A FRAMEWORK FOR EFFECTIVE ICT UTILIZATION IN TEACHING IN UGANDA'S SECONDARY SCHOOLS

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DIRECTORATE OF GRADUATE STUDIES, RESEARCH AND ENTERPRISE

Master's Dissertation

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DEDICATION

This thesis is dedicated, first and foremost, to the respondents who generously shared their time, experiences, and insights. Their willingness to participate and their invaluable contributions were the cornerstone of this research. Without their openness and cooperation, this study would not have been possible. Their dedication to improving education and their passion for teaching have been a constant source of inspiration and motivation throughout this journey.

To my family, this work is a testament to your unwavering support and belief in my abilities. Your encouragement and sacrifices have been the bedrock upon which I have built my academic pursuits. Your love and understanding have provided me with the strength and resilience to overcome challenges and pursue my dreams. This achievement is as much yours as it is mine, and I am deeply grateful for your constant presence in my life.

I also dedicate this thesis to the educators and mentors who have guided and inspired me throughout my academic journey. Your wisdom, patience, and dedication to teaching have shaped my intellectual growth and fuelled my passion for learning. Your belief in my potential has been a driving force behind my pursuit of knowledge and excellence.

Lastly, this work is dedicated to all those who strive for excellence in education and seek to make a positive impact in the lives of others. May this research contribute to the advancement of knowledge and the improvement of teaching practices. May it inspire others to pursue their dreams and make a difference in the world. Thank you all for being a part of this journey and for your unwavering support and dedication.

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I am profoundly grateful to my family for their unwavering support and encouragement throughout this academic journey. Their belief in my abilities and their constant motivation provided me with the strength and resilience to overcome challenges and persist in my efforts. Their sacrifices and understanding created an environment where I could focus on my research and achieve my goals.

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LIST OF ABBREVIATIONS

TP	Teacher Performance
ICT	Information and Communication Technology
UNESCO	United Nations Educational Scientific and Cultural Organization
MoFPED	Ministry of Finance Planning and Economic Development
UNICEF	United Nations International Children's Emergency Fund.
TELA	Teacher Effectiveness and Learner Achievement
NPA	National Planning Authority
MOES	Ministry of Education and Sports
TOE	Technology Organization Environment
DOI	Diffusion of Innovations
SDGs	Sustainable Development Goals
TAM	Technology Acceptance Model
SEM	Structural Equation Model
MDGs	Millennium Development Goals
USE	Universal Secondary Education
LMS	Learning Management Systems
API	Application Programming Interface
TAF	Teacher Accountability Framework
KEC	Kenya Education Cloud
UN	United Nations
SPSS	Statistical Package for the Social Sciences
AI	Artificial Intelligence
NDP	National Development Plan
NCDC	National Curriculum Development Centre
CA	Curriculum Alignment
TTR	Teacher Training and Resources
PI	Policy Implementation
QA	Quality Assurance
NEA	National Education Association
ISTE	International Society for Technology in Education
AEE	Alliance for Excellent Education
NEPC	National Education Policy Centre

DEFINITION OF KEY TERMS

a) ICT Utilization in Teaching

ICT utilization in teaching refers to the effective integration and application of information and communication technologies—such as computers, digital content, internet tools, and multimedia platforms—into classroom instruction to support teaching. It encompasses lesson preparation, delivery, assessment, and feedback processes (UNESCO, 2021).

b) Teaching Effectiveness

Teaching effectiveness is the extent to which instructional methods, teacher behaviors, and learning environments lead to improved student understanding, engagement, and academic achievement. It includes the teacher's ability to plan lessons, manage classrooms, deliver content, and assess learning meaningfully (Darling-Hammond, 2017).

c) System Interoperability

System interoperability refers to the ability of different educational technologies and digital platforms—such as Learning Management Systems (LMS), biometric tools, and reporting dashboards—to communicate, exchange data, and operate cohesively within a unified ICT environment (Venkatesh et al., 2012).

d) User Accessibility

User accessibility in an educational ICT context involves ensuring that all users—particularly teachers and learners with varying levels of digital literacy or physical ability—can effectively access, navigate, and benefit from digital tools. This includes usability, interface design, and inclusive features such as language localization and offline access (Mutebi et al., 2023).

e) ICT Usability Framework

An ICT usability framework in education refers to a structured model that guides the implementation, evaluation, and enhancement of digital tools for teaching. It includes components such as infrastructure readiness, data security, interoperability, and user support, tailored to fit the educational and contextual needs of schools (Adipala & Ekimwere, 2023).

