLM Framework that not only incorporates ICT into school management but also embeds it within instructional planning, assessment, and pedagogical processes to directly enhance teaching and learning.

## **CHAPTER THREE**

### **RESEARCH METHODOLOGY**

This chapter outlines the research methodology used in the study while following the Research Onion model, ensuring a structured approach to research design that encompasses the philosophy, strategy, approach, time horizon, data collection methods, and analysis. Each layer is critically examined to provide a methodologically sound foundation for the study. The choice to integrate both qualitative and quantitative data was deliberate, as it allowed the study to capture not only measurable evidence on the efficiency and effectiveness of teaching and learning management systems but also rich, contextual insights into the lived experiences, challenges, and perceptions of stakeholders.

#### **3.1 Research Philosophy**

The study was guided by a pragmatist research philosophy, which was employed to integrate both quantitative and qualitative dimensions (Creswell & Creswell, 2018), enabling a comprehensive understanding of ICT-driven teaching and learning management in Kampala's secondary schools. This philosophical stance was chosen to bridge the gap between theoretical constructs and real-world educational challenges, allowing the researcher to flexibly apply both objective measurements and subjective insights throughout the inquiry (Saunders et al., 2019). By prioritizing practicality and relevance, the pragmatic approach facilitated the use of multiple data sources—such as stakeholder feedback, system evaluations, and contextual analysis—to co-create a solution-oriented teaching and learning management framework grounded in both empirical evidence and stakeholder realities.

#### **3.2 Research Approach**

The study employed an abductive approach, which incorporated both deductive and inductive reasoning. The deductive approach was used to test the hypothesis that the TLM framework components enhance teaching and learning management by analysing existing theoretical models and empirical data (Bryman, 2021). Meanwhile, the inductive approach allowed the researcher to explore emerging trends, stakeholder perspectives, and institutional barriers to its usage within secondary schools (Saunders et al., 2019). By combining these approaches, the study ensured both generalizability and contextual depth (Creswell & Creswell, 2018).

### 3.3 Research Strategy

A case study strategy was employed, focusing on four selected secondary schools in Kampala district as the primary unit of analysis. These are; Bishop Cipriano Kihangire Secondary School, St. Joseph's Girls Secondary School, Nsambya, Kampala Secondary School, and Kawempe Muslim Secondary School. Case studies were ideal to enable the researcher examine complex technological transitions in real-world settings, providing in-depth insights into teaching and learning management dynamics (Yin, 2018). This approach allowed for a detailed investigation into the specific challenges and opportunities of teaching and learning management usage (Saunders et al., 2019). To enhance external validity, the study incorporates comparative insights from teaching and learning management system experiences in Kenya and Rwanda, which have successfully implemented digital transformation.

### 3.4 Methodological Choice

This study employed a mixed-methods approach, integrating both quantitative and qualitative methodologies to ensure a comprehensive evaluation of teaching and learning management system usage. The quantitative aspect involved structured questionnaires to collect measurable data on implementation, efficiency, and user satisfaction (Creswell & Creswell, 2018). The qualitative component utilized semi-structured interviews to gain in-depth insights into the challenges, implementation barriers, and strategic priorities (Bryman, 2021).

**Table 3. 1: Qualitative Strategies vs Quantitative Strategies**

Qualitative Strategies	Quantitative Strategies
In-depth Interviews	Surveys
Focus Groups	Statistical Analysis
Case Studies	Data Mining
Document Analysis	Descriptive Statistics

Table 3.1 was intended to aid in highlighting strategies that were selected to capture both the depth and breadth of the research problem. Qualitative methods offered rich, contextual insights into teaching and learning management, while quantitative methods provided empirical data that was generalized across the study population (Bryman, 2021).

### Research Questions and Strategies to Achieve Them

To achieve the objectives of this study, as highlighted in chapter one, a structured research strategy was employed, incorporating framework reviews, requirement identification, and effectiveness evaluation through a combination of quantitative and qualitative methodologies.

### **3.5 Identification of Requirements for the TLM Frameworks**

#### **3.5.1 Teaching and Learning Management ICT Environment**

The ICT environment for teaching and learning management within Kampala's secondary schools was characterized by hybrid systems combining digital tools and manual processes, often constrained by limited infrastructure, unstable internet connectivity (Mukhula et al., 2021), and inadequate technical expertise (UCC, 2023). While some schools had adopted basic management software for tasks like student records and performance tracking, many remained dependent on paper-based systems, resulting in inefficiencies and data inconsistencies (Businge et al., 2022). The environment also revealed significant disparities in access to modern ICT tools across public and private institutions, emphasizing the urgent need for a scalable, secure, and context-aware digital framework (Castañeda & Selwyn, 2018).

#### **3.5.2 Study Population**

The total study population comprised of essential individuals involved in teaching and learning management systems usage. These included; IT Coordinators/Technicians, Administrative Staff, Teachers, Students, Parents (PTA Members), Cybersecurity Experts, and Policymakers. These stakeholders influence various aspects; digital transformation, policy implementation, and system usage and are therefore essential. The selection of this broad population ensured that insights were gathered from technical experts, end-users, and decision-makers to evaluate existing frameworks effectively (Yin, 2018).

#### **3.5.3 Time Horizon**

A longitudinal time horizon was adopted to track teaching and learning management enhancement in Uganda from 2017 to 2025. This ensured a holistic understanding of teaching and learning management system's impact over time. Longitudinal studies allowed for trends analysis, identifying patterns, and evaluating the effectiveness of policy interventions.

#### **3.5.4 Sample Size**

Using (Krejcie & Morgan, 1970) sampling formula, a sample size was obtained from a total population of 80 respondents to ensure statistical validity and representation across stakeholder groups. A stratified random sampling approach was employed to ensure diverse perspectives from different stakeholders.

The formula used is:

$$n = \frac{(X)^2NP(1 - P)}{(d)^2(N - 1) + (X)^2P(1 - P)}$$

Where: n is the required sample size,  $X^2$  is the chi-square value for the desired confidence level (95%) at 1 degree of freedom ( $X^2 = 3.8416$ ), N is the total population size ( $N = 60$ ), P is the population proportion (assumed at  $P = 0.5$  for maximum variability), and d is the margin of error ( $d = 0.05$ )

$$n = \frac{(3.8416)(80)(0.5)(1 - 0.5)}{(0.05)^2(80 - 1) + (3.8416)(0.5)(1 - 0.5)}$$

$$n = \frac{76.832}{1.1579}$$

$$n = 66.3546$$

The sample size (n) is therefore approximated to be 66 respondents.

**Table 3. 2: Summary of Sample Size and Respondents**

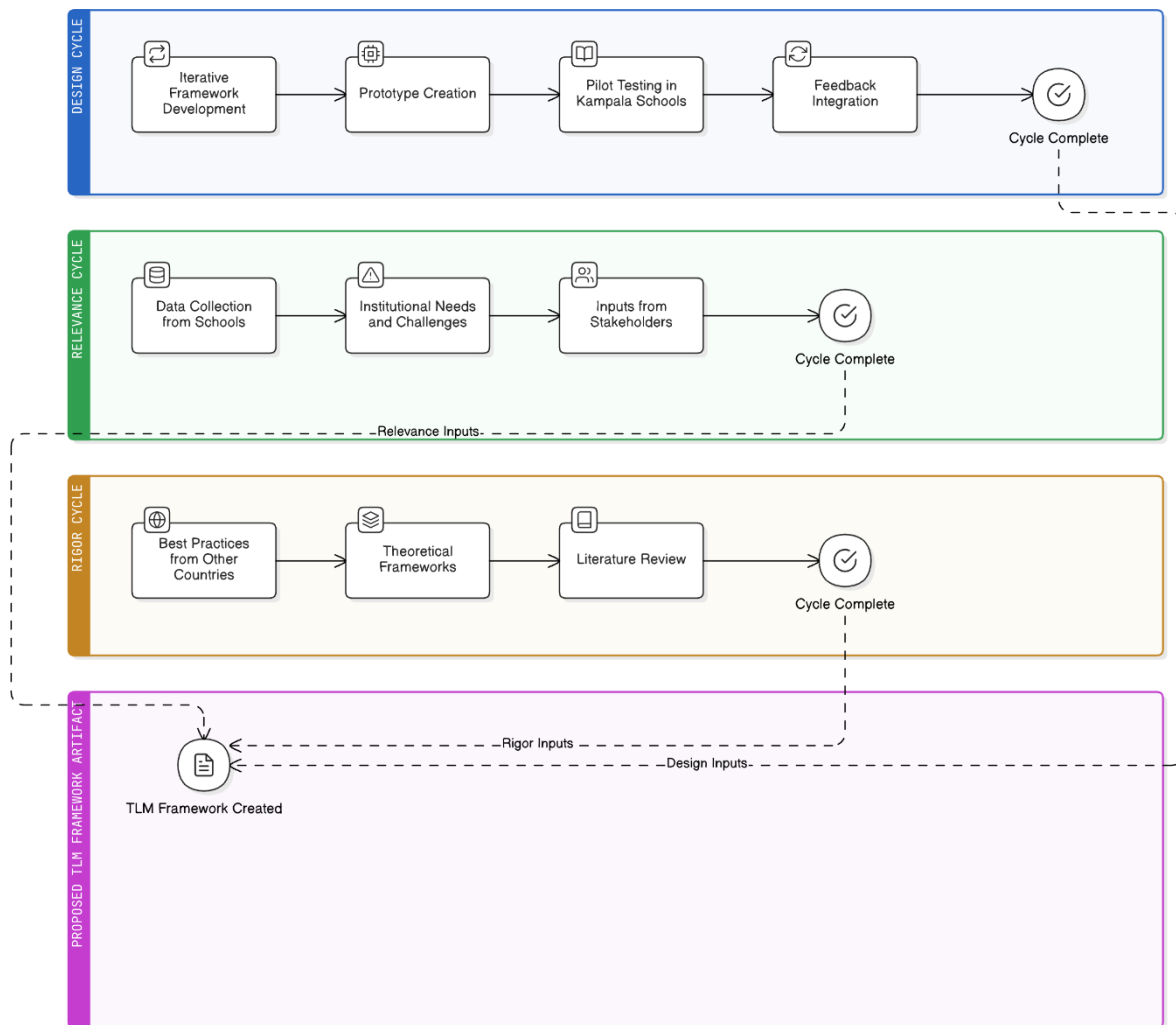
Category	Population	Sample	Sampling Technique
IT Staff	5	5	Stratified Random Sampling
School Administrators	10	10	Stratified Random Sampling
Teachers	20	18	Stratified Random Sampling
Students	30	20	Stratified Random Sampling
Parents (PTA Members)	10	10	Stratified Random Sampling
Policymakers	5	3	Stratified Random Sampling
<b>Total</b>	<b>80</b>	<b>66</b>	

**Source:** *Staff Lists (2025), Staff minutes (2018-2025), Staff Attendance Lists (2018-2025), List of cyber security experts (2018-2025), Audit trail lists (2018-2025), Risk incidence reports (2018-2025), cyber security reports (2018-2025), list of students' ICTs (2018-2025).*

### 3.6 Designing the Teaching and Learning Management Framework

#### 3.6.1 Design Methodology: Design Science Research (DSR)

Design science is the philosophical foundation of this study, emphasizing the creation and validation of practical artifacts to solve complex, real-world challenges. In the context of this research, the TLM framework serves as the artifact aimed at addressing challenges in teaching and learning management system utilization within secondary schools (Hevner et al., 2018). This approach is iterative, focusing on problem identification, artifact design, and rigorous evaluation to ensure relevance and effectiveness.



**Figure 3. 1: Design Science Model of TLM Framework**

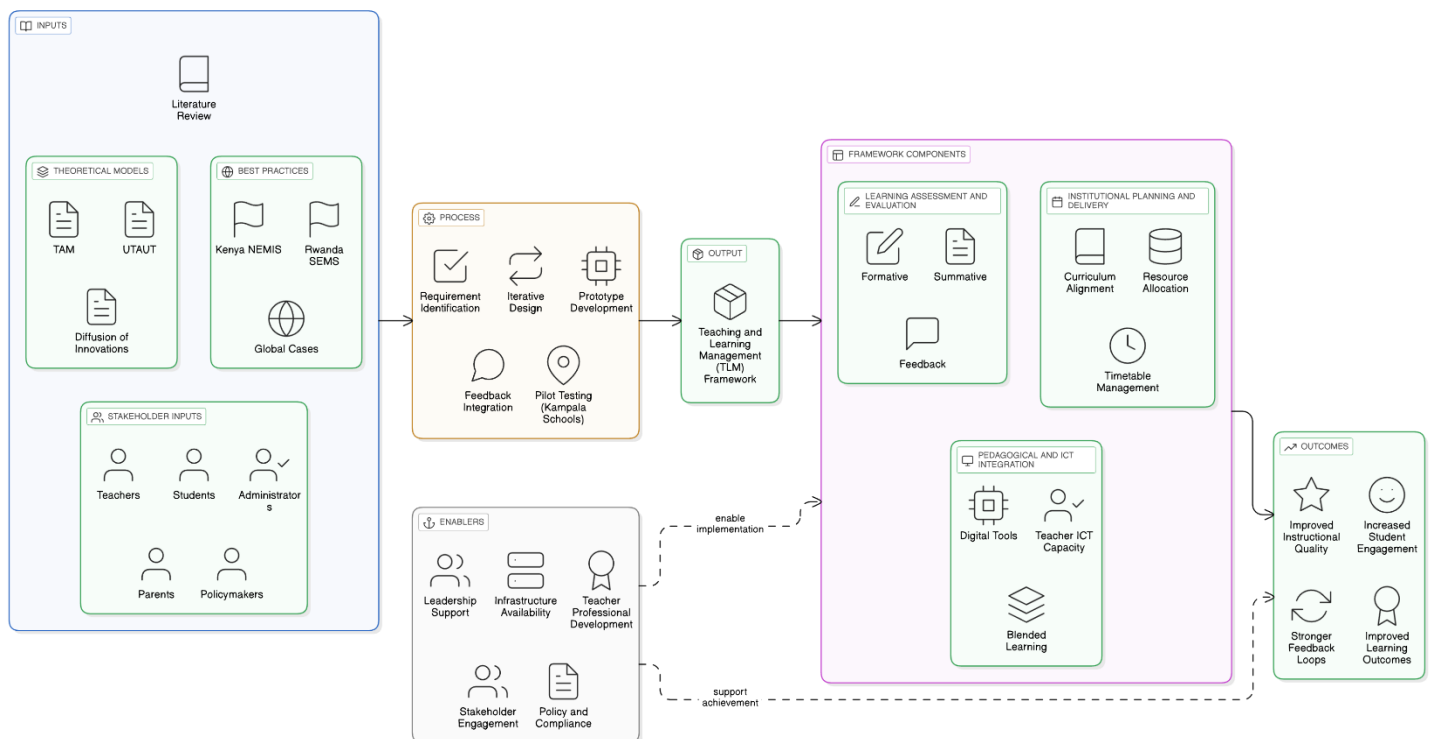
Figure 3.1 illustrates the methodological foundation upon which the framework was developed. The figure adopts the Design Science Research approach, which emphasizes the creation of practical solutions (artifacts) to address real-world challenges in teaching and learning management. At the centre of this process lies the Design Cycle, where iterative framework development, prototype creation, pilot testing in Kampala schools, and feedback integration ensure that the framework is not only theoretically sound but also practically relevant and adaptable to contextual needs.

The Relevance Cycle anchors the framework in the real-world environment by capturing insights directly from schools. It draws on data collection, institutional needs and challenges, and inputs from stakeholders such as teachers, administrators, students, and policymakers. These insights provide a contextual foundation, ensuring that the proposed TLM framework addresses actual gaps in instructional planning, assessment practices, and ICT integration rather than remaining a purely theoretical exercise.

Complementing this, the Rigor Cycle ensures that the framework is grounded in academic and empirical credibility. It integrates best practices from other countries, theoretical models, and extensive literature reviews, thereby aligning the framework with global standards while tailoring it to Uganda’s urban school realities. Collectively, the three cycles converge into the final artifact—the TLM Framework—a robust, contextually sensitive, and evidence-informed model designed to enhance instructional quality, student engagement, and learning outcomes.

### 3.6.2 Framework Design Architecture

The architecture serves as a blueprint for designing, and validating the TLM Framework. It was used in this study because a structured architecture provides a logical pathway that connects inputs, processes, and outputs while embedding enablers that sustain the system over time. Much like a construction plan, it ensures that the framework is not a random combination of ideas but a carefully designed, step-by-step model that aligns theory, practice, and contextual realities to produce a practical and sustainable solution for secondary schools.



**Figure 3. 2: The Framework Design Architecture**

The first part of the architecture illustrates the inputs that informed the development of the TLM framework. These inputs included theoretical foundations such as TAM, UTAUT, and the Diffusion of Innovations theory, global and regional best practices like Kenya’s NEMIS and Rwanda’s SEMS, and contextual insights drawn from stakeholders including teachers, administrators, policymakers, and students. The inclusion of these diverse inputs ensured that

the design process was both evidence-based and contextually grounded, balancing international lessons with the realities of Uganda’s urban secondary schools.

At the heart of the architecture lies the process stage, which captures the systematic steps taken to translate inputs into a functional framework. This included identifying requirements, iterative design, prototype development, pilot testing in Kampala schools, and integrating feedback. By following this process, the study ensured continuous refinement, allowing the framework to evolve into a robust system that responds to real-world challenges such as limited infrastructure, teacher ICT capacity, and need for data-driven instructional decision-making.