ABSTRACT

This thesis presents the design, validation, and evaluation of a framework aimed at enhancing the utilization of Information and Communication Technology (ICT) in teaching within secondary schools in Uganda. The study addresses critical challenges such as limited digital literacy, inadequate infrastructure, and fragmented systems that hinder effective ICT integration in educational settings. Through a comprehensive mixed-methods approach, the research identifies key components essential for ICT usability: system interoperability, user accessibility, infrastructure readiness, and data security.

Empirical findings, validated through Structural Equation Modelling (SEM), reveal significant relationships between these components and teaching effectiveness. System interoperability emerged as the most influential factor with a path coefficient of 0.38, followed by user accessibility (0.35), infrastructure readiness (0.30), and data security (0.29). These coefficients underscore the critical role of well-integrated and secure ICT systems in enhancing teaching practices. Additionally, prototype testing demonstrated high levels of user satisfaction, with 100% of experts agreeing on the ease of use and 93.3% strongly endorsing the platform's resource management capabilities.

The study also highlights the practical implications of the framework, showing that 86.7% of experts validated its seamless integration with existing school systems. Furthermore, 80% of respondents strongly agreed that the reporting tools provided meaningful insights into teaching performance, affirming the framework's potential to transform educational delivery and management. These results collectively validate the framework's effectiveness and its potential for wide-scale adoption in Uganda's secondary school system.

In conclusion, this research offers a robust, empirically validated framework for ICT utilization in teaching, addressing both technical and functional challenges. The findings provide valuable insights for policymakers, educators, and stakeholders, emphasizing the importance of a holistic approach to ICT integration in education. The framework's success in improving teaching effectiveness and its alignment with national education goals position it as a vital tool for advancing digital transformation in Uganda's educational sector.

CHAPTER ONE
GENERAL INTRODUCTION

This chapter presents a comprehensive overview of the study that aims to design a framework for effective ICT utilization in teaching within secondary schools in Uganda, a case study of selected secondary schools in Bulo Sub-County, Butambala District. This chapter assesses; the background of the study, problem statement, objectives of the study, research questions, significance, justification, and scope of the study.

1.1 Background of the Study

The role of education as a transformative force in society has long been emphasized, with historical efforts across the globe highlighting the importance of enhancing teaching methodologies and expanding access to learning. In the early 20th century, education systems globally relied heavily on traditional, teacher-centred approaches, with limited use of technology in the classroom. Over time, as economies evolved and technological advancements accelerated, countries began to recognize the potential of Information and Communication Technologies (ICT) in revolutionizing the education sector (Gwamba, 2016). During the late 1990s and early 2000s, international frameworks such as the Millennium Development Goals (MDGs) and the Education for All (EFA) initiative called for increased integration of ICT in education to improve access, quality, and equity in learning opportunities (Unterhalter, 2013). These global commitments have driven significant policy reforms in many countries, aiming to leverage technology to enhance teaching and learning outcomes.

The theoretical foundations underpinning ICT integration in education are grounded in well-established learning and technology adoption theories. Bandura's Social Learning Theory posits that individuals learn through observation, imitation, and modelling, underscoring the importance of social interaction and collaborative learning environments (Bandura, 1986). In the context of ICT in education, this theory highlights the role of technology in facilitating peer learning and knowledge sharing among teachers and students. The Technology-Organization-Environment framework further explains how technological innovations are adopted within organizations, emphasizing three critical factors: technological readiness, organizational capacity, and environmental conditions (Tornatzky & Fleischer, 1990).

The TOE is particularly relevant in examining how schools adopt ICT systems, considering factors like infrastructure availability, institutional support, and external pressures like

government policies. Complementing the TOE framework is the Unified Theory of Acceptance and Use of Technology 2 (UTAUT2), which focuses on individual user acceptance of technology. UTAUT2 extends the original model by incorporating additional factors such as hedonic motivation, price value, and habit, making it particularly applicable to educational settings where teachers' attitudes, perceived ease of use, and cost considerations influence technology adoption (Venkatesh et al., 2012).

In the education sector, Learning Management Systems (LMS) frameworks, such as Moodle, provide structured digital platforms for instructional delivery, assessment, and professional development. These frameworks are designed to promote interactive, self-paced learning and enhance access to educational resources, particularly in remote areas (Koehler & Mishra, 2019). LMS platforms have been widely adopted in many countries to improve the efficiency of educational delivery, though their effectiveness often depends on user readiness and system design. Specific to the African context, frameworks such as Uganda's Teacher Effectiveness and Learner Achievement (TELA) program and Rwanda's Smart Classroom Initiative offer practical insights into ICT integration in education.

The TELA program, introduced by the Ugandan government, sought to enhance teacher accountability and improve student outcomes through digital tools that monitor teacher attendance and performance (Pace & Mellard, 2016). Despite its promise, it faced challenges such as system fragmentation, limited interoperability with other platforms, and low digital literacy among teachers, which constrained its effectiveness (Musoke et al., 2022). In contrast, the Smart Classroom Initiative from Rwanda successfully leveraged cloud-based technologies to transform classroom instruction, reporting significant improvements in learner engagement, teacher preparedness, and digital literacy among students (UNICEF, 2022). These regional experiences underscore the need for tailored, context-specific frameworks that address infrastructural constraints, and digital skills gaps.

Uganda's education system, particularly at the secondary school level, has historically faced challenges related to limited ICT infrastructure, teacher capacity gaps, and insufficient instructional resources. Although the government has prioritized digital inclusion through programs like TELA and various e-learning initiatives, implementation has been uneven, especially in rural areas where schools face persistent connectivity issues and lack of hardware (NPA, 2021). Secondary schools in Uganda often struggle with low levels of ICT utilization in teaching, primarily due to barriers such as inadequate training, unreliable internet access, and

fragmented digital tools that do not support seamless teaching and learning processes (Adipala & Ekimwere, 2023). As a result, teacher performance and instructional quality remain suboptimal in many schools, hindering efforts to improve learning outcomes and reduce disparities between urban and rural education systems.

Despite these challenges, there is growing recognition among Ugandan policymakers and educators of the need for a unified framework that effectively integrates ICT into teaching processes. The National Development Plan III and the ICT in Education Policy explicitly identify digital transformation as a key strategy for improving education quality and inclusiveness (NPA, 2021). Various studies have also shown that the integration of cloud-based systems can enhance instructional effectiveness by providing teachers with real-time access to teaching resources, facilitating collaboration, and supporting data-driven decision-making (Etengu & Namwano, 2020). These systems offer significant advantages such as scalability, cost-effectiveness, and the ability to function in low-connectivity environments, making them suitable for Uganda's diverse educational landscape.

Furthermore, case studies from other countries demonstrate that effective ICT utilization frameworks must go beyond the mere provision of digital tools. Successful frameworks incorporate critical elements such as system interoperability, user accessibility, data security, and robust stakeholder engagement mechanisms to ensure sustainability and wide-scale adoption (UNESCO, 2021). For instance, Kenya's Education Cloud integrates LMS functionalities with professional development resources and performance monitoring tools, leading to improved teaching effectiveness and student engagement (Mutebi et al., 2023). These insights highlight the importance of designing a comprehensive, context-sensitive framework that addresses the practical realities of Ugandan secondary schools while drawing from global best practices in ICT integration.

1.2 Statement of the Problem

Despite notable progress in global and regional efforts to integrate digital tools in education, Uganda's secondary schools continue to grapple with persistent challenges in effectively utilizing ICT for teaching and learning. In many schools, especially those in rural and peri-urban areas, the availability of ICT infrastructure remains limited, teachers lack adequate digital training, and internet connectivity is unreliable. These systemic gaps have meant that digital transformation goals outlined in national education policies have not translated into

effective classroom practices (MoES, 2022), leaving teaching effectiveness and learner engagement at suboptimal levels (NPA, 2021).

The consequences of these challenges are far-reaching. Inconsistent use of ICT tools constrains opportunities for collaborative learning, limits access to updated educational content, and reduces the overall quality of instructional delivery. This has widened the digital divide between urban and rural schools and restricted student-centred teaching approaches that promote active participation and knowledge sharing. Comparative evidence from Rwanda's Smart Classroom Initiative shows that when ICT is effectively integrated, it significantly enhances both teaching effectiveness and learner performance (UNESCO, 2021), yet Ugandan schools remain constrained by infrastructural, technical, and financial barriers that continue to undermine ICT's potential (Mutebi et al., 2023).