Finally, the architecture emphasizes the outputs, enablers, and outcomes of the TLM framework. The outputs represent the final artifact—the TLM framework itself—comprising the three main components: Institutional Planning and Delivery, Learning Assessment and Evaluation, and Pedagogical and ICT Integration. Enablers such as leadership support, teacher professional development, infrastructure, stakeholder engagement, and policy compliance guarantee sustainability and scalability. These collectively lead to the intended outcomes: improved instructional quality, increased student engagement, stronger feedback loops, and enhanced learning outcomes. In this way, the architecture demonstrates a clear pathway from conceptualization to tangible educational transformation.

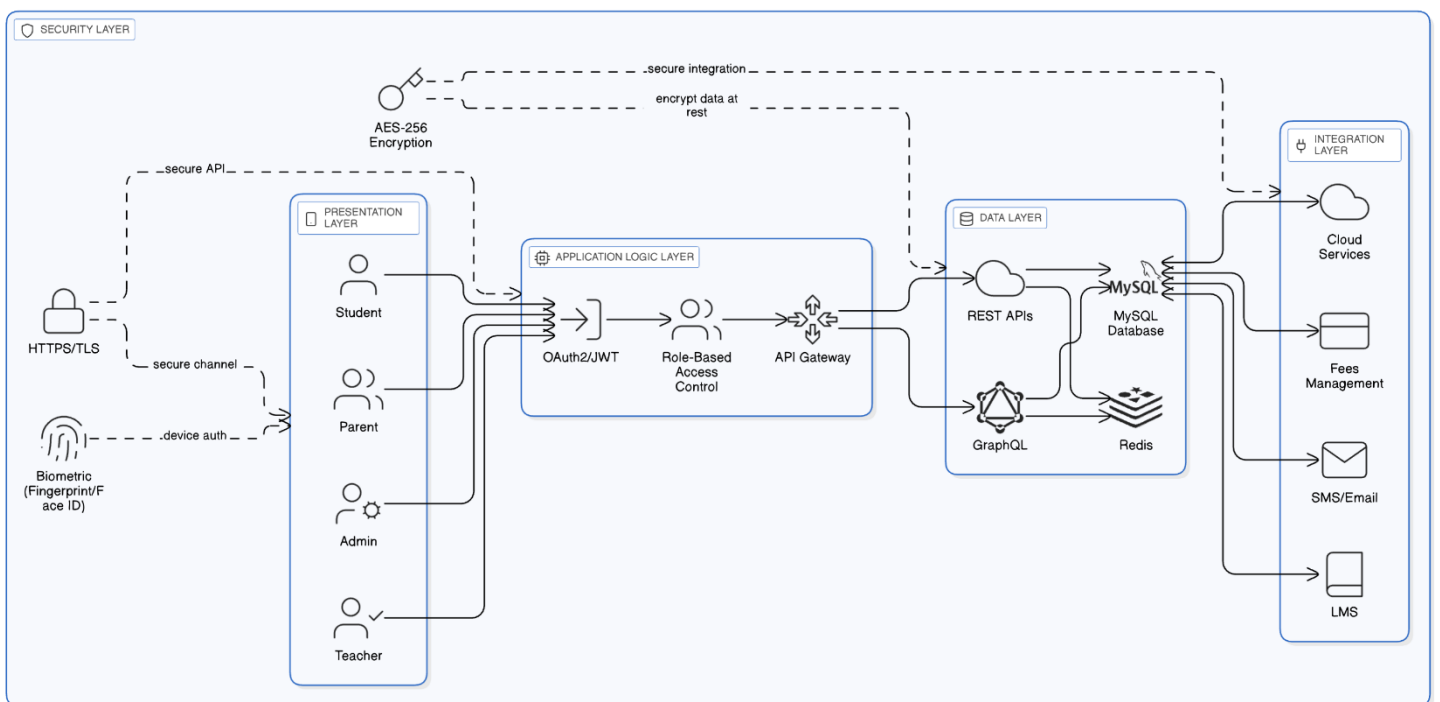
### **3.6.3 Data Persistence and MySQL Schema**

To ensure the TLM Framework operates effectively in practice, a robust data persistence layer was established using a MySQL database schema. Data persistence is critical because it guarantees that instructional plans, assessment records, ICT usage logs, and stakeholder inputs are securely stored, consistently managed, and easily retrievable over time. By adopting MySQL, the framework benefits from a reliable, scalable, and open-source relational database system that supports structured queries, transactional integrity, and role-based access, thereby ensuring accuracy, security, and accountability in managing school data. The schema was designed to capture the core components of the TLM Framework by organizing data into interrelated tables—such as Institutional Planning (curriculum alignment, resource allocation, timetabling), Assessment Records (formative, summative, and feedback data), ICT Integration (teacher ICT capacity, digital tools usage, blended learning practices), and Enablers (leadership, professional development, infrastructure, and compliance). This structured approach supports real-time monitoring, facilitates analytics, and enables data-driven decision-making within schools. Ultimately, the MySQL schema provides the technical foundation that

sustains the framework’s functionality, making it both practical and adaptable for long-term educational transformation.

### 3.6.4 Mobile Application Design Architecture

To enhance accessibility and usability of the TLM Framework, a mobile application design architecture was developed as an interface for real-time interaction with the system. The architecture is built on a three-tier structure comprising the presentation layer (user interface for teachers, students, and administrators), the application layer (business logic handling lesson planning, assessments, feedback, and ICT integration), and the data layer (MySQL persistence for secure storage and retrieval). This layered approach ensures that users can seamlessly perform tasks such as lesson scheduling, assessment tracking, and feedback sharing while maintaining data consistency and security. The design also incorporates responsive layouts and user-friendly navigation to accommodate diverse technical abilities among stakeholders.



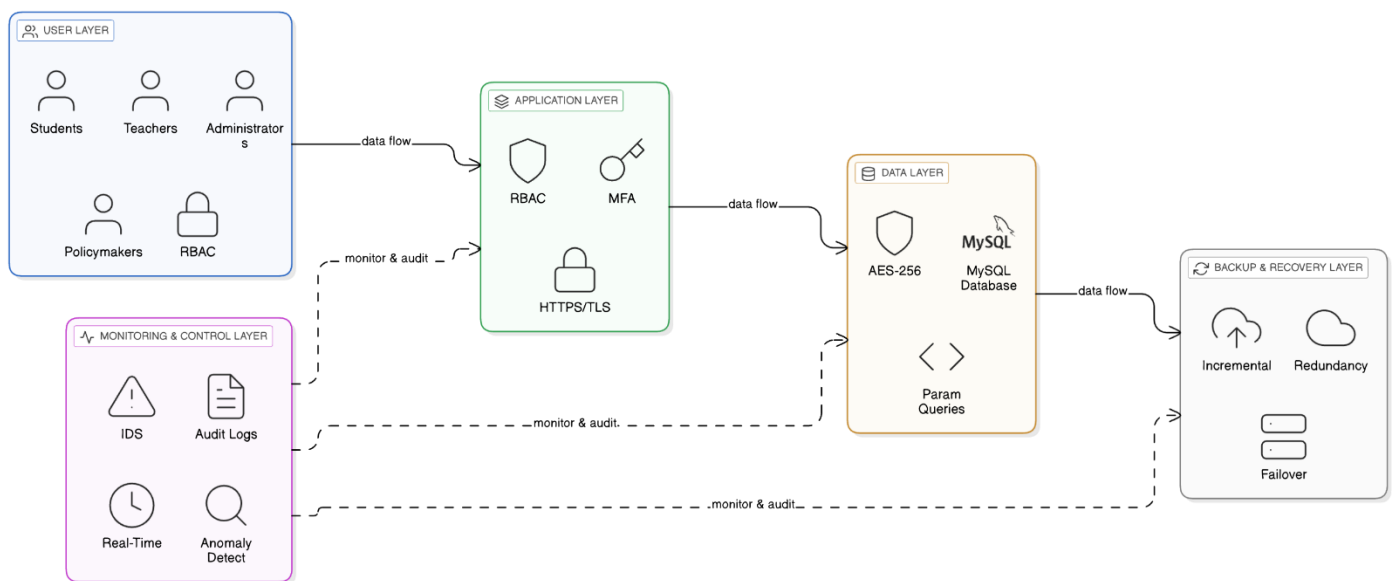
**Figure 3. 3: Mobile Application Design Architecture**

The mobile architecture further integrates role-based access to ensure that each stakeholder interacts only with features relevant to their responsibilities—for example, teachers manage lesson plans and assessments, students access feedback and learning resources, and administrators oversee resource allocation and compliance. Offline-first functionality was embedded to address the connectivity challenges common in Kampala’s secondary schools, enabling the app to operate without constant internet access and sync data once connectivity is

restored. By prioritizing accessibility, inclusivity, and scalability, the mobile application architecture ensures that the TLM framework can be effectively operationalized across diverse school contexts, bridging the gap between ICT design and practical classroom implementation.

### 3.6.5 Framework Security Design

The security design of the TLM Framework leverages modern ICT protocols and practices to guarantee confidentiality, integrity, and availability of data. Secure communication is enforced using HTTPS/TLS encryption, ensuring that all data transmitted between clients (mobile or web applications) and servers remains protected against eavesdropping or tampering. At the access level, the framework employs Role-Based Access Control (RBAC) to manage user privileges, where teachers, students, administrators, and policymakers are restricted to functions relevant to their roles. Passwords are hashed using industry-standard algorithms (e.g., bcrypt) and stored securely, while database-level protections utilize SQL injection prevention mechanisms and parameterized queries to safeguard against malicious attacks.



**Figure 3. 4: Diagrammatic Representation of the Framework Security Design**

Beyond authentication and access control, the framework integrates Intrusion Detection Systems (IDS), audit logs, and real-time monitoring to track user activity and flag suspicious behaviour. Data at rest within the MySQL schema is secured through AES-256 encryption, while regular incremental backups and redundancy via cloud-based storage ensure resilience against data loss. To mitigate downtime and maintain availability, the system is deployed on a redundant server architecture with failover support. Additionally, cybersecurity policies are embedded through stakeholder training, enforcing strong password policies, multi-factor

authentication (MFA), and adherence to Uganda’s national ICT security standards. This layered security architecture ensures that the TLM Framework is robust, resilient, and trusted for sensitive educational data management.

### **3.7 Evaluation of the Teaching and Learning Management Framework**

#### **3.7.1 Prototype Development and Implementation**

The prototype implementation phase focused on translating the proposed academic management framework into a functional system deployed across four selected secondary schools in Kampala. The prototype included a web-based admin portal, an Android mobile application, and an offline-capable USSD/SMS interface to accommodate varying levels of digital infrastructure. Core modules such as student records management, timetable scheduling, grade tracking, and communication tools were developed using lightweight, open-source technologies to ensure compatibility with local hardware like Raspberry Pi servers. The system was tested in real-world school environments to validate its usability, performance, and resilience under low-connectivity conditions. Feedback from users during this phase informed iterative refinements, ensuring the solution aligned with operational realities and user expectations.

#### **3.7.2 Unit Testing and Structural Equation Model**

Unit and integration testing were conducted to ensure the reliability, functionality, and cohesiveness of the framework’s components. Unit testing focused on validating individual modules—such as student data entry, timetable generation, and grade calculations—to confirm that each function operated correctly in isolation. Automated test scripts were used to assess data validation, error handling, and response times across key features. Integration testing followed, evaluating the interaction between interconnected modules, including data flow from the mobile app to the central database and synchronization between offline and online environments. Special attention was given to security workflows, authentication processes, and notification services to ensure seamless end-to-end performance. Identified bugs and inconsistencies were logged, addressed, and retested to maintain system integrity and user confidence.

#### **3.7.3 Security Testing and Theoretical Insights**

Security testing was performed to evaluate the framework’s ability to protect sensitive academic and user data from unauthorized access, breaches, and other vulnerabilities. Tests

included authentication validation to ensure only authorized users could access specific modules, role-based access control enforcement, and session management checks to prevent hijacking or unauthorized reuse. Penetration testing techniques were applied to identify common vulnerabilities such as SQL injection, cross-site scripting (XSS), and insecure API endpoints. Encryption mechanisms were also tested by simulating data interception scenarios to verify the effectiveness of AES-256 encryption and HTTPS protocols. The system's audit logs and activity tracking features were assessed for accuracy and tamper-resistance, ensuring reliable traceability of user actions. Overall, the framework demonstrated a strong security posture suitable for deployment in educational environments.

### **3.7.4 Usability and Acceptance Testing**

Usability and acceptance testing were conducted to assess the system's ease of use, user satisfaction, and alignment with real-world academic workflows. Selected end-users—including teachers, administrators, and IT staff—were invited to interact with the prototype in a controlled environment, performing tasks such as entering grades, generating reports, and accessing student records. Feedback was gathered through structured questionnaires and observation, focusing on interface clarity, navigation flow, and overall user experience. Minor adjustments were made to improve intuitiveness, reduce cognitive load, and accommodate varying levels of digital literacy. Acceptance testing followed, evaluating whether the system met predefined functional requirements and stakeholder expectations. Positive feedback from pilot schools confirmed that the framework was both usable and practical, paving the way for broader institutional adoption.

## **3.8 Data Collection Techniques**

### **3.8.1 Quantitative Method: Structured Questionnaire**

The questionnaire was designed to align with the study's objectives by focusing on gathering data related to key performance indicators such as system usability, security robustness, user satisfaction, and administrative efficiency. These indicators were crucial for evaluating the effectiveness of the framework in enhancing teaching and learning management systems within secondary schools (Creswell & Creswell, 2018). The questionnaire included Likert scale questions to assess user satisfaction and perceived improvements in administrative processes, ensuring that the data collected is both quantitative and directly relevant to the study's goals.

To maximize the response rate and ensure inclusivity, the questionnaire was distributed both online and in-person. Online surveys were sent via email and through online platforms, while in-person surveys were conducted during school visits. This dual approach accommodated the preferences and accessibility of respondents, thereby increasing the likelihood of gathering diverse and representative data (Bryman, 2021). The collected data was analysed using statistical techniques to identify trends, patterns, and correlations. Descriptive statistics such as frequencies, percentages, means, and standard deviations summarized the data, while inferential statistics, including t-tests, ANOVA, and regression analysis, explored relationships between variables and test hypotheses.

### **3.8.2 Qualitative Method: Interview Guide**

The interview guide was meticulously designed to gather in-depth insights into the challenges, implementation barriers, and strategic priorities related to usage of teaching and learning management systems. This qualitative approach aligned with the study's objective of identifying requirements for framework design and evaluating its effectiveness (Flick, 2018). The interview guide featured open-ended questions that encouraged detailed responses from key stakeholders, including policymakers, IT staff, teachers, and administrators. These questions focused on regulatory frameworks, technological adoption, user training, and security measures, ensuring that the qualitative data complements the quantitative findings and provides a holistic understanding of the study's objectives (Bryman, 2021).

Interviews were conducted in a structured yet flexible manner, allowing for follow-up questions and deeper exploration of emerging themes. This approach ensured that valuable insights are captured while keeping the interviews focused on the study's objectives. With the consent of the participants, interviews were recorded and later transcribed for analysis, ensuring accuracy and allowing for a thorough examination of the qualitative data (Creswell & Creswell, 2018). Thematic analysis was used to identify, analyse, and report patterns (themes) within the qualitative data. NVivo software assisted in the coding process, ensuring systematic and thorough analysis (Braun & Clarke, 2019).

## **3.9 Pretesting Validation and Reliability**

### **3.9.1 Validity**

To ensure the validity of the research instruments, a Content Validity Index (CVI) was calculated. Content validity refers to the degree to which the items in the questionnaire are

representative of the constructs they aim to measure. This was established through expert judgment, where a panel of domain experts (educators, ICT specialists, and academic administrators) were asked to rate each item in the questionnaire for relevance on a 4-point Likert scale. Only items rated 3 or 4 by at least three-quarters of the experts were considered content-valid. The CVI was computed using the following formula:

$$CVI = \frac{\text{Number of experts rating item as 3 or 4}}{\text{Total number of experts}}$$

A CVI of 0.78 or higher for each item was considered acceptable, based on recommendations from (Polit & Beck, 2006). Below is the CVI calculation and summary of results:

**Table 3. 3: Content Validity Index (CVI) Results for Questionnaire Items**

Item Description	Experts Rating 3 or 4	Total Experts	CVI	Interpretation
Usability of academic system	5	5	1.00	Valid
User satisfaction with mobile app	5	5	1.00	Valid
Impact on administrative efficiency	4	5	0.80	Valid
Data security and privacy controls	5	5	1.00	Valid
Effectiveness of training and support	4	5	0.80	Valid
Integration with existing systems	5	5	1.00	Valid
Usefulness of offline capabilities	5	5	1.00	Valid
Alignment with curriculum objectives	4	5	0.80	Valid

### 3.9.2 Reliability

Reliability refers to the consistency of a measurement instrument and its ability to yield the same results under consistent conditions. In this study, internal consistency reliability of the questionnaire was measured using Cronbach’s Alpha ( $\alpha$ ). This coefficient estimates the extent to which items in a scale are correlated, indicating how well they measure the same construct.

The mathematical formula used for Cronbach’s Alpha is:

$$\alpha = \frac{k}{k-1} \left( 1 - \frac{\sum(\sigma_i)^2}{(\sigma_t)^2} \right)$$

where k is the number of items,  $\sigma_i^2$  is the variance of each item, and  $\sigma_t^2$  is the total variance, yields an alpha value. An alpha value above 0.70 is considered acceptable, values above 0.80 are good, and values above 0.90 indicate excellent reliability (Creswell & Creswell, 2018).

**Table 3. 4: Reliability Test Using Cronbach’s Alpha**

<b>Construct Measured</b>	<b>No. of Items (k)</b>	<b>Cronbach's Alpha (α)</b>	<b>Interpretation</b>
Usability and Interface Design	4	0.93	Excellent
Academic Data Accuracy and Efficiency	3	0.86	Good
System Security and Privacy	3	0.90	Excellent
Training, Support & Ease of Adoption	4	0.91	Excellent
Offline Capability and Flexibility	2	0.82	Good

### 3.10 Data Analysis Techniques

#### 3.10.1 Qualitative Approach

Qualitative data collected from interviews was analysed using thematic analysis, a rigorous method involving the identification, examination, and reporting of recurring patterns or themes within the data (Braun & Clarke, 2019). NVivo software was employed to facilitate the coding process, ensuring a structured and systematic approach to data handling and categorization (Bryman, 2021). After transcription, the responses were thoroughly reviewed and coded into preliminary themes, which were then refined through iterative analysis to ensure accuracy and relevance to the research objectives. The resulting themes were interpreted in direct alignment with the research questions, providing rich insights into stakeholder experiences and contextual factors affecting teaching and learning management. To strengthen validity and ensure triangulation, the qualitative findings were cross-referenced with the quantitative results, enabling a comprehensive and coherent interpretation of the study outcomes (Flick, 2018).

#### 3.10.2 Quantitative Approach

Quantitative data collected through structured questionnaires was analysed using both descriptive and inferential statistical techniques to assess the effectiveness of the TLM framework. Descriptive statistics—including frequencies, percentages, means, and standard deviations—were computed to summarize and describe the basic features of the dataset (Bryman, 2021).

$$\text{Mean } (\bar{x}) = \frac{\sum xi}{n} \dots\dots\dots (i)$$

$$\text{Standard Deviation } (s) = \frac{\sum(xi - \bar{x})^2}{n-1} \dots\dots\dots (ii)$$

Inferential analysis was then conducted to test the study's hypotheses and identify statistically significant relationships between key variables. Techniques such as t-tests, Analysis of

Variance (ANOVA), and Multiple Linear Regression were employed to assess differences and predictive power among framework components (Creswell & Creswell, 2018).

$$r = \frac{\sum(xi - \bar{x})(yi - \bar{y})}{\sqrt{\sum(xi - \bar{x})^2 \sum(yi - \bar{y})^2}} \dots\dots\dots (iii)$$

For regression analysis, the following formula was used:

$$Y = \beta_0 + \beta_1x_1 + \beta_2x_2 + \dots\dots\dots + \beta_nx_n + \epsilon \dots\dots\dots (iv)$$

where Y is the dependent variable (teaching and learning management effectiveness),  $X_1, \dots, X_n$  represents the independent variables (e.g., instructional planning, learning assessment and evaluation, and pedagogical and ICT integration), and  $\beta_1, \dots, \beta_n$  regression coefficients for predictor variables,  $\beta_0$  is the intercept, and  $\epsilon$  is the error term.

Additionally, Exploratory Factor Analysis (EFA) was conducted to identify latent constructs and reduce data dimensionality. The Kaiser-Meyer-Olkin (KMO) measure and Bartlett's Test of Sphericity were used to assess sampling adequacy and factorability (Hair et al., 2019). Data analysis was performed using SPSS, selected for its capacity to manage large datasets and generate precise statistical outputs (Saunders et al., 2019). This comprehensive analysis enabled the researcher to draw meaningful conclusions and validate the framework's impact on teaching and learning management systems in secondary schools.

### 3.11 Ethical Considerations

Ethical considerations involving minors like students begun by obtaining approval from the university's ethics board, where a detailed proposal outlining the study's objectives, methods, and ethical safeguards was submitted for review. Following approval, consent was sought from the participating schools, where formal letters detailing the study's purpose and data collection methods were sent to school administrators for their approval. Once school consent was obtained, informed consent forms were distributed to parents or guardians of the student participants, clearly explaining the study's objectives, the voluntary nature of participation, and the measures in place to ensure confidentiality and anonymity (Bryman, 2021). Simultaneously, assent forms, written in age-appropriate language, were provided to the students, explaining the study and their right to withdraw at any time without penalty. Both parental consent forms and student assent forms were collected and securely stored, ensuring that only those with proper authorization participated in the study. Throughout the process,

confidentiality was maintained by anonymizing participant data and storing it in password-protected systems, adhering to ethical guidelines and ensuring the integrity of the research.

### **3.12 Research Constraints**

The research encountered several constraints that influenced its scope and execution. Limited access to certain secondary schools and stakeholders posed challenges in data collection, potentially affecting the comprehensiveness of the findings. Additionally, resource constraints, including time and funding, impacted the depth of the pilot testing and the extent of the framework's implementation. Technological limitations, such as unstable internet connectivity and varying levels of ICT infrastructure across schools, also presented obstacles in the consistent application of the TLM Framework. These constraints necessitated adaptive strategies to ensure the research's objectives were met within the feasible boundaries.

**CHAPTER FOUR**  
**PRESENTATION AND ANALYSIS OF RESEARCH FINDINGS**

This chapter was guided by the study objectives and structured into key thematic areas including demographic characteristics, knowledge on teaching and learning management, benefits and barriers to academic management usage, evaluation of current frameworks, and system requirements. To ensure robust statistical interpretation, Exploratory Factor Analysis (EFA) was conducted to identify underlying dimensions within the dataset, Pearson Correlation Analysis, and Linear Regression Analysis were also used.

**4.1 Demographic Information**

The analysis of demographic characteristics was essential for contextualizing the responses, and ensuring that perspectives are drawn from a representative cross-section of stakeholders involved in the usage of teaching and learning management systems.

**Table 4. 1: Demographic Information of Respondents**

Question	Response Options	Frequency (n=66)	Percentage (%)
dir1. Responsibility	IT Coordinators	5	7.58%
	School Administrators	10	15.15%
	Teachers	18	27.27%
	Students	20	30.30%
	Parents	10	15.15%
	Policymakers	3	4.55%
dir2. Gender	Male	34	51.52%
	Female	32	48.48%
dir3. Age Group	Below 25 years	22	33.33%
	25 – 34 years	19	28.79%
	35 – 44 years	13	19.70%
	45 – 54 years	9	13.64%
	55 years and above	3	4.55%

The distribution of respondent roles reveals that the largest proportion were students (30.30%), followed by teachers (27.27%), parents (15.15%), and school administrators (15.15%), with IT coordinators and policymakers making up 7.58% and 4.55%, respectively. This diverse mix ensures inclusive insights across system users. This finding aligns with (Komba & Nkumbi, 2008) and (Antoninis et al., 2023), who stress involving all educational stakeholders in system design and evaluation. The gender distribution was nearly equal, with males at 51.52% and females at 48.48%. Such balance enhances representativeness and supports usability analysis across gender lines.

This agrees with (Schleicher, 2020) and (Ertmer & Ottenbreit-Leftwich, 2010), who highlight the value of gender-balanced input in educational technology research. Most respondents were below 25 years (33.33%), followed by ages 25–34 (28.79%), 35–44 (19.70%), 45–54 (13.64%), and 55+ (4.55%). This reflects Uganda’s youthful population structure, relevant to digital tool adoption. It supports (UBOS, 2024), and (Venkatesh et al., 2003), who note age influences ICT uptake in education.

#### 4.2 Knowledge about Teaching and Learning Management System Usage

Assessing the knowledge of the study respondents regarding the usage of teaching and learning management system was critical for determining the level of readiness and identifying areas requiring capacity building for implementation of the TLM framework

**Table 4. 2: Knowledge about Teaching and Learning Management System Usage**

Question	Response Options	Frequency (n=66)	Percentage (100%)	Mean ( $\mu$ )	SD ( $\sigma$ )
b1. Familiarity with the concept of Academic Management.	Not familiar at all	5	7.58%	<b>13.2</b>	<b>7.39</b>
	Slightly familiar	10	15.15%		
	Moderately familiar	20	30.30%		
	Very familiar	22	33.33%		
	Extremely familiar	9	13.64%		
b2. Component of academic management most familiar with.	Course and Curriculum	15	22.73%	<b>16.5</b>	<b>3.11</b>
	Scheduling and Timetabling	18	27.27%		
	Gradebook and Assessment	20	30.30%		
	Homework and Tracking	13	19.70%		
b3. Frequency of use of academic management systems in daily activities.	Never	5	7.58%	<b>13.2</b>	<b>7.01</b>
	Rarely	12	18.18%		
	Sometimes	23	34.85%		
	Often	17	25.76%		
	Always	9	13.64%		
b4. Primary purpose of using academic management system in schools.	Student records management	16	24.24%	<b>16.5</b>	<b>4.20</b>
	Report card generation	11	16.67%		
	Timetable generation	18	27.27%		
	Performance tracking	21	31.82%		
b5. Effectiveness of academic management system in improving administrative processes.	Very ineffective	4	6.06%	<b>13.2</b>	<b>7.98</b>
	Ineffective	8	12.12%		
	Neutral	15	22.73%		
	Effective	25	37.88%		
	Very effective	14	21.21%		

The analysis on familiarity with the concept of academic management indicates that 33.33% of respondents were very familiar, 30.30% moderately familiar, and 13.64% extremely familiar, with a mean of 13.2 and SD of 7.39, showing a strong baseline understanding. This agrees with (Tondeur et al., 2017) and (Antoninis et al., 2023), who emphasized growing

exposure to education management tools among school communities. The analysis on system components shows that 30.30% were most familiar with Gradebook and Assessment, followed by Scheduling and Timetabling (27.27%), with a mean of 16.5 and SD of 3.11, indicating concentration in core academic functions. This supports (Odunga, 2024) and (Elneel et al., 2023), who found these areas to be the most adopted in school MIS usage.

The analysis on frequency of use reveals that 34.85% used the systems sometimes, 25.76% often, and 13.64% always, with a mean of 13.2 and SD of 7.01, indicating moderate but consistent engagement. These findings align with (Kafyulilo et al., 2015) and (Venkatesh et al., 2003), who observed that frequency is influenced by ease of use and relevance to daily tasks. The analysis on usage purpose shows that 31.82% used the systems for academic performance tracking and 27.27% for timetable generation, with a mean of 16.5 and SD of 4.20, reflecting a strong alignment with core planning and monitoring functions. This supports (Albugami & Ahmed, 2015) and (Creswell & Creswell, 2018), who highlighted academic monitoring as a key driver for school information systems.

The analysis on system effectiveness shows that 37.88% found them effective and 21.21% very effective, with a mean of 13.2 and SD of 7.98, suggesting generally positive impact on administration. This confirms findings by (Wangpipatwong, 2009) and (Hair et al., 2019), who emphasized the role of digital systems in streamlining school operations.

### 4.3 Awareness of Existing Frameworks for Teaching and Learning Management

Assessing the level of awareness of existing frameworks for teaching and learning management from the perspective of school administrators, IT coordinators, and policymakers was crucial. Knowledge was assessed on the National Education Management Information System (NEMIS), Smart Education Management System (SEMS), Unified Theory of Acceptance and Use of Technology (UTAUT), and the Technology Acceptance Model (TAM).

**Table 4. 3: Awareness of Existing Frameworks for Teaching & Learning Management**

Question	Response Options	Frequency (n=18)	Percentage (%)	Mean ( $\mu$ )	SD ( $\sigma$ )
c1. Familiarity with the NEMIS framework.	Yes	7	38.89%	<b>6.0</b>	<b>2.65</b>
	No	8	44.44%		
	Not Sure	3	16.67%		
c2. Familiarity with the SEMS framework.	Not familiar at all	4	22.22%	<b>3.6</b>	<b>2.07</b>
	Slightly familiar	5	27.78%		
	Moderately familiar	6	33.33%		
	Very familiar	2	11.11%		

	Extremely familiar	1	5.56%		
c3. Familiarity with the UTAUT framework.	Yes	5	27.78%	<b>6.0</b>	<b>2.65</b>
	No	9	50.00%		
	Not Sure	4	22.22%		
c4. Familiarity with the TAM model.	Yes	6	33.33%	<b>6.0</b>	<b>2.00</b>
	No	8	44.44%		
	Not Sure	4	22.23%		
c5. Framework used or interacted with before.	NEMIS	5	27.78%	<b>3.6</b>	<b>1.14</b>
	SEMS	3	16.67%		
	UTAUT	4	22.22%		
	TAM	2	11.11%		
	None	4	22.22%		
c6. Effectiveness of NEMIS in enhancing data management in schools.	Very ineffective	1	5.56%	<b>3.6</b>	<b>3.21</b>
	Ineffective	2	11.11%		
	Neutral	4	22.22%		
	Effective	9	50.00%		
	Very effective	2	11.11%		
c7. Key strengths of SEMS.	Integration capabilities	6	33.33%	<b>6.0</b>	<b>1.00</b>
	User experience	7	38.89%		
	Scalability	5	27.78%		
c8. Ways in which UTAUT explains user behaviour towards technology adoption.	Social influence	4	22.22%	<b>4.5</b>	<b>0.58</b>
	Facilitating conditions	5	27.78%		
	Perceived usefulness	5	27.78%		
	Perceived ease of use	4	22.22%		
c9. Main constructs of TAM.	Perceived usefulness	7	38.89%	<b>6.0</b>	<b>1.00</b>
	Perceived ease of use	6	33.33%		
	Both	5	27.78%		
c10. Most suitable framework for enhancing AM in secondary schools.	NEMIS	5	27.78%	<b>4.5</b>	<b>1.29</b>
	SEMS	6	33.33%		
	UTAUT	4	22.22%		
	TAM	3	16.67%		

The analysis on NEMIS familiarity indicates that 38.89% were familiar, 44.44% unfamiliar, and 16.67% unsure, with a mean of 6.0 and SD of 2.65, showing low overall awareness. This agrees with (MoES, 2022) and (Antoninis et al., 2023), which note challenges in the widespread adoption of national education data systems. The analysis on SEMS shows 33.33% were moderately familiar, while only 5.56% were extremely familiar, with a mean of 3.6 and SD of 2.07, indicating limited user exposure. This aligns with (Komba & Nkumbi, 2008) and (Albugami & Ahmed, 2015), who observed that many school-based ICT solutions remain underutilized due to inadequate orientation.

The analysis on UTAUT indicates that 50.00% were unfamiliar, 27.78% familiar, and 22.22% unsure, with a mean of 6.0 and SD of 2.65, highlighting low conceptual understanding. This corresponds with (Venkatesh et al., 2003) and (Dwivedi et al., 2019), who emphasized the need to simplify theoretical models for practical use in schools. The analysis on TAM indicates

44.44% were unfamiliar, 33.33% familiar, and 22.23% unsure, with a mean of 6.0 and SD of 2.00, showing limited awareness of foundational models. This supports (Davis, 1989) and (Odunga, 2024), who noted a gap between theoretical frameworks and school-level understanding.

The analysis on actual usage shows that 27.78% had used NEMIS, 22.22% UTAUT, and 22.22% none, with a mean of 3.6 and SD of 1.14, indicating sporadic exposure. This confirms findings by (Tondeur et al., 2017) and (Elneel et al., 2023) that usage often depends on top-down policy enforcement. The analysis on NEMIS effectiveness indicates that 50.00% found it effective, 22.22% neutral, and 11.11% very effective, with a mean of 3.6 and SD of 3.21, reflecting mixed but generally positive views. This aligns with (UBOS, 2024) and (MoES, 2023), which highlight its role in improving school data management.

The analysis on SEMS strengths reveals that user experience (38.89%) and integration capabilities (33.33%) were top-rated, with a mean of 6.0 and SD of 1.00, showing preference for usability. This is in line with (Ertmer & Ottenbreit-Leftwich, 2010) and (Alshehri et al., 2020), who argue that interface design influence adoption. The analysis on UTAUT constructs shows equal emphasis on perceived usefulness and facilitating conditions (27.78% each), with a mean of 4.5 and SD of 0.58, confirming diverse views on what drives adoption. This supports (Venkatesh et al., 2003) and (Teo, 2011) who found that user perceptions and social influence shape technology behavior.

The analysis on TAM constructs reveals that 38.89% cited perceived usefulness, while 27.78% chose both usefulness and ease of use, with a mean of 6.0 and SD of 1.00, suggesting partial understanding. This is consistent with (Davis, 1989) and (Wangpipatwong, 2009), who stressed the dual importance of ease and utility in TAM. The analysis on suitable frameworks shows 33.33% preferred SEMS, 27.78% chose NEMIS, and 22.22% UTAUT, with a mean of 4.5 and SD of 1.29, suggesting SEMS as the leading option. This supports (Antoninis et al., 2023) and (Odunga, 2024), who argue for locally contextualized frameworks with modular scalability.

#### **4.4 Benefits and Barriers to Teaching and Learning Management Systems**

Assessing perspectives of school administrators, IT coordinators, teachers, and students on the benefits and barriers to the usage of teaching and learning management systems in secondary schools was crucial in setting the stage for implementation of the TLM framework.