Existing frameworks such as Learning Management Systems and Smart Classroom models have proven less applicable in Uganda due to their dependence on stable power supply, reliable broadband, and adequate teacher digital literacy. Rwanda's Smart Classrooms thrived because of heavy investment in infrastructure, teacher preparedness, and strong institutional support, conditions that are still lacking in Uganda (UNESCO, 2021). Similarly, mainstream LMS platforms such as Moodle are often resource-intensive, requiring continuous connectivity, technical support, and user readiness, which remain limited in Ugandan secondary schools (Koehler & Mishra, 2019). Uganda's TELA program has also struggled, as it relies on digital monitoring tools that demand high connectivity and user competence. The system has faced setbacks due to poor integration with other platforms, limited interoperability, and low levels of digital literacy among teachers, reducing it to a compliance-driven tool rather than one that strengthens teaching effectiveness (Musoke et al., 2022).

To address these limitations, this study proposes the design of a context-specific ICT utilization framework tailored for Ugandan secondary schools. Unlike generic models, the framework prioritizes system interoperability, offline capabilities, low-bandwidth adaptability, and embedded professional development to equip teachers with digital pedagogical skills. By incorporating features such as accessible cloud-based resources, data security, and scalability, the framework is positioned to overcome infrastructural constraints while promoting more effective teaching practices (Etengu & Namwano, 2020). Learning from regional experiences like Kenya's Education Cloud and Rwanda's Smart Classrooms, this framework seeks to

provide a sustainable, inclusive, and adaptable solution that bridges digital gaps and enhances teaching effectiveness in Uganda's secondary schools (UNESCO, 2021).

1.3 Objectives of the Study

1.3.1 Major Objective

To design a framework that aims to facilitate the effective ICT utilization within secondary schools in Uganda, using selected secondary schools in Butambala District as a case study.

1.3.2 Specific Objectives

1. To review the existing frameworks in order to customize key requirements for designing an ICT utilization framework for secondary schools in Uganda.
2. To design a framework that leverages ICT tools to address existing challenges and promote effective utilization of ICT within secondary schools in Uganda.
3. To validate the framework that leverages ICT tools in order to promote effective ICT utilization within secondary schools in Uganda.

1.4 Research Questions

1. What are the requirements for designing a framework that promotes effective utilization of ICTs within secondary schools in Uganda?
2. How can an ICT utilization framework that addresses existing ICT utilization challenges within secondary schools in Uganda be designed?
3. How effective is the framework in promoting effective ICT utilization within secondary schools in Uganda?

1.5 Scope of the Study

1.5.1 Geographical Scope

This study is to be conducted in Bulo Sub-County, Butambala District, focusing on Butawuka Magezi Ntake SS and Kitagobwa Secondary School. These schools have been purposefully selected due to their representation of rural secondary education challenges, particularly regarding limited access to ICT infrastructure and digital training for teachers (Butambala Local Government, 2022). They provide the study with resourceful insights.

1.5.2 Time Scope

The study covers the period from 2024 to 2025 to capture a comprehensive understanding of recent trends, challenges, and reforms affecting teaching effectiveness in Uganda's secondary schools. This timeline includes key national initiatives such as the TELA program and the increasing integration of ICT-driven solutions, making it relevant for assessing both past and current interventions (UNESCO, 2021).

1.5.3 Content Scope

This study focuses on the design, implementation, and evaluation of a Framework for ICT Utilization as the independent variable, which includes key components such as system interoperability, user accessibility, infrastructure readiness, and data security. These components are examined for their potential to improve teaching effectiveness, the dependent variable, which involves instructional quality, classroom management, and learner engagement. The study assesses how integrating these ICT components can enhance teaching effectiveness within Uganda's secondary schools (Etengu & Namwano, 2020).

1.6 Significance of the Study

The significance of this study lies in its potential to benefit multiple stakeholders across Uganda's secondary education system. School administrators and teachers will gain from improved access to interoperable ICT tools that enhance instructional delivery, classroom management, and professional development (Etengu & Namwano, 2020). Students will benefit through increased engagement, access to diverse digital learning resources, and improved learning outcomes, while parents will indirectly benefit from better educational performance and accountability in schools (UNESCO, 2021). Policymakers, particularly the Ministry of Education and Sports, will receive evidence-based recommendations to guide ICT policy formulation and resource allocation, thereby supporting Uganda's broader digital transformation agenda (NPA, 2021). Academically, the study contributes by filling gaps in literature on ICT utilization frameworks in low-resource contexts, offering a scalable, context-specific model that can inform future research and practice in educational technology integration (Koehler & Mishra, 2019).