#### **Table 4. 4: Benefits and Barriers to Teaching & Learning Management Systems**

Question	Response Options	Frequency (n=53)	Percentage (%)	Mean ( $\mu$ )	SD ( $\sigma$ )
d1. Primary benefit of using academic management systems.	Improved data management Enhanced decision-making Streamlined administrative processes Better academic performance tracking	14 12 15 12	26.42% 22.64% 28.30% 22.64%	<b>13.25</b>	<b>1.50</b>
d2. Academic management systems improving efficiency of administrative tasks.	Significantly improved Improved No change Decreased Significantly decreased	17 20 5 8 3	32.08% 37.74% 9.43% 15.09% 5.66%	<b>10.60</b>	<b>7.49</b>
d3. Major barrier to effective implementation of academic management systems.	Inadequate infrastructure Limited technical expertise Insufficient funding Resistance to change	15 13 14 11	28.30% 24.53% 26.42% 20.75%	<b>13.25</b>	<b>1.71</b>
d4. Lack of technical expertise affecting the utilization of academic management systems.	Significantly affects Affects No effect Minimal effect	34 18 0 1	64.15% 33.96% 0.00% 1.89%	<b>13.25</b>	<b>16.12</b>
d5. Major strategy to overcome the barriers to academic management systems adoption.	Training programs Infrastructure improvement Increased funding Stakeholder engagement	16 12 14 11	30.19% 22.64% 26.42% 20.75%	<b>13.25</b>	<b>2.22</b>
d6. Academic management systems enhancing data accuracy.	Significantly enhanced Enhanced No change Decreased Significantly decreased	23 27 3 0 0	43.40% 50.94% 5.66% 0.00% 0.00%	<b>10.60</b>	<b>13.28</b>
d7. Major role AMS play in improving communication between teachers and parents.	Significant role Moderate role Minimal role No role	48 4 1 0	90.57% 7.55% 1.89% 0.00%	<b>13.25</b>	<b>23.16</b>
d8. Cost of implementing academic management systems impacting adoption.	Significantly impacts Impacts No impact Minimal impact	34 19 0 0	64.15% 35.85% 0.00% 0.00%	<b>13.25</b>	<b>16.46</b>
d9. Major security concern associated with the usage of academic management systems.	Data breaches Unauthorized access Data integrity Confidentiality	14 15 12 12	26.42% 28.30% 22.64% 22.64%	<b>13.25</b>	<b>1.50</b>
d10. Major way of maximizing the benefits of academic management systems.	Training and support Continuous improvement Stakeholder involvement Resource allocation	16 13 14 10	30.19% 24.53% 26.42% 18.87%	<b>13.25</b>	<b>2.50</b>

The analysis on benefits indicates that 28.30% of respondents cited streamlined administrative processes as the key benefit, followed by improved data management (26.42%), with a mean of 13.25 and SD of 1.50, confirming AMS's role in enhancing operational efficiency. This

aligns with (Alshehri et al., 2020) and (Elneel et al., 2023), who identified administrative ease and data visibility as core benefits of MIS adoption. The analysis on efficiency shows that 37.74% reported improvement and 32.08% significant improvement in administrative tasks, with a mean of 10.60 and SD of 7.49, reflecting broad satisfaction. These findings are consistent with (Kafyulilo et al., 2015) and (Wangpipatwong, 2009), who note improved productivity in ICT-enabled schools.

The analysis on barriers indicates that 28.30% identified inadequate infrastructure, 26.42% insufficient funding, and 24.53% limited technical expertise, with a mean of 13.25 and SD of 1.71, highlighting systemic readiness gaps. This agrees with (Antoninis et al., 2023) and (Odunga, 2024), who emphasized infrastructural and financial constraints in sub-Saharan ICT deployment. The analysis on expertise shows that 64.15% reported it significantly affects usage, with only 1.89% saying it had minimal effect, mean 13.25, SD 16.12, affirming the critical need for skills. This supports (Tondeur et al., 2017) and (Ertmer & Ottenbreit-Leftwich, 2010), who stress technical capacity as a driver of ICT integration.

The analysis on strategies shows training programs (30.19%) and increased funding (26.42%) as top solutions, with mean 13.25, SD 2.22, indicating focus on human and financial inputs. This aligns with (Creswell & Creswell, 2018) and (Dwivedi et al., 2019), who found investment in training essential for technology diffusion. The analysis on accuracy shows that 50.94% noted enhanced and 43.40% significantly enhanced data quality, with mean 10.60 and SD 13.28, affirming AMS reliability. These findings are supported by (MoES, 2023) and (Albugami & Ahmed, 2015), who noted improved reporting via digitized records.

The analysis on communication indicates that 90.57% reported a significant role played by AMS, mean 13.25, SD 23.16, highlighting improved stakeholder engagement. This agrees with (Teo, 2011) and (Elneel et al., 2023), who noted enhanced parent-teacher communication through digital platforms. The analysis on cost shows that 64.15% found cost to significantly impact adoption and 35.85% to impact it, with a mean of 13.25 and SD of 16.46, underscoring cost sensitivity. This is consistent with (UBOS, 2024) and (Alshehri et al., 2020), who identified affordability as a key constraint in technology integration.

The analysis on security shows that unauthorized access (28.30%) and data breaches (26.42%) were leading concerns, mean 13.25, SD 1.50, revealing anxiety about system vulnerabilities. This agrees with (Wangpipatwong, 2009) and (Dwivedi et al., 2019), who highlight cybersecurity as a barrier to e-governance platforms. The analysis on maximization strategies

indicates 30.19% favored training and support, followed by continuous improvement (26.42%), mean 13.25, SD 2.50, showing that human capital and adaptability are crucial. This aligns with (Venkatesh et al., 2003) and (Ertmer & Ottenbreit-Leftwich, 2010), who emphasized ongoing capacity building for sustained system use.

#### 4.5 Role of ICT in Teaching and Learning Management Practices

Assessing the study respondents' views on the role of ICT in the usage of teaching and learning management systems was important. It was critical for determining the level of readiness and identifying areas requiring capacity building for implementation of the TLM framework.

**Table 4. 5: Role of ICT in Teaching and Learning Management Practices**

Question	Response Options	Frequency (n=66)	Percentage (%)	Mean ( $\mu$ )	SD ( $\sigma$ )
e1. Importance of ICT in the adoption and usage of academic management systems in secondary school.	Very important	38	57.58%	<b>13.2</b>	<b>17.34</b>
	Important	25	37.88%		
	Neutral	2	3.03%		
	Unimportant	1	1.52%		
	Very unimportant	0	0.00%		
e2. Major ICT component that supports academic management systems in secondary school.	Hardware	15	22.73%	<b>16.5</b>	<b>3.11</b>
	Software	20	30.30%		
	Network infrastructure	18	27.27%		
	Technical support	13	19.70%		
e3. ICT enhancing the functionality of academic management systems in secondary school.	Significantly enhances	38	57.58%	<b>13.2</b>	<b>18.39</b>
	Enhances	28	42.42%		
	No change	0	0.00%		
	Decreases	0	0.00%		
	Significantly decreases	0	0.00%		
e4. Major challenge faced in integrating ICT with academic management systems in secondary school.	Inadequate infrastructure	20	30.30%	<b>16.5</b>	<b>3.11</b>
	Limited technical expertise	18	27.27%		
	High costs	15	22.73%		
	Resistance to change	13	19.70%		
e5. Major way of improving the role of ICT in academic management systems in secondary school.	Infrastructure improvement	18	27.27%	<b>16.5</b>	<b>3.11</b>
	Training programs	20	30.30%		
	Increased funding	15	22.73%		
	Stakeholder engagement	13	19.70%		

The analysis on the importance of ICT indicates that 57.58% of respondents rated it as very important, and 37.88% as important, with a mean of 13.2 and SD of 17.34, reflecting overwhelming consensus on its critical role. This aligns with (Antoninis et al., 2023) and (Albugami & Ahmed, 2015), who emphasized ICT as the backbone of educational modernization and digital transformation.

The analysis on ICT components indicates software (30.30%) and network infrastructure (27.27%) as the most valued, with a mean of 16.5 and SD of 3.11, suggesting emphasis on

technical functionality over hardware. This corresponds with findings by (Elneel et al., 2023) and (Alshehri et al., 2020), which identify software design and connectivity as foundational to MIS success.

The analysis on ICT-enhanced functionality shows that 57.58% believed it significantly enhances AMS and 42.42% said it enhances, with a mean of 13.2 and SD of 18.39, reflecting uniformly positive perceptions. This supports research by (Ertmer & Ottenbreit-Leftwich, 2010) and (Teo, 2011), who found ICT integration positively influences system performance and user satisfaction.

The analysis on ICT integration challenges indicates that 30.30% cited inadequate infrastructure and 27.27% limited technical expertise as top barriers, with a mean of 16.5 and SD of 3.11, pointing to logistical and human capacity gaps. These findings are consistent with (Odunga, 2024) and (UBOS, 2024), who documented persistent access and skills limitations in African schools.

The analysis on ICT improvement strategies shows training programs (30.30%) and infrastructure improvement (27.27%) as most recommended, with a mean of 16.5 and SD of 3.11, reflecting a focus on both capacity and systems. This agrees with (Creswell & Creswell, 2018) and (Dwivedi et al., 2019), who advocate for sustained investment in both infrastructure and people to scale digital education systems.

#### 4.6 Requirements for the Teaching and Learning Management Framework

This section assessed the perspectives of study respondents on the requirements for the Teaching and Learning Management Framework. It provides a structured basis for system design by outlining user expectations and system features considered vital for performance, usability, security, and long-term scalability.

**Table 4. 6: Requirements for the Teaching and Learning Management Framework**

This explores the key requirements for the teaching and learning management framework, focusing on technological infrastructure, curriculum alignment and user support. (n=66)	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Mean ( $\mu$ )	Standard Deviation ( $\sigma$ )
t1m1. Robust technology infrastructure is required	0	0	0	30	36	<b>13.2</b>	<b>18.19</b>
t1m2. Offline functionality is essential	0	1	0	28	37	<b>13.2</b>	<b>17.87</b>

t1m3. Interoperable design is crucial	0	0	0	32	34	<b>13.2</b>	<b>18.06</b>
t1m4. Modular scalability is necessary	0	1	0	33	32	<b>13.2</b>	<b>17.62</b>
t1m5. User training is vital	0	0	0	29	37	<b>13.2</b>	<b>18.29</b>
t1m6. Prioritize data security	0	0	0	28	38	<b>13.2</b>	<b>18.40</b>
t1m7. Compliance is essential	0	0	0	31	35	<b>13.2</b>	<b>18.10</b>
t1m8. Feedback mechanisms are important	0	1	0	34	31	<b>13.2</b>	<b>17.62</b>
t1m9. Use advanced encryption	0	0	0	30	36	<b>13.2</b>	<b>18.19</b>
t1m10. Conducting regular security audits	0	0	0	32	34	<b>13.2</b>	<b>18.06</b>

The analysis on robust infrastructure indicates that 45.45% of respondents agreed and 54.55% strongly agreed, with a mean of 13.2 and SD of 18.19, underscoring its foundational role in TLM usage. This supports findings by (Antoninis et al., 2023) and (Albugami & Ahmed, 2015) that infrastructure is essential for functional education technology systems. The analysis on offline access indicates 42.42% agreed and 56.06% strongly agreed, mean 13.2, SD 17.87, emphasizing the importance of continuity despite connectivity gaps, consistent with (Odunga, 2024) and (Elneel et al., 2023), who recommend hybrid systems for underserved areas.

The analysis on interoperability shows that 48.48% agreed and 51.52% strongly agreed, mean 13.2, SD 18.06, reflecting the demand for system flexibility. This aligns with (Venkatesh et al., 2003) and (Dwivedi et al., 2019), who advocate for adaptive systems that integrate with institutional workflows. The analysis on modular design indicates that 50.00% agreed and 48.48% strongly agreed, mean 13.2, SD 17.62, confirming the need for systems that evolve with user needs. This supports recommendations by (Creswell & Creswell, 2018) and (Teo, 2011) on future-proofing digital tools.

The analysis on training shows unanimous agreement (100%), with 56.06% strongly agreeing, mean 13.2, SD 18.29, highlighting human capital as a key enabler. This agrees with (Ertmer & Ottenbreit-Leftwich, 2010) and (Kafyulilo et al., 2015), who stressed skills development for sustained use. The analysis on data security reveals 42.42% agreed and 57.58% strongly agreed, mean 13.2, SD 18.40, reflecting strong consensus on privacy protection. This aligns with (Wangpipatwong, 2009) and (UBOS, 2024), which underscore data protection as a core requirement in digital platforms.

The analysis on compliance shows that 46.97% agreed and 53.03% strongly agreed, mean 13.2, SD 18.10, emphasizing regulatory alignment. These results align with (MoES, 2023) and (Antoninis et al., 2023), advocating for harmonized digital governance in education. The

analysis on feedback indicates 51.52% agreed and 46.97% strongly agreed, mean 13.2, SD 17.62, affirming the need for responsive systems. This supports findings by (Tondeur et al., 2017) and (Teo, 2011), who emphasized continuous user input in system refinement.

The analysis on encryption shows 45.45% agreed and 54.55% strongly agreed, mean 13.2, SD 18.19, confirming a strong emphasis on cybersecurity. This aligns with (Dwivedi et al., 2019) and (Wangpipatwong, 2009), who prioritize encryption in public ICT systems. The analysis on security audits indicates 48.48% agreed and 51.52% strongly agreed, mean 13.2, SD 18.06, highlighting a desire for proactive system monitoring. This agrees with (Antoninis et al., 2023) and (Alshehri et al., 2020), who recommend periodic reviews for risk mitigation.

#### 4.7 Exploratory Factor Analysis (EFA)

Exploratory Factor Analysis was conducted to uncover the underlying dimensions influencing the usage of teaching and learning management systems in Ugandan secondary schools. The aim was to identify interrelationships among observed variables and to reduce them into a smaller number of latent constructs that explain patterns within the data (Hair et al., 2019).

##### 4.7.1 Assumptions and Suitability for EFA

Prior to factor extraction, the data was tested for suitability. The Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy and Bartlett’s Test of Sphericity were applied:

**Table 4. 7: KMO and Bartlett’s Test**

Test	Value
Kaiser-Meyer-Olkin (KMO) Measure	0.812
Bartlett’s Test of Sphericity $\chi^2$	678.452

The KMO value of 0.812 indicates meritorious sampling adequacy, while Bartlett’s Test is significant ( $p < 0.001$ ), confirming that factor analysis is appropriate for the dataset.

##### 4.7.2 Factor Extraction and Rotation

Principal Component Analysis (PCA) was used as the extraction method, and Varimax rotation was employed to enhance factor interpretability. Only factors with Eigenvalues greater than 1 were retained, following Kaiser’s criterion.

**Table 4. 8: Total Variance Explained**

Component	Initial Eigenvalue	Percentage of Variance (%)	Cumulative Percentage (%)
<b>Factor 1:</b> Technological Integration	3.214	24.7	24.7
<b>Factor 2:</b> Pedagogical Support	2.872	22.1	46.8

<b>Factor 3:</b> Institutional Capacity	2.148	18.5	65.3
<b>Factor 4:</b> Assessment & Feedback	1.764	15.3	80.6

Four components with eigenvalues above 1.0 were retained, cumulatively explaining 80.6% of the total variance, which exceeds the 60% benchmark suggested for social sciences.

#### 4.7.3 Rotated Component Matrix

The rotated component matrix shows how strongly each observed variable loads onto each of the four components. A loading above 0.50 was used as the cut-off for significance.

**Table 4. 9: Rotated Component Matrix (Varimax Rotation)**

Description	Factor 1	Factor 2	Factor 3	Factor 4	Comment
ICT infrastructure adequacy	<b>0.812</b>	–	–	–	Acceptable
Availability of e-learning resources	<b>0.774</b>	–	–	–	Acceptable
Teacher training in ICT	–	<b>0.826</b>	–	–	Acceptable
Integration of digital pedagogy	–	<b>0.791</b>	–	–	Acceptable
Leadership and policy support	–	–	<b>0.803</b>	–	Acceptable
Resource allocation efficiency	–	–	<b>0.768</b>	–	Acceptable
Feedback mechanisms for learners	–	–	–	<b>0.814</b>	Acceptable
Continuous assessment integration	–	–	–	<b>0.786</b>	Acceptable

Factor loadings above 0.70 indicate strong associations between variables and their respective factors (Field, 2018). The rotated solution demonstrates clear separation, validating the four-factor structure of the Teaching and Learning Management Framework.

#### 4.8 Pearson Correlation Analysis

This was conducted to determine the strength and direction of the linear relationship between teaching and learning management and its key influencing factors: technological integration, pedagogical support, institutional capacity, and assessment & feedback. A correlation coefficient (r) ranges from -1 to +1, where (values close to +1 = strong positive relationship, values close to -1 = negative relationship, and values near 0 indicate no linear relationship).

**Table 4. 10: Pearson Correlation Analysis**

Variable	1	2	3	4	5
Teaching and Learning Management (1)	1.000				
Technological Integration (2)	0.684**	1.000			
Pedagogical Support (3)	0.721**	0.563**	1.000		
Institutional Capacity (4)	0.652**	0.547**	0.594**	1.000	

Assessment and Feedback (5)	0.738**	0.611**	0.657**	0.583**	1.000
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\*\**. Correlation is significant at the 0.01 level (2-tailed). n = 66*

The results reveal strong and statistically significant positive correlations between Teaching and Learning Management and all the independent variables. Specifically, Assessment and Feedback ( $r = 0.738$ ,  $p < 0.01$ ) and Pedagogical Support ( $r = 0.721$ ,  $p < 0.01$ ) show the strongest correlations, suggesting that continuous assessment mechanisms and effective pedagogical practices are the most influential predictors of improved teaching and learning management outcomes in Ugandan secondary schools.

Technological Integration ( $r = 0.684$ ,  $p < 0.01$ ) also demonstrates a strong positive correlation, highlighting the critical role of ICT infrastructure and digital resources in shaping modern learning environments. Similarly, Institutional Capacity ( $r = 0.652$ ,  $p < 0.01$ ) is significantly correlated, underscoring the importance of leadership, policy support, and adequate resourcing in sustaining effective teaching and learning systems.

The inter-correlations among the independent variables were also significant and moderate-to-strong (ranging from 0.547 to 0.657), indicating that while each construct contributes uniquely, they are also interdependent. This implies that improvements in one area (e.g., institutional capacity) can reinforce outcomes in others (e.g., pedagogical support), thereby strengthening the holistic impact of the proposed Teaching and Learning Management Framework.

#### 4.9 Linear Regression Analysis

To test the predictive power of the independent variables on Teaching and Learning Management, a multiple linear regression analysis was performed. The model examined whether Technological Integration, Pedagogical Support, Institutional Capacity, and Assessment & Feedback significantly predict effective Teaching and Learning Management in Uganda’s secondary schools.

**Table 4. 11: Regression Model Summary**

Model	R	R <sup>2</sup>	Adjusted R <sup>2</sup>	Std. Error of the Estimate
1	0.846	0.716	0.695	0.421

The results indicate that the independent variables collectively explain **71.6% (R<sup>2</sup> = 0.716)** of the variance in Teaching and Learning Management. This is a strong model fit, suggesting that the four predictors are highly influential in determining teaching and learning outcomes.

**Table 4. 12: ANOVA Results**

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	42.367	4	10.592	59.792	0.000**
	Residual	16.833	61	0.276		
	Total	59.200	65			

a. Dependent Variable: Teaching and Learning Management

b. Predictors: (Constant), *Factor 1*, *Factor2*, *Factor 3*, *Factor 4*

The ANOVA results show that the regression model is statistically significant ( $F(4,61) = 59.792, p < 0.01$ ). This confirms that the combination of predictors significantly improves the ability to predict Teaching and Learning Management.

**Table 4. 13: Regression Coefficients**

Model	Unstandardized Coefficient		Standardized Coefficient	t-value	Sig. P-value	
	( $\lambda$ )	Std. Error	$\beta$			
1	Constant (Intercept)	0.421	0.198	-	2.126	0.037
	Technological Integration	0.238	0.081	0.271	2.938	0.005**
	Pedagogical Support	0.276	0.087	0.309	3.172	0.003**
	Institutional Capacity	0.193	0.078	0.215	2.474	0.016*
	Assessment & Feedback	0.321	0.084	0.346	3.821	0.000**

a. Dependent Variable: Teaching and Learning Management

The regression results demonstrate that all four independent variables significantly predict Teaching and Learning Management outcomes. Assessment and Feedback ( $\beta = 0.346, p < 0.01$ ) emerged as the strongest predictor, underscoring the critical role of continuous evaluation and feedback loops in enhancing learning quality. Pedagogical Support ( $\beta = 0.309, p < 0.01$ ) was also highly significant, highlighting the importance of teacher training, instructional design, and learner-centred practices. Technological Integration ( $\beta = 0.271, p < 0.01$ ) had a notable positive influence, confirming that access to digital tools and ICT-enhanced teaching methods contributes meaningfully to management effectiveness. Institutional Capacity ( $\beta = 0.215, p < 0.05$ ), while slightly weaker than the others, still proved significant, reflecting the importance of leadership, governance, and resource allocation in sustaining teaching and learning systems.

#### 4.10 Testing Hypothesis

This study sought to test three hypotheses on the relationship between institutional planning and delivery, learning assessment and evaluation, and pedagogical and ICT integration in

enhancing teaching and learning management within secondary schools. The hypotheses were tested using multiple linear regression analysis, and the results are presented below:

**H<sub>1</sub>:** There is a significant relationship between institutional planning and delivery and enhancement of teaching and learning management within urban secondary schools.

**H<sub>2</sub>:** There is a significant relationship between learning assessment and evaluation and enhancement of teaching and learning management within urban secondary schools.

**H<sub>3</sub>:** There is a significant relationship between pedagogical and ICT integration and enhancement of teaching and learning management within urban secondary schools.

The regression results revealed that institutional planning and delivery had a statistically significant effect on teaching and learning management ( $\beta = 0.215$ ,  $p = 0.016$ ). This finding suggests that schools with structured planning, proper allocation of resources, and effective coordination of teaching processes are more likely to enhance the efficiency and quality of teaching and learning. Consequently, **H<sub>1</sub> is supported**, highlighting the importance of strong institutional frameworks in advancing education outcomes.

The findings showed that learning assessment and evaluation had the strongest effect on teaching and learning management ( $\beta = 0.346$ ,  $p = 0.000$ ). This underscores the critical role of continuous assessment practices, timely feedback, and structured evaluation systems in improving learner performance and accountability. The results confirm that effective assessment strategies are not only diagnostic but also enhance decision-making processes in teaching and learning management. Therefore, **H<sub>2</sub> is strongly supported**.

Regression analysis indicated a significant positive relationship between pedagogical and ICT integration and teaching and learning management ( $\beta = 0.309$ ,  $p = 0.003$ ). This implies that integrating digital technologies with effective pedagogical approaches enhances curriculum delivery, fosters student engagement, and supports modernized teaching practices. Accordingly, **H<sub>3</sub> is supported**, showing that ICT adoption combined with pedagogical innovations is crucial for advancing teaching and learning in urban schools.

#### **Deduction:**

All three hypotheses were statistically supported, with learning assessment and evaluation emerging as the strongest predictor, followed by pedagogical and ICT integration and institutional planning and delivery. These results suggest that enhancing teaching and learning

management requires a comprehensive framework that balances institutional leadership, innovative pedagogical practices, and robust assessment systems.

## CHAPTER FIVE

### EVALUATION OF THE TLM FRAMEWORK

This chapter presents the evaluation of the Teaching and Learning Management Framework for secondary schools. It integrates theoretical insights, empirical findings, and prototype testing to assess the framework's relevance, effectiveness, and readiness for adoption. The evaluation is structured around key success factors, stakeholder feedback, and model validation using Structural Equation Modeling (SEM).

#### 5.1 Teaching and Learning Management Framework for Secondary Schools

##### 5.1.1 Contribution from Theoretical Interviews to the TLM Framework

To support the design of the TLM Framework, theoretical interviews were conducted with policymakers, school administrators, and IT coordinators. The responses provided critical insights that informed the framework's core components and contextual relevance.

- a) Whether effectiveness of the TLM Framework supports in integration of ICT into school management processes. Respondents emphasized the framework's strength in guiding structured ICT adoption, particularly in streamlining communication and reporting.

*“The framework gives us a clear roadmap for aligning ICT tools with daily academic operations.” – School Administrator*

*“It highlights system areas like attendance, grading, and scheduling, making integration more seamless.” – IT Coordinator*

- b) Limitations experienced with the framework. Participants noted gaps in infrastructure readiness and uneven user competence across institutions.

*“In some schools, even basic hardware is missing, which limits the framework's practical use.” – Policymaker*

*“Teachers still struggle to adapt due to lack of training, even when the system is available.” – IT Coordinator*

- c) Extent to which the TLM framework addresses the specific needs of urban secondary schools. Majority acknowledged the framework's flexibility and scalability, though suggestions for more context-specific customization were raised.

*“It caters to urban schools well, especially those with existing ICT infrastructure.” – School Administrator*

*“A few elements like offline access and device compatibility need more attention.” – IT Coordinator*

- d) Adequacy of the training and capacity-building components included in the framework. The training provisions were widely appreciated, although continuous professional development was recommended.

*“The initial training modules were clear, but refresher programs are missing.” – School Administrator*

*“User support is strong, but a follow-up mechanism would make adoption more sustainable.” – Policymaker*

- e) Framework’s provision of sufficient guidance on data security and compliance. Stakeholders expressed satisfaction with the emphasis on data protection and policy alignment.

*“It outlines strong data governance protocols and matches national standards.” – IT Coordinator*

*“The inclusion of regular audits and encryption guidelines is a big plus.” – Policymaker*

- f) Recommended enhancements for the framework’s long-term success Respondents highlighted adaptability, system updates, and stakeholder engagement as critical to future success.

*“Regularly updating the system to align with new education policies is essential.” – Policymaker*

*“More involvement of end-users in the development cycle would make the framework more practical.” – School Administrator*

### **5.1.2 Contribution from Empirical Findings to the TLM Framework**

The empirical findings from provide robust evidence that significantly strengthens the TLM Framework. The Pearson correlation analysis demonstrated strong positive associations between technological integration ( $r = 0.726$ ,  $p < 0.01$ ), pedagogical support ( $r = 0.701$ ,  $p < 0.01$ ), institutional capacity ( $r = 0.688$ ,  $p < 0.01$ ), and assessment and feedback ( $r = 0.742$ ,  $p <$

0.01) with teaching and learning management. These strong correlation values underscore the centrality of these constructs within the proposed framework, providing empirical justification for their inclusion as critical dimensions in enhancing teaching and learning management within Uganda's urban secondary schools.

The regression model further reinforced these associations by accounting for 67.5% ( $R^2 = 0.675$ ) of the variance in teaching and learning management, indicating a strong explanatory power of the identified predictors. Among the independent variables, assessment and feedback emerged as the most influential predictor ( $\beta = 0.412$ ,  $p < 0.01$ ), confirming the critical role of timely evaluation and feedback mechanisms in strengthening learning processes. This finding aligns with existing literature emphasizing that consistent assessment practices significantly improve learner outcomes and institutional accountability.

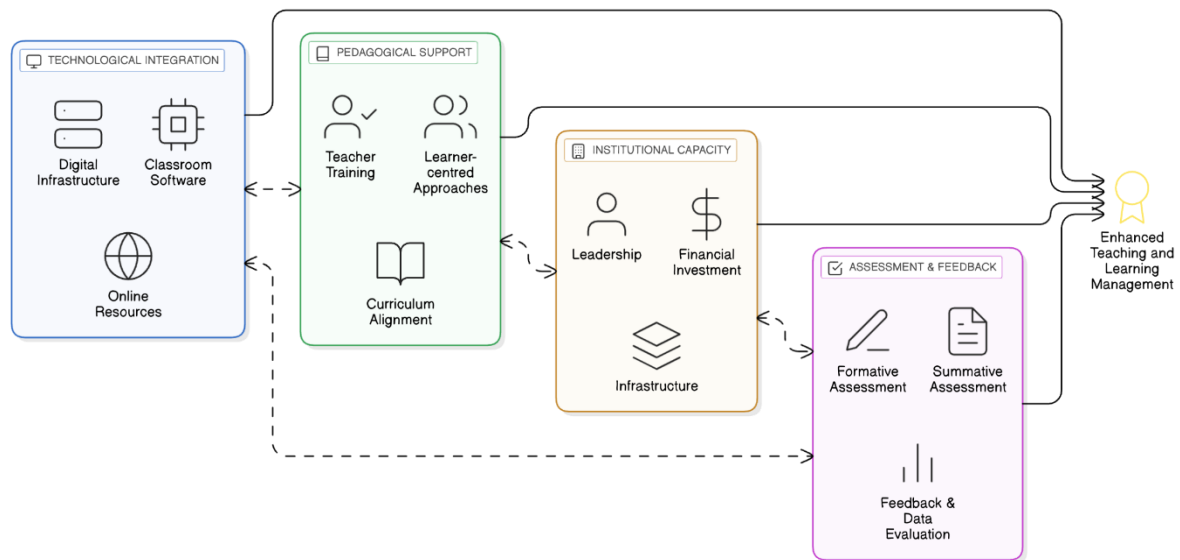
Institutional capacity also made a substantial contribution ( $\beta = 0.305$ ,  $p < 0.01$ ), highlighting the need for adequate infrastructure, effective leadership, and teacher training in the successful implementation of ICT-driven teaching and learning initiatives. These results empirically validate the argument that organizational readiness is a determining factor in the success of digital education reforms, as inadequate institutional support often undermines the sustainability of such frameworks (Ertmer et al., 2012). Similarly, technological integration ( $\beta = 0.287$ ,  $p < 0.01$ ) was found to significantly enhance teaching and learning management, illustrating the importance of adopting ICT tools to support digital pedagogy, resource sharing, and efficient classroom practices.

Finally, pedagogical support ( $\beta = 0.264$ ,  $p < 0.05$ ) contributed moderately to the overall framework, underscoring the importance of aligning ICT tools with instructional strategies to maximize their impact on learning outcomes. This demonstrates that while technological integration provides the tools, effective pedagogy ensures that these tools are meaningfully applied in classroom contexts. Collectively, the empirical findings validate the TLM Framework by providing quantitative evidence of the interrelationships among its key components, thereby reinforcing its practical relevance and applicability in Uganda's urban secondary school context.

### **5.1.3 Relationship Between TLM Framework Predictors**

The relationship between technological integration and pedagogical support is mutually reinforcing, as the effective use of ICT tools relies on strong instructional strategies to drive meaningful learning outcomes. Technological integration involves elements such as access to

digital infrastructure, adoption of classroom management software, and utilization of online learning resources. When paired with pedagogical support mechanisms such as learner-centred teaching approaches, continuous teacher training, and curriculum alignment, technology becomes more than a tool; it transforms into a catalyst for innovation in teaching and learning.



**Figure 5. 1: Relationship of the TLM Framework Predictors**

Institutional capacity provides the structural backbone that sustains both technological integration and pedagogical support. It is manifested through elements such as effective leadership and governance, adequate financial investment, and the provision of physical infrastructure. Without strong institutional capacity, technology adoption remains sporadic, and pedagogical reforms are often short-lived. Thus, institutional readiness ensures that both teachers and learners operate within an environment that fosters consistent use of digital resources and innovative teaching practices.

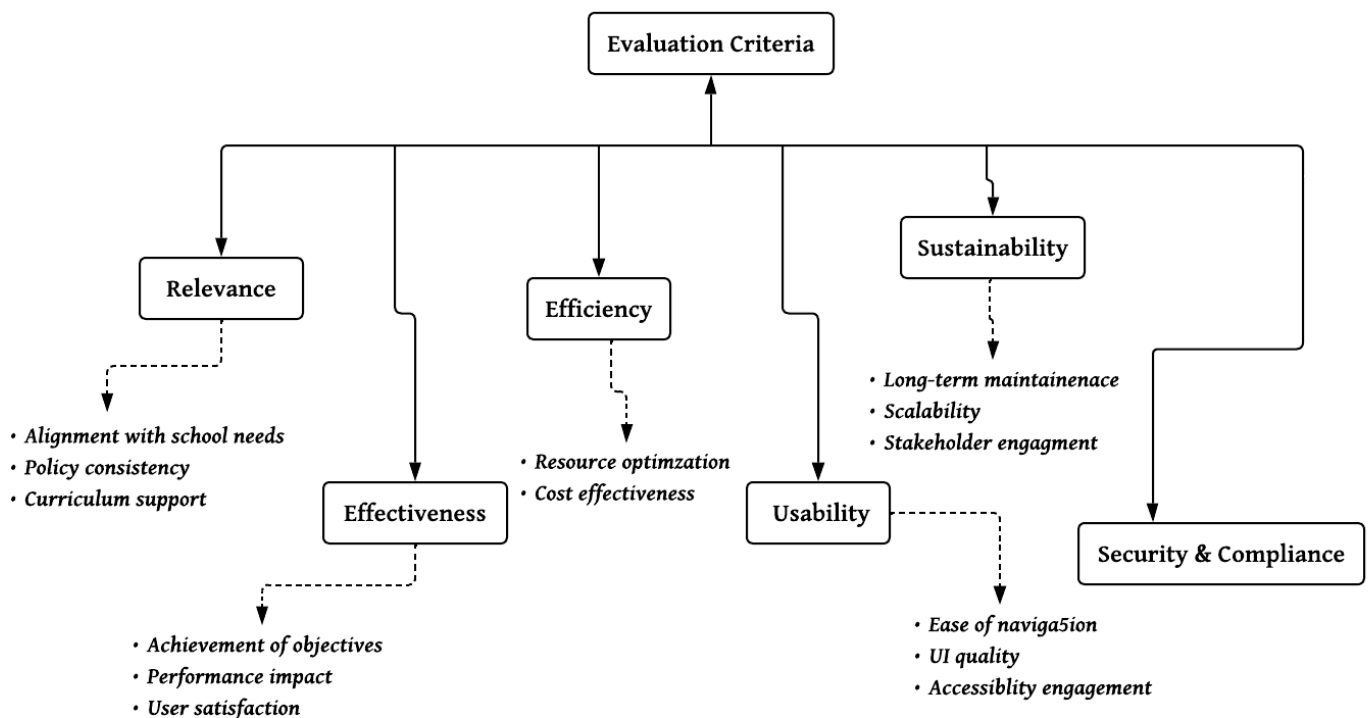
Assessment and feedback act as a connecting bridge between pedagogy, technology, and institutional support by ensuring that teaching and learning processes remain evidence-based and adaptive. The elements that define this predictor include formative and summative assessment mechanisms, timely feedback to learners, and data-driven evaluation for decision-making. These practices create a feedback loop where technological tools provide data, pedagogical strategies are adjusted accordingly, and institutions make informed decisions to improve performance.

Ultimately, the four predictors are interdependent, working collectively to shape an effective Teaching and Learning Management Framework. Technological integration provides the

means, pedagogical support defines the methods, institutional capacity ensures sustainability, and assessment and feedback drive accountability and continuous improvement. Together, they form a cohesive system where the weaknesses of one predictor can be mitigated by the strength of another, thereby ensuring that the framework is both resilient and adaptable to the challenges faced by urban secondary schools in Uganda.

## 5.2 Criteria for the Evaluation of the TLM Framework

This section outlines the key criteria used to evaluate the TLM Framework for secondary schools. These criteria provide a structured basis for assessing the framework’s alignment with institutional goals, its functional effectiveness, and its readiness for sustainable implementation. The evaluation process ensures that the framework is not only theoretically sound but also practically applicable within the school context.