1.7 Justification of the Study

This study is timely and essential as it responds to Uganda's increasing need for effective ICT integration in secondary education to improve teaching effectiveness. With the growing

emphasis on digital learning, there is an urgent demand for a unified, practical framework that supports system interoperability, user accessibility, infrastructure readiness, and data security (NPA, 2021). By offering solutions that enhance instructional quality and learner engagement, the framework will support national education goals and help schools and policymakers bridge digital gaps, building on lessons from regional initiatives like Rwanda's Smart Classrooms and Kenya's Education Cloud (UNICEF, 2022).

Despite previous efforts such as the Teacher Effectiveness and Learner Achievement (TELA) program, challenges like limited ICT infrastructure, fragmented systems, and low digital literacy among teachers persist (Musoke et al., 2022). These barriers continue to undermine teaching effectiveness, particularly in rural and underserved schools. This study is therefore urgent, as it offers a context-specific, scalable solution to address these persistent gaps, promoting inclusive and sustainable ICT adoption to improve teaching outcomes in Uganda's secondary schools (Etengu & Namwano, 2020).

CHAPTER TWO
LITERATURE REVIEW

This chapter presents a comprehensive review of the literature on ICT utilization in teaching, focusing on key components such as interoperability, user accessibility, data security, and stakeholder engagement. Additionally, the chapter discusses the current state of teacher performance in Uganda's secondary schools, the benefits and impact of improved teaching, and the challenges associated with declining performance.

2.1 Utilization of ICT in Teaching within Secondary Schools

The effective utilization of ICT in teaching has become a central strategy in transforming education systems worldwide. In Uganda, however, the adoption of digital tools in secondary schools remains uneven, especially in rural districts like Butambala. This section explores the current state, benefits, challenges, and components of ICT utilization frameworks that can enhance teaching effectiveness.

2.1.1 Current State of ICT Utilization in Teaching within Butambala

The integration of ICT in teaching within Butambala District remains limited, with significant disparities between schools in rural areas and those in better-resourced urban centers. In secondary schools such as Butawuka Magezi Ntake SS and Kitagobwa Secondary School, ICT usage in teaching is minimal due to infrastructural constraints, including lack of computer labs, unstable electricity, and weak internet connectivity. At least 45% of secondary school teachers in Butambala report having regular access to digital teaching tools (MoES, 2022). The situation is further worsened by the absence of ICT integration policies at school level, and a lack of clear operational frameworks to guide the use of technology in the classroom (NPA, 2021).

Many teachers in the district still rely on traditional teaching methods such as chalk-and-board, and printed notes, with ICT tools mainly used for administrative functions like typing exams or keeping student records (Musoke et al., 2022). For example, at Kitagobwa SS, only one outdated desktop computer is available in the staffroom, shared by over 15 teachers, primarily for administrative duties. This limits the opportunity for meaningful digital engagement in lesson planning or instruction. The lack of tailored digital content aligned with Uganda's curriculum further demotivates teachers from adopting ICT, especially in subjects like History, Agriculture, or Luganda, where locally relevant digital resources are scarce (Adipala & Ekimwere, 2023).

Efforts such as the Teacher Effectiveness and Learner Achievement (TELA) program, introduced to monitor teacher attendance and performance digitally, have seen limited success in Butambala. A recent evaluation showed that less than 30% of teachers actively engage with the TELA mobile application due to lack of training and low smartphone ownership (MoES, 2022). Moreover, the system's poor interoperability with existing school workflows and limited internet access rendered it ineffective in providing real-time data for performance tracking in most rural schools (Etengu & Namwano, 2020). These limitations have contributed to skepticism among educators about the reliability and usefulness of ICT tools in teaching.

The digital divide in Butambala has also affected learners. Students rarely interact with digital tools, and most secondary schools lack basic ICT infrastructure such as projectors, e-learning platforms, or smartboards. According to (UNICEF, 2022), students in regions with low digital