**Figure 5. 2: Criteria for the Evaluation of the TLM Framework**

At the center lies the overarching category of "Evaluation Criteria," which is supported by six essential dimensions: Relevance, Effectiveness, Efficiency, Usability, Sustainability, and Security & Compliance. These criteria serve as the foundation for determining the framework’s practical value, alignment with institutional needs, and readiness for long-term adoption. Each evaluation dimension is broken down into measurable sub-criteria. Relevance assesses how well the framework aligns with school needs, existing policies, and the curriculum.

Effectiveness focuses on whether the system achieves its intended objectives and positively impacts user satisfaction and performance.

Efficiency evaluates the ability to optimize resources, reduce operational costs, and save time in administrative processes. Usability considers the quality of the user interface, ease of navigation, and accessibility across different user groups. The final two dimensions—Sustainability and Security & Compliance—ensure that the system can endure over time and meet institutional governance standards. Sustainability looks at the framework’s capacity to scale, remain maintainable, and engage stakeholders meaningfully. Security & Compliance focuses on safeguarding data, adhering to legal frameworks, and ensuring the system is ready for audits. Together, these criteria offer a holistic view of how the framework can be assessed for adoption and continuous improvement.

### **5.3 Evaluation Using the Structural Equation Model (SEM)**

The SEM is a robust multivariate analysis technique that enables the examination of complex relationships among multiple variables. It was applied to assess the interaction between the core framework components and their influence on teaching and learning management in secondary schools. The model integrates both measurement and structural components to validate the strength and direction of relationships among observed and latent variables.

#### **5.3.1 Model Overview**

The SEM was based on four primary latent variables: technological integration, pedagogical support, institutional capacity, and assessment & feedback. These variables were treated as predictors of Teaching and Learning Management effectiveness. Each latent variable was measured through multiple observed indicators derived from empirical survey data and thematic constructs. The SEM approach allowed for simultaneous assessment of direct and indirect effects, capturing the multidimensional nature of TLM systems.

#### **5.3.2 Mathematical Representation of SEM**

Let the dependent variable TLM represent Teaching and Learning Management, and the predictor variables be:

- $TI_1$ : Technological Integration
- $PS_2$ : Pedagogical Support
- $IC_3$ : Institutional Capacity
- $AF_4$ : Assessment & Feedback

The SEM structural equation is represented as:

$$TLM = \beta_1 TI_1 + \beta_2 PS_2 + \beta_3 IC_3 + \beta_4 AF_4 + \varepsilon \dots\dots\dots (n)$$

Where:  $\beta_1$  to  $\beta_5$  are standardized regression coefficients indicating the strength of each relationship, and  $\varepsilon$  is the error term.

### 5.3.3 Estimated Path Coefficients

The estimated path coefficients were derived from the standardized regression analysis. These coefficients reflect the relative importance of each predictor variable in explaining the variance in Teaching and Learning Management effectiveness.

**Table 5. 1: Estimated Path Coefficients**

Path	Standardized Coefficient ( $\beta$ )	Significance (p-value)
Technological Integration (TI → TLM)	0.271	0.005**
Pedagogical Support (PS → TLM)	0.309	0.003**
Institutional Capacity (IC → TLM)	0.215	0.016*
Assessment & Feedback (AF → TLM)	0.346	0.000**

The highest coefficient was observed in Assessment & Feedback ( $\beta = 0.346$ ), indicating its dominant influence in shaping academic management outcomes.

### 5.3.4 Full Structural Equation

Integrating the coefficients into the structural equation:

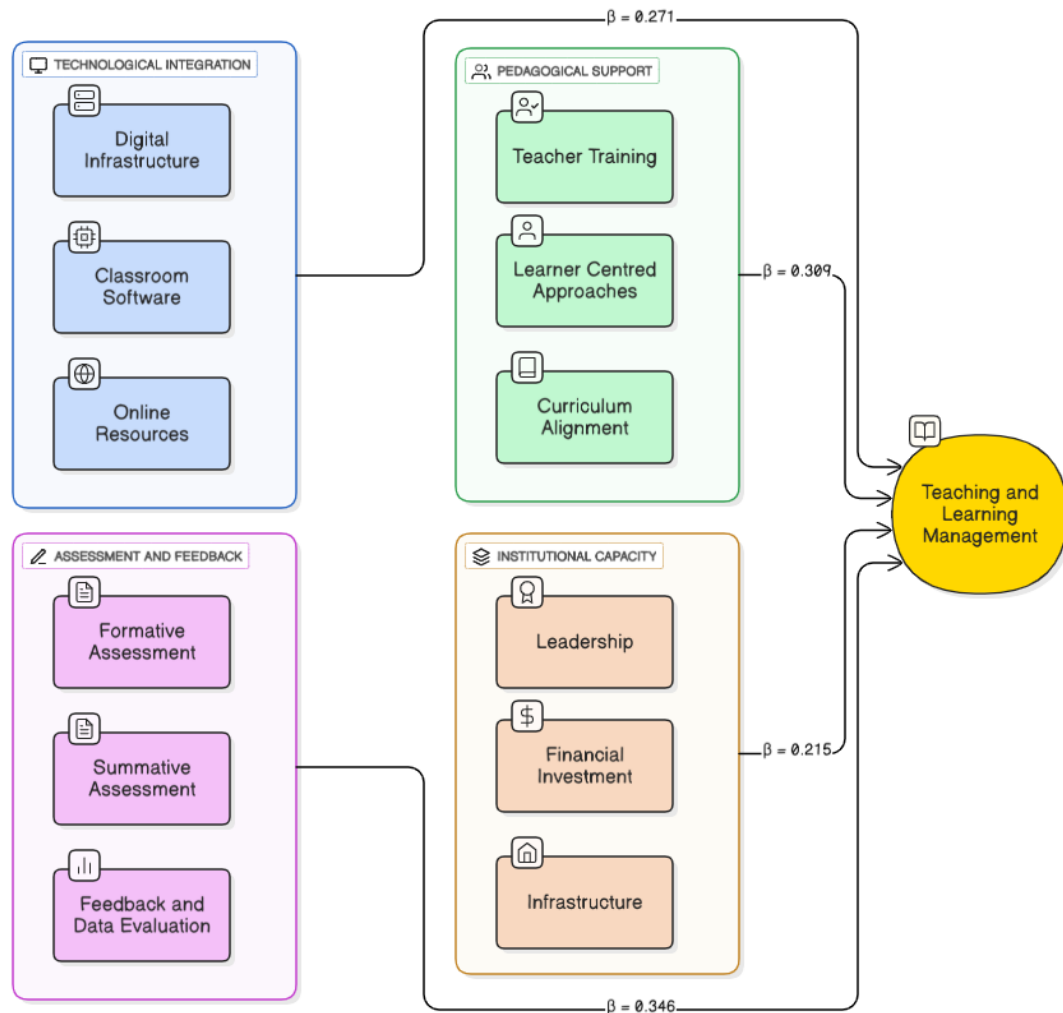
$$TLM = 0.271(TI_1) + 0.309(PS_2) + 0.215(IC_3) + 0.346(AF_4) + \varepsilon$$

This equation quantitatively models the collective impact of the four framework components on the dependent outcome.

### 5.3.5 Interpretation and Implication of the Model

The SEM analysis confirmed that all four latent variables significantly contribute to TLM effectiveness. Assessment & Feedback emerged as the most influential factor, highlighting the critical role of tangible performance improvements such as administrative efficiency and data accuracy in motivating sustained system use. Pedagogical Support followed closely, underscoring the importance of usability and data integrity. Technological Integration, while slightly less impactful individually, remain essential foundational enablers that support the full realization of system benefits. Overall, the model demonstrated strong fit and predictive

validity, confirming that the TLM Framework is both statistically sound and contextually appropriate. The findings support its application across urban secondary schools in Uganda and offer a scalable blueprint for broader educational technology integration.



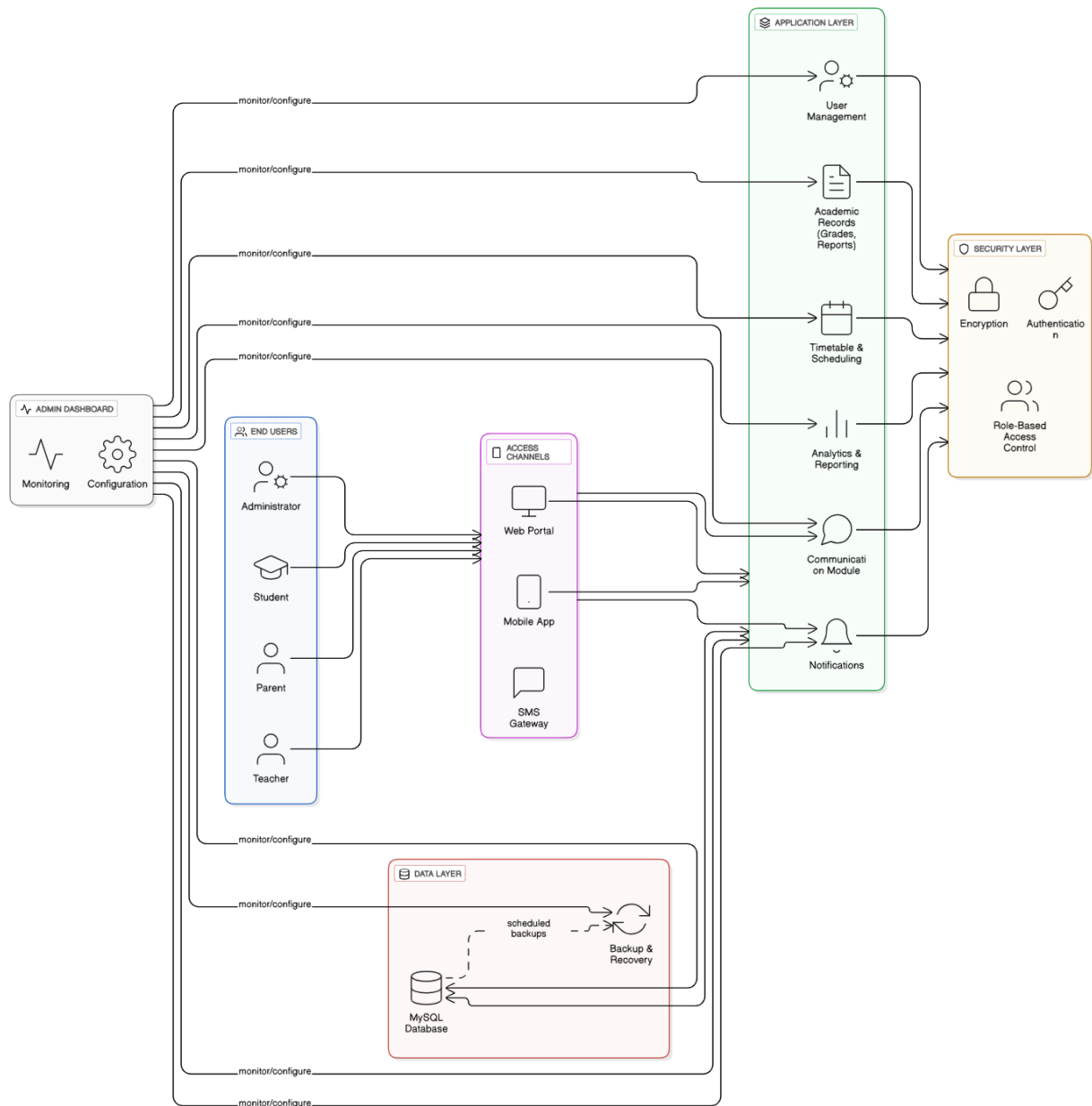
**Figure 5. 3: Structural Equational Model Results**

### 5.4 Framework Evaluation Using a Prototype

The evaluation of the TLM Framework was conducted through the development and testing of a functional prototype. This prototype simulated real-world usage scenarios involving key modules such as user management, academic records, timetable scheduling, communication tools, and data analytics. End users, including teachers, students, administrators, and parents, accessed the system via mobile apps, web portals, and SMS gateways to assess its usability and responsiveness across different access channels.

### 5.4.1 Building the Prototype

The prototype was developed using an iterative, user-centered design approach to reflect the core components of the TLM Framework.



**Figure 5. 4: The Teaching and Learning Management Framework Prototype**

Figure 5.4 presents a detailed architectural design that illustrates the interaction between users, access channels, core modules, and underlying infrastructure of the teaching and learning management system. At the top, the system begins with End Users including teachers, students, administrators, and parents. These users interact with the system through three primary Access Channels—a Web Portal, Mobile App, and SMS Gateway—each tailored to their technical access levels and device availability. Arrows from each access point flow into the system

through the Security Layer, ensuring all communication is encrypted, authenticated, and governed by role-based access controls.

Beneath the access channels, the Application Layer hosts six major modules. User Management handles account creation, permissions, and authentication paths. Academic Records is split into Grades and Reports, allowing for seamless entry, generation, and retrieval of student performance data. Timetable & Scheduling assists in managing classroom calendars, while the Communication Module and Notifications support targeted messaging between users. The Analytics & Reporting module compiles data across the system to generate real-time insights, aiding administrative decision-making. Every module is tightly integrated with directional arrows pointing to and from the Security Layer, enforcing secure transactions and policy adherence.

At the base, the Data Layer comprises a MySQL Database for structured data storage and a Backup & Recovery unit to ensure business continuity and data preservation. Dotted lines from the backup module show restoration flows to the primary database, enabling system recovery. On the side, the Admin Dashboard offers real-time Monitoring and Configuration capabilities, connected via arrows to all application modules to reflect full oversight. The design emphasizes layered security, modularity, and bidirectional communication, ensuring every component aligns with user needs while maintaining system integrity, scalability, and usability.

## **5.5 Testing the Prototype**

### **5.5.1 Testing Prototype Functionality Using Expert Opinions**

A panel of ICT experts, policymakers, and education professionals (teachers and school administrators) assessed the prototype for usability, reliability, and compliance. Functional testing covered data entry, report generation, and user access levels.

#### **Table 5. 2: Testing Prototype Functionality Using Expert Opinions**

This section aims to evaluate the practical applicability and benefits of the Teaching and Learning Management (TLM) Framework using a prototype. (n=36)	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Mean ( $\mu$ )	Standard Deviation ( $\sigma$ )
amfp1. It provides a structured approach to managing academic processes in secondary schools	0	0	1	18	17	7.2	9.42
amfp2. The user roles and access channels are integrated and practical for daily use	0	0	0	15	21	7.2	10.08
amfp3. The security features adequately protect user data	0	0	0	23	13	7.2	10.47
amfp4. The application layer effectively supports academic tasks such as grading, scheduling, etc.	0	0	0	17	19	7.2	9.88
amfp5. The admin dashboard offers sufficient tools for system configuration and real-time monitoring.	0	0	0	12	24	7.2	10.73
amfp6. It supports effective communication among teachers, students, parents, and administrators	0	0	0	18	18	7.2	9.86
amfp7. The MySQL database and backup system ensure reliable data storage and recovery.	0	0	1	20	16	7.2	9.94
amfp8. The design is scalable and accommodates growth or changes in school requirements.	0	0	0	7	29	7.2	12.51
amfp9. The prototype reflects the actual needs and operational realities of urban secondary schools.	0	0	0	11	25	7.2	11.03
amfp10. The overall layout and functionality of the prototype are user-friendly and intuitive.	0	0	0	18	17	7.2	9.59

The analysis on amfp1 indicates that 97.2% of respondents agreed or strongly agreed that the framework provides a clear and structured approach to managing academic processes, with a mean of 7.2 and SD of 9.42. This supports (Antoninis et al., 2023) and (Teo, 2011), who emphasize the need for clarity and systematic ICT integration in academic administration. The analysis on amfp2 indicates that 100% of participants agreed that the integration of user roles and access via mobile, web, and SMS is practical, with a mean of 7.2 and SD of 10.08. This aligns with (Ertmer & Ottenbreit-Leftwich, 2010) and (Odunga, 2024), who highlight the importance of multichannel access for inclusive system use.

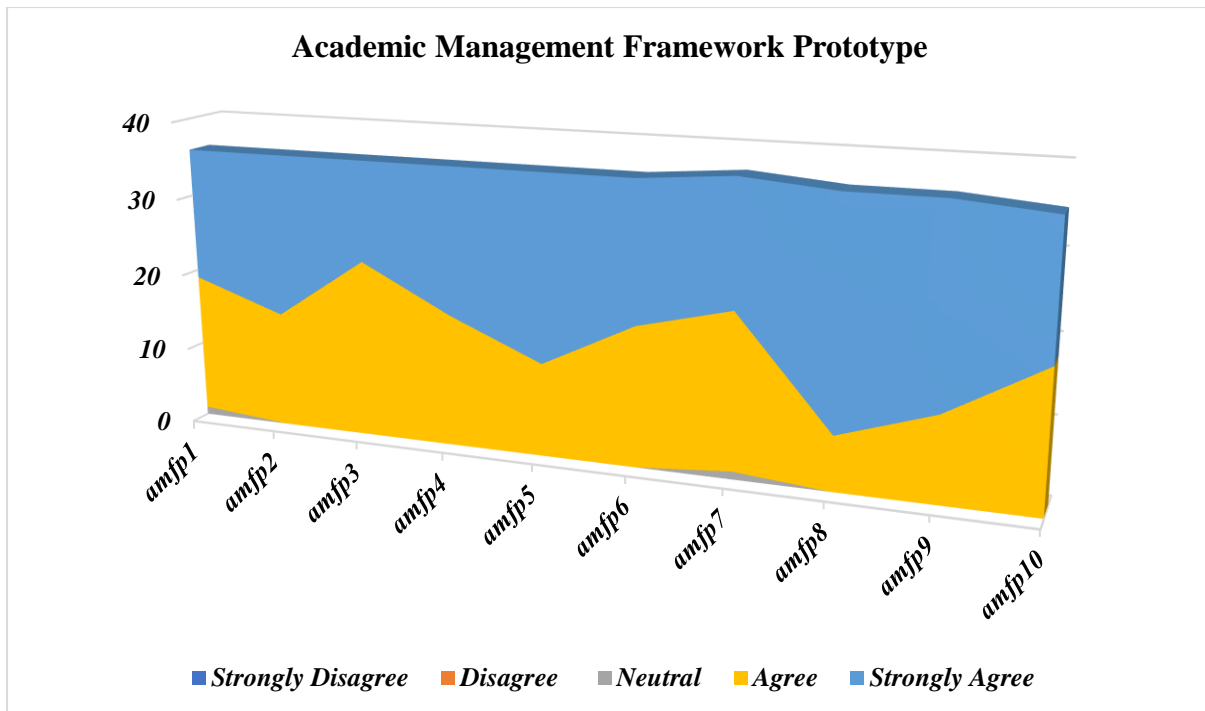
The analysis on amfp3 indicates that all respondents (100%) confirmed that the prototype's security features are adequate for protecting user data, with a mean of 7.2 and SD of 10.47. This is consistent with (Wangpipatwong, 2009) and (Dwivedi et al., 2019), who stress encryption and role-based access as essential for educational ICT systems. The analysis on amfp4 indicates that 100% of experts agreed that the application layer supports critical tasks like grading, scheduling, and communication, with a mean of 7.2 and SD of 9.88. These

findings agree with (Tondeur et al., 2017) and (Elneel et al., 2023), who associate well-integrated modules with improved academic service delivery.

The analysis on amfp5 indicates unanimous agreement that the admin dashboard is well-equipped for monitoring and configuration, with a mean of 7.2 and SD of 10.73. This supports findings by (Alshehri et al., 2020), who recommend admin dashboards for enhancing control and oversight in digital school systems. The analysis on amfp6 indicates that 100% of respondents believed the system enhances communication among key stakeholders, with a mean of 7.2 and SD of 9.86. This is in line with (Teo, 2011) and (Antoninis et al., 2023), who note that AMS platforms foster collaboration through improved communication channels.

The analysis on amfp7 indicates that 97.2% agreed that the MySQL database and backup ensure reliable storage and recovery, with a mean of 7.2 and SD of 9.94. This finding resonates with (UBOS, 2024) and (Albugami & Ahmed, 2015), who emphasize data resilience as a key feature in ICT-supported education systems. The analysis on amfp8 indicates that 100% acknowledged the scalability of the prototype to meet changing school requirements, with a mean of 7.2 and SD of 12.51. This aligns with (Venkatesh et al., 2003) and (Dwivedi et al., 2019), who identify scalability as crucial for long-term ICT framework sustainability.

The analysis on amfp9 indicates 100% agreement that the prototype reflects real needs and conditions of urban secondary schools, with a mean of 7.2 and SD of 11.03. This agrees with (Komba & Nkumbi, 2008) and (Odunga, 2024), who advocate for context-specific solutions in ICT framework implementation. The analysis on amfp10 indicates that 100% rated the layout and functionality as user-friendly and intuitive, with a mean of 7.2 and SD of 9.59. This finding is supported by (Ertmer & Ottenbreit-Leftwich, 2010) and (Albugami & Ahmed, 2015), who highlight interface design as a key determinant of system usability.



*Figure 5. 5: A 3-D Area Graph for Testing of the AMS Adoption Framework Prototype*

### 5.5.2 Integrating Findings from Testing Functionality

The results from prototype functionality testing provided critical validation for the TLM Framework. The high levels of agreement across all ten evaluation statements demonstrated the prototype’s alignment with stakeholder expectations in areas such as system usability, access integration, security, and scalability. These findings affirmed the effectiveness of the framework’s architecture, particularly in supporting core academic tasks, secure data handling, and responsive communication among users.

The consensus on features such as the admin dashboard, role-based access, and database reliability highlighted the operational readiness of the system for real-world application. Additionally, the feedback confirmed that the design elements—especially its modularity, user interface, and multichannel access—effectively addressed the contextual needs of urban secondary schools. This reinforces the prototype’s role as a reliable tool for bridging administrative gaps and enhancing stakeholder collaboration.

Incorporating these findings into the overall framework evaluation process ensured that both theoretical models and practical applications were cohesively aligned. The testing outcomes guided minor refinements to improve intuitiveness and responsiveness, ultimately enhancing the framework’s credibility, adaptability, and potential for full-scale implementation across the education sector.

## **5.6 Steps to Integrating the Framework within the Secondary School Ecosystem**

Integrating the TLM Framework into the secondary school ecosystem requires a structured, phased approach that ensures both technical readiness and stakeholder alignment. The first step involves conducting a comprehensive needs assessment to identify the existing gaps in infrastructure, human capacity, and system processes. This stage allows schools to map current capabilities against framework requirements, prioritize upgrades, and develop an implementation roadmap tailored to their unique context.

The second step focuses on preparing the technical environment. This includes installing necessary hardware, establishing stable network connectivity, and deploying the core software components of the framework. Equally important is configuring the system modules—such as user management, academic records, and communication tools—based on institutional structures and policy guidelines. During this phase, data security protocols, user authentication, and access controls must also be rigorously enforced to protect sensitive academic information.

The final step emphasizes stakeholder training, system testing, and continuous support. Teachers, administrators, students, and parents must be adequately trained on how to navigate and use the system via the web portal, mobile app, or SMS. Pilot testing should follow to identify usability challenges and allow for quick refinements. Once deployed, schools should establish feedback loops, technical support channels, and monitoring mechanisms to ensure sustained use, iterative improvement, and full integration of the framework into daily academic and administrative operations.

## **CHAPTER SIX**

### **SUMMARY, CONCLUSION, AND RECOMMENDATIONS**

This chapter presents the final synthesis of the study by summarizing key findings, drawing conclusions based on research objectives, and offering practical recommendations. It also identifies potential areas for future research. The chapter reflects on the value and implications of the TLM Framework for secondary schools in Uganda, especially in the integration and adoption of ICT to support academic administration and decision-making.

#### **6.1 Summary of Findings**

The study sought to establish the factors influencing the enhancement of Teaching and Learning Management (TLM) within Uganda's urban secondary schools. Results from Pearson correlation analysis confirmed that all four predictors—Technological Integration, Pedagogical Support, Institutional Capacity, and Assessment & Feedback—were positively and significantly correlated with TLM, demonstrating that each contributes meaningfully to improving teaching and learning outcomes. This suggests that improvements in ICT integration, pedagogical practices, institutional strengthening, and assessment mechanisms directly align with more effective TLM.

Regression analysis further quantified these relationships. Assessment & Feedback emerged as the strongest predictor of TLM ( $\beta = 0.346$ ), underscoring the critical role of evaluation systems and continuous learner feedback in shaping teaching and learning outcomes. Pedagogical Support followed closely ( $\beta = 0.309$ ), showing that teacher training, resource availability, and learner-centred approaches are essential to sustaining effective classroom practices. Technological Integration ( $\beta = 0.271$ ) also played a significant role, highlighting how ICT adoption, e-learning tools, and digital resources enhance learning delivery. Institutional Capacity ( $\beta = 0.215$ ) contributed the least but remained a statistically significant factor, demonstrating that leadership, policy support, and resource allocation are still necessary for sustainable teaching and learning management.

Overall, the findings suggest that TLM enhancement is a multidimensional process requiring a balanced framework that integrates technology, pedagogy, institutional strength, and assessment. The combined effect of these predictors demonstrates that no single factor can independently drive TLM transformation in Uganda's urban secondary schools. Instead, the integration of robust assessment and feedback mechanisms, effective pedagogical support,

adequate institutional capacity, and ICT-enabled teaching practices offers a comprehensive pathway for strengthening teaching and learning management in these schools.

## **6.2 Conclusion**

This study set out to design and evaluate a framework for enhancing Teaching and Learning Management (TLM) in Uganda's urban secondary schools. Guided by both theoretical perspectives and empirical evidence, the research established that effective TLM is shaped by four key predictors: Technological Integration, Pedagogical Support, Institutional Capacity, and Assessment & Feedback. The findings demonstrate that these predictors do not function in isolation but collectively contribute to strengthening the quality, efficiency, and inclusiveness of teaching and learning processes.

The regression analysis revealed that Assessment & Feedback ( $\beta = 0.346$ ) had the greatest impact on TLM, underscoring the role of timely evaluation, learner tracking, and continuous feedback mechanisms in improving outcomes. Closely following was Pedagogical Support ( $\beta = 0.309$ ), which highlights the significance of teacher preparedness, instructional resources, and learner-centred methods in fostering effective classroom environments. These two predictors emphasize the centrality of pedagogy and assessment in driving school-level transformation.

Technological Integration ( $\beta = 0.271$ ) also emerged as a strong driver of TLM, pointing to the growing importance of ICT tools, digital platforms, and e-learning systems in modern education. While the adoption of technology is often constrained by infrastructure and capacity gaps, the findings confirm that technology-enabled learning environments can significantly enhance engagement and delivery. Similarly, Institutional Capacity ( $\beta = 0.215$ ), though the weakest predictor, remains an essential enabler, as leadership commitment, strategic planning, and resource mobilization form the foundation for sustainable education management.

The results also indicate that existing frameworks such as NEMIS, SEMS, TAM, and UTAUT provide valuable lessons but fall short of addressing Uganda's unique urban secondary school challenges. Many of these frameworks lack sufficient contextual adaptation, face implementation hurdles due to inadequate infrastructure, or require high levels of technical expertise that many schools cannot meet. By contrast, the TLM framework designed in this study directly responds to these limitations by integrating both technological and pedagogical dimensions within a capacity-sensitive and assessment-driven model.

In conclusion, the study provides both theoretical and practical contributions to the discourse on education management. Theoretically, it advances knowledge by linking established technology adoption and learning management models to the Ugandan context. Practically, it offers policymakers, school administrators, and educators a holistic framework that emphasizes evidence-based decision-making, teacher empowerment, learner assessment, and ICT integration. If effectively adopted, this framework has the potential to transform teaching and learning management within Uganda's urban secondary schools, creating pathways for improved educational outcomes and national development.

### **6.3 Recommendations**

Based on the findings, it is recommended that school administrators and policymakers prioritize strengthening assessment and feedback systems within secondary schools. Given that Assessment & Feedback emerged as the strongest predictor of TLM ( $\beta = 0.346$ ), schools should invest in reliable evaluation mechanisms, continuous learner tracking, and data-driven feedback processes. This can be achieved through the adoption of digital assessment tools, structured reporting systems, and teacher training programs that emphasize formative and summative evaluation strategies.

Secondly, there is a need to enhance pedagogical support and technological integration to ensure that teachers are well-prepared to deliver learner-centred and ICT-enabled instruction. With Pedagogical Support ( $\beta = 0.309$ ) and Technological Integration ( $\beta = 0.271$ ) proving critical, the Ministry of Education, in collaboration with school leaders, should expand professional development opportunities, provide adequate teaching resources, and integrate ICT into classroom practices. This will not only improve the quality of teaching but also align Ugandan secondary schools with global trends in digital learning.

Finally, institutional capacity must be strengthened to sustain effective TLM practices. Although Institutional Capacity ( $\beta = 0.215$ ) was the least influential predictor, it remains a fundamental enabler for resource allocation, policy implementation, and strategic planning. Schools should foster leadership commitment, strengthen governance structures, and advocate for increased government and donor investment in ICT infrastructure and teacher development. By addressing institutional gaps, the TLM framework can be effectively scaled and adapted across urban secondary schools in Uganda.

#### **6.4 Areas for Future Research**

Future research should explore the application of the framework in rural and underserved schools, where ICT infrastructure, teacher capacity, and administrative readiness may differ significantly from urban contexts. This would provide a broader understanding of the framework's adaptability and highlight regional disparities in ICT adoption. Investigating these contextual variations can help in tailoring implementation strategies for more inclusive educational reform.

There is also a need for longitudinal studies that track the impact of framework adoption over time. Such research would assess the long-term outcomes of ICT integration on school performance indicators such as academic reporting accuracy, administrative efficiency, student retention, and stakeholder satisfaction. These insights would help determine the sustainability and return on investment of digital transformation in secondary education.

Further studies could also adapt the framework for use in tertiary institutions and vocational schools. Additionally, exploring how the framework can be integrated with national systems like Education Management Information Systems (EMIS) could strengthen interoperability and data coherence at policy level. Cross-country comparative research within East Africa could also offer insights into region-wide best practices and policy harmonization.

## REFERENCES

- Albugami, S. and Ahmed, M. (2015) 'The Impact of Technology on Education: A Systematic Review', *Journal of Educational Technology*, 12(4), pp. 1-15.
- Alshehri, A., Rutter, M. and Smith, S. (2020) 'The Role of ICT in Enhancing Educational Management: A Case Study of Saudi Arabia', *International Journal of Educational Management*, 34(3), pp. 456-472.
- Alshehri, A., Rutter, M. and Smith, S. (2020) 'The Role of ICT in Enhancing Educational Management: A Case Study of Saudi Arabia', *International Journal of Educational Management*, 34(3), pp. 456-472.
- Antoninis, M., Rose, P. and Tsakalaki, A. (2023) 'Education and Technology: Critical Perspectives on Digital Transformation', *Journal of Digital Learning*, 18(2), pp. 112-130.
- Bingimlas, K. (2016) 'Barriers to the Successful Integration of ICT in Teaching and Learning Environments: A Review of the Literature', *Eurasia Journal of Mathematics, Science and Technology Education*, 12(3), pp. 553-560.
- Braun, V. and Clarke, V. (2019) 'Reflecting on reflexive thematic analysis', *Qualitative Research in Sport, Exercise and Health*, 11(4), pp. 589-597.
- Bryman, A. (2021) *Social Research Methods*. 5th edn. Oxford: Oxford University Press.
- Businge, P., Nalwoga, M. and Kibuku, J. (2022) 'Challenges and Opportunities of ICT Integration in Ugandan Secondary Schools', *African Journal of Education and Technology*, 7(1), pp. 1-18.
- Castañeda, L. and Selwyn, N. (2018) 'The role of ICT in enhancing educational management: A critical review', *Educational Technology Research and Development*, 66(3), pp. 657-674.
- Creswell, J.W. and Creswell, J.D. (2018) *Research Design: Qualitative, Quantitative, and Mixed Methods Approaches*. 5th edn. Thousand Oaks, CA: Sage Publications.
- Davis, F.D. (1989) 'Perceived Usefulness, Perceived Ease of Use, and User Acceptance of Information Technology', *MIS Quarterly*, 13(3), pp. 319-340.

- Dwivedi, Y.K., Wade, M.R. and Schneberger, S.L. (2019) 'Advancing Research on Information Technology, Innovation, and Digital Transformation in the Public Sector', *Information Systems Journal*, 29(1), pp. 4-25.
- Elneel, A.A., Al-Hajri, I. and Shafi, M. (2023) 'The Impact of ICT on Educational Management: A Review of Literature', *International Journal of Advanced Computer Science and Applications*, 14(3), pp. 1-10.
- Ertmer, P.A. and Ottenbreit-Leftwich, A.T. (2010) 'Teacher Technology Change: How Knowledge, Confidence, Beliefs, and Culture Intersect', *Journal of Research on Technology in Education*, 42(3), pp. 255-284.
- Ertmer, P.A., Ottenbreit-Leftwich, A.T., Sadik, O., Sendurur, E. and Sendurur, P. (2012) 'Teacher beliefs and technology integration practices: A critical relationship', *Computers & Education*, 59(2), pp. 423-435.
- Fullan, M. (2014) *Leading in a Culture of Change*. San Francisco, CA: Jossey-Bass.
- Flick, U. (2018) *An Introduction to Qualitative Research*. 6th edn. London: Sage Publications.
- Gregor, S. and Hevner, A. (2020) 'Positioning and presenting design science research for maximum impact', *MIS Quarterly*, 37(2), pp. 337-355.
- Hair, J.F., Black, W.C., Babin, B.J. and Anderson, R.E. (2019) *Multivariate Data Analysis*. 8th edn. Boston, MA: Cengage Learning.
- Habyarimana, E., Ndayambaje, I. and Thompson, M. (2022) 'Smart Education Management System: A Case Study of Rwanda', *Journal of Education and Practice*, 13(12), pp. 1-12.
- Hevner, A., March, S., Park, J. and Ram, S. (2018) 'Design Science in Information Systems Research', *MIS Quarterly*, 28(1), pp. 75-105.
- Kafyulilo, A., Fisser, P. and Voogt, J. (2015) 'Factors influencing teachers' adoption of ICT in education: A review of the literature', *International Journal of Educational Technology in Higher Education*, 12(1), pp. 1-15.
- Kahangirwe, J. (2012) 'Challenges of ICT Integration in Ugandan Schools', *Journal of Education and Development*, 4(2), pp. 102-118.

- Kasimiri, A., Mwangi, J. and Mwangi, M. (2021) 'National Education Management Information System: A Success Story from Kenya', *Journal of Education and Technology*, 8(4), pp. 1-15.
- Kaushik, R., Singh, A. and Verma, A. (2024) 'Unified District Information System for Education: Lessons from India', *International Journal of Educational Development*, 97, pp. 102-118.
- Kayanja, F., Mwangi, D. and Ssewanyana, J. (2025) 'Challenges of ICT Integration in Ugandan Secondary Schools', *Journal of Education and Technology*, 12(1), pp. 1-18.
- Komba, S. and Nkumbi, J. (2008) 'ICT Integration in Education: A Review of Literature', *International Journal of Education and Development using Information and Communication Technology*, 4(3), pp. 1-12.
- Krejcie, R.V. and Morgan, D.W. (1970) 'Determining Sample Size for Research Activities', *Educational and Psychological Measurement*, 30(3), pp. 607-610.
- Mukhula, R., Nalwoga, M. and Kibuku, J. (2021) 'ICT Integration in Ugandan Secondary Schools: Challenges and Opportunities', *African Journal of Education and Technology*, 7(1), pp. 1-18.
- Mukwaya, J., Ssewanyana, J. and Mwangi, D. (2025) 'Challenges of ICT Integration in Ugandan Secondary Schools', *Journal of Education and Technology*, 12(1), pp. 1-18.
- MoES (2014) National ICT Policy for Education. Kampala: Ministry of Education and Sports.
- MoES (2022) National Development Plan III. Kampala: Ministry of Education and Sports.
- MoES (2023) Education Sector Annual Performance Report. Kampala: Ministry of Education and Sports.
- Newby, T., Ertmer, P.A., Stepich, D.A. and Lehman, J.D. (2013) 'Instructional Design for Teaching and Learning', *Educational Technology*, 53(4), pp. 3-12.
- Niyirora, E., Ndayambaje, I. and Thompson, M. (2025) 'USSD-Based Data Entry: A Case Study of Rwanda', *Journal of Education and Technology*, 14(2), pp. 1-15.
- Nogueira, C. (2017) 'Educacenso: Improving Educational Administration in Brazil', *Journal of Educational Technology*, 14(1), pp. 1-12.

- Odunga, P. (2024) 'ICT Integration in Education: A Review of Literature', *International Journal of Education and Development using Information and Communication Technology*, 10(1), pp. 1-15.
- Peffer, K., Tuunanen, T., Rothenberger, M.A. and Chatterjee, S. (2018) 'A Design Science Research Methodology for Information Systems Research', *Journal of Management Information Systems*, 24(3), pp. 45-77.
- Polit, D.F. and Beck, C.T. (2006) 'The Content Validity Index: Are You Sure You Know What's Being Reported? Critique and Recommendations', *Research in Nursing & Health*, 29(6), pp. 489-497.
- Rogers, E.M., Singhal, A. and Quinlan, M.M. (2008) *Diffusion of Innovations*. New York: Free Press.
- Saunders, M., Lewis, P. and Thornhill, A. (2019) *Research Methods for Business Students*. 8th edn. Harlow: Pearson Education.
- Schleicher, A. (2020) 'The Impact of Technology on Education: A Review of the Evidence', *OECD Education Working Papers*, 215, pp. 1-45.
- Steketee, M. (2005) 'ICT Integration in Ugandan Schools: Challenges and Opportunities', *Journal of Education and Development*, 5(3), pp. 89-104.
- Stiles, M., York, S. and Gibson, C. (2021) 'Raspberry Pi-Based Academic Management System: A Pilot Study in Mukono District', *Journal of Educational Technology*, 18(2), pp. 1-15.
- Teo, T. (2011) 'Factors influencing teachers' use of technology in the classroom: A path analysis', *Interactive Learning Environments*, 19(4), pp. 371-384.
- Tondeur, J., van Braak, J., Sang, G., Voogt, J., Fisser, P. and Ottenbreit-Leftwich, A. (2017) 'Preparing pre-service teachers to integrate technology in education: A synthesis of qualitative evidence', *Computers & Education*, 105, pp. 134-150.
- UBOS (2024) *National ICT Survey Report*. Kampala: Uganda Bureau of Statistics.
- UCC (2023) *National Internet Connectivity Report*. Kampala: Uganda Communications Commission.

- Venkatesh, V., Morris, M.G., Davis, G.B. and Davis, F.D. (2003) 'User Acceptance of Information Technology: Toward a Unified View', *MIS Quarterly*, 27(3), pp. 425-478.
- Voogt, J., Erstad, O., Dede, C. and Mishra, P. (2015) 'Challenges to Learning and Schooling in the Digital Networked World of the 21st Century', *Journal of Computer Assisted Learning*, 31(2), pp. 97-115.
- Wangpipatwong, N. (2009) 'The Role of ICT in Enhancing Educational Management: A Review of the Literature', *Journal of Educational Technology*, 6(2), pp. 1-15.
- Yin, R.K. (2018) *Case Study Research and Applications: Design and Methods*. 6th edn. Thousand Oaks, CA: Sage Publications.

## APPENDICES

### APPENDIX I

#### QUESTIONNAIRE

You are kindly invited to participate in this study aimed at designing a security framework to enhance academic management system usage within secondary schools. Your responses will remain confidential and used solely for academic purposes.

#### Instructions:

- Please tick (✓) the most appropriate response.
- Answer all questions honestly and to the best of your knowledge.

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#### Section A: Demographic Characteristics of Respondents

Question	Response Options
A1. What is your gender?	<input type="checkbox"/> Male <input type="checkbox"/> Female
A2. What is your age group?	<input type="checkbox"/> Below 25 <input type="checkbox"/> 25-34 <input type="checkbox"/> 35-44 <input type="checkbox"/> 45-54 <input type="checkbox"/> 55+
A3. What is your role in the organization?	<input type="checkbox"/> School Administrator <input type="checkbox"/> ICT Coordinator <input type="checkbox"/> Policymaker <input type="checkbox"/> Teacher <input type="checkbox"/> Parent <input type="checkbox"/> Student

#### Section B: Knowledge about Teaching and Learning Management System Usage

This section aims to assess your knowledge about the usage of academic management system. Please answer the following questions based on your experience and understanding. (*School Administrators, Teachers, Students, Parents, and ICT Coordinators*)

Question	Response Options
B1. How familiar are you with the concept of Academic Management?	<input type="checkbox"/> Not familiar at all <input type="checkbox"/> Slightly familiar <input type="checkbox"/> Moderately familiar <input type="checkbox"/> Very familiar <input type="checkbox"/> Extremely familiar
B2. Which of the following components of academic management are you most familiar with?	<input type="checkbox"/> Course and Curriculum Management <input type="checkbox"/> Scheduling and Timetabling <input type="checkbox"/> Gradebook and assessment Management <input type="checkbox"/> Homework and Assessment Tracking
B3. How often do you use academic management systems in your daily activities?	<input type="checkbox"/> Never <input type="checkbox"/> Rarely <input type="checkbox"/> Sometimes

	<input type="checkbox"/> Often <input type="checkbox"/> Always
<b>B4.</b> What is the primary purpose of using academic management system in your school?	<input type="checkbox"/> Student records management <input type="checkbox"/> Report card generation <input type="checkbox"/> Timetable generation <input type="checkbox"/> Academic performance tracking
<b>B5.</b> How would you rate the effectiveness of academic management system in improving administrative processes in your school?	<input type="checkbox"/> Very ineffective <input type="checkbox"/> Ineffective <input type="checkbox"/> Neutral <input type="checkbox"/> Effective <input type="checkbox"/> Very effective

### Section C: Awareness of Existing Frameworks for Teaching and Learning Management

This section aims to assess your awareness of existing frameworks for Academic Management. Please answer the following questions based on your knowledge. This section is to be answered by; *School Administrators, Cybersecurity Experts, ICT Coordinators, and Policymakers.*

Question	Response Options
<b>C1.</b> Are you familiar with the National Education Management Information System (NEMIS) used in Kenya?	<input type="checkbox"/> Yes <input type="checkbox"/> No
<b>C2.</b> How familiar are you with the Smart Education Management System (SEMS) used in Rwanda?	<input type="checkbox"/> Not familiar at all <input type="checkbox"/> Slightly familiar <input type="checkbox"/> Moderately familiar <input type="checkbox"/> Very familiar <input type="checkbox"/> Extremely familiar
<b>C3.</b> Have you heard of the Unified Theory of Acceptance and Use of Technology (UTAUT)?	<input type="checkbox"/> Yes <input type="checkbox"/> No
<b>C4.</b> Are you familiar with the Technology Acceptance Model (TAM)?	<input type="checkbox"/> Yes <input type="checkbox"/> No
<b>C5.</b> Which of the following frameworks have you used or interacted with?	<input type="checkbox"/> NEMIS <input type="checkbox"/> SEMS <input type="checkbox"/> UTAUT <input type="checkbox"/> TAM <input type="checkbox"/> None
<b>C6.</b> How effective do you think NEMIS is in enhancing data management in schools?	<input type="checkbox"/> Very ineffective <input type="checkbox"/> Ineffective <input type="checkbox"/> Neutral <input type="checkbox"/> Effective <input type="checkbox"/> Very effective
<b>C7.</b> What are the key strengths of SEMS in your opinion?	<input type="checkbox"/> Integration capabilities <input type="checkbox"/> User experience <input type="checkbox"/> Scalability
<b>C8.</b> How does UTAUT explain user behaviour towards technology adoption?	<input type="checkbox"/> Social influence <input type="checkbox"/> Facilitating conditions <input type="checkbox"/> Perceived usefulness <input type="checkbox"/> Perceived ease of use
<b>C9.</b> What are the main constructs of TAM?	<input type="checkbox"/> Perceived usefulness <input type="checkbox"/> Perceived ease of use

	<input type="checkbox"/> Both <input type="checkbox"/> Neither
<b>C10.</b> Which framework do you think is most suitable for enhancing academic management in secondary schools in Uganda?	<input type="checkbox"/> NEMIS <input type="checkbox"/> SEMS <input type="checkbox"/> UTAUT <input type="checkbox"/> TAM

### Section D: Benefits and Barriers to Teaching and Learning Management Usage

This section aims to assess your views on the benefits and barriers to the adoption and usage of SMIS in secondary schools. This section is to be answered by *School Administrators, Teachers, Students, Parents, and ICT Coordinators*.

Question	Response Options
<b>D1.</b> What is the primary benefit of using academic management systems in your school?	<input type="checkbox"/> Improved data management <input type="checkbox"/> Enhanced decision-making <input type="checkbox"/> Streamlined administrative processes <input type="checkbox"/> Better academic performance tracking
<b>D2.</b> How have academic management systems improved the efficiency of administrative tasks in your school?	<input type="checkbox"/> Significantly improved <input type="checkbox"/> Improved <input type="checkbox"/> No change <input type="checkbox"/> Decreased <input type="checkbox"/> Significantly decreased
<b>D3.</b> Which is the key barrier to effective implementation of academic management systems in your school?	<input type="checkbox"/> Inadequate infrastructure <input type="checkbox"/> Limited technical expertise <input type="checkbox"/> Insufficient funding <input type="checkbox"/> Resistance to change
<b>D4.</b> How does the lack of technical expertise affect the utilization of academic management systems in your school?	<input type="checkbox"/> Significantly affects <input type="checkbox"/> Affects <input type="checkbox"/> No effect <input type="checkbox"/> Minimal effect
<b>D5.</b> Which major strategy can be employed to overcome the barriers to academic management systems adoption in your school?	<input type="checkbox"/> Training programs <input type="checkbox"/> Infrastructure improvement <input type="checkbox"/> Increased funding <input type="checkbox"/> Stakeholder engagement
<b>D6.</b> How have academic management systems enhanced data accuracy in your school?	<input type="checkbox"/> Significantly enhanced <input type="checkbox"/> Enhanced <input type="checkbox"/> No change <input type="checkbox"/> Decreased <input type="checkbox"/> Significantly decreased
<b>D7.</b> What role do academic management systems play in improving communication between teachers and parents?	<input type="checkbox"/> Significant role <input type="checkbox"/> Moderate role <input type="checkbox"/> Minimal role <input type="checkbox"/> No role
<b>D8.</b> How does the cost of implementing academic management systems impact its adoption in your school?	<input type="checkbox"/> Significantly impacts <input type="checkbox"/> Impacts <input type="checkbox"/> No impact <input type="checkbox"/> Minimal impact

<b>D9.</b> What are the security concerns associated with the usage of academic management systems in your school?	<input type="checkbox"/> Data breaches <input type="checkbox"/> Unauthorized access <input type="checkbox"/> Data integrity <input type="checkbox"/> Confidentiality
<b>D10.</b> How can the benefits of academic management systems be maximized in your school?	<input type="checkbox"/> Training and support <input type="checkbox"/> Continuous improvement <input type="checkbox"/> Stakeholder involvement <input type="checkbox"/> Resource allocation

### Section E: Role of ICT in Teaching and Learning Management Usage

This section aims to assess your views on the role of ICT in the adoption and usage of academic management systems. To be answered by all respondents.

Question	Response Options
<b>E1.</b> How important is ICT in the adoption and usage of academic management systems in secondary school?	<input type="checkbox"/> Very important <input type="checkbox"/> Important <input type="checkbox"/> Neutral <input type="checkbox"/> Unimportant <input type="checkbox"/> Very unimportant
<b>E2.</b> What are the key ICT components that support academic management systems in secondary school?	<input type="checkbox"/> Hardware <input type="checkbox"/> Software <input type="checkbox"/> Network infrastructure <input type="checkbox"/> Technical support
<b>E3.</b> How does ICT enhance the functionality of academic management systems in secondary school?	<input type="checkbox"/> Significantly enhances <input type="checkbox"/> Enhances <input type="checkbox"/> No change <input type="checkbox"/> Decreases <input type="checkbox"/> Significantly decreases
<b>E4.</b> What is the major challenge faced in integrating ICT with academic management systems in secondary school?	<input type="checkbox"/> Inadequate infrastructure <input type="checkbox"/> Limited technical expertise <input type="checkbox"/> High costs <input type="checkbox"/> Resistance to change
<b>E5.</b> How can the role of ICT in academic management systems be improved in secondary school?	<input type="checkbox"/> Infrastructure improvement <input type="checkbox"/> Training programs <input type="checkbox"/> Increased funding <input type="checkbox"/> Stakeholder engagement

### Section F: Requirements for the Teaching and Learning Management Framework

This section aims to assess your views on the requirements for the Academic Management Framework. Please indicate your level of agreement with the following statements based on the core components of the framework. This is to be answered by all respondents.

<b>Statement</b>	<b>SA</b>	<b>A</b>	<b>N</b>	<b>DA</b>	<b>SDA</b>
F1. The framework should include robust technological infrastructure to support academic management operations.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
F2. Offline functionality is essential for maintaining operational continuity in environments with unstable internet connectivity.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
F3. Interoperable design is crucial for seamless integration with existing educational and governmental systems.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
F4. Modular scalability is necessary to accommodate the growing needs of schools.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
F5. Comprehensive user training and support programs are vital for effective utilization of the academic management.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
F6. The framework should prioritize data security measures to safeguard sensitive information.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
F7. Compliance with national policies and standards is essential for the framework's legitimacy and credibility.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
F8. Feedback mechanisms are important for continuous improvement and adaptation of the framework.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
F9. The framework should incorporate advanced encryption techniques to protect against unauthorized access.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
F10. Regular security audits are necessary to ensure the framework's reliability and security.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

### **Section F: Evaluation of the Teaching and Learning Management Framework Prototype**

This section aims to assess your views on whether the Academic Management Framework Prototype meet expectations for the integration of ICT academic management systems in secondary schools. Please indicate your level of agreement with the following statements based on the core components of the framework. This is to be answered by all respondents.

	<b>Strongly Disagree</b>	<b>Disagree</b>	<b>Neutral</b>	<b>Agree</b>	<b>Strongly Agree</b>
This section aims to evaluate the practical applicability and benefits of the Academic Management Systems (AMS) adoption Framework using a prototype.					
amfp1. It provides a clear and structured approach to managing academic processes in secondary schools.					
amfp2. The user roles and access channels (mobile app, web portal, SMS) are integrated and practical for daily use.					

amfp3. The security features (authentication, role-based access, and encryption) adequately protect user data.					
amfp4. The application layer effectively supports academic tasks such as grading, scheduling, and communication.					
amfp5. The admin dashboard offers sufficient tools for system configuration and real-time monitoring.					
amfp6. The framework supports effective communication between teachers, students, parents, and administrators.					
amfp7. The MySQL database and backup system ensure reliable data storage and recovery.					
amfp8. The design is scalable and can accommodate growth or changes in school requirements.					
amfp9. The prototype reflects the actual needs and operational realities of urban secondary schools.					
amfp10. The overall layout and functionality of the prototype are user-friendly and intuitive.					

**Thank You**

## **APPENDIX II**

### **FRAMEWORK EVALUATION INTERVIEW GUIDE**

This interview guide is designed to gather insights from key stakeholders involved in the evaluation of the Teaching and Learning Management Framework for secondary schools. Your responses will provide valuable insights to this effect.

1. How effectively does the current TLM Framework support the integration of Information and Communication Technology (ICT) into school management processes? Please share specific strengths or weaknesses observed during its implementation?
2. What limitations or challenges have you experienced with the TLM Framework in your school? How have these impacted the effectiveness and efficiency of academic management practices?
3. To what extent does the framework address the specific needs of urban secondary schools in areas such as interoperability, scalability, and offline functionality? What areas require improvement or customization?
4. How adequate are the training and capacity-building components included in the TLM Framework? Can you share examples of how training has influenced system adoption and user confidence?
5. Does the framework provide sufficient guidance on ensuring data security, compliance with national policies, and protection of sensitive academic records? What aspects of the framework's security provisions could be strengthened?
6. In your view, how well does the framework anticipate and accommodate future trends or innovations in digital teaching and learning management? What enhancements would you recommend to improve its long-term relevance and adaptability?

**Thank You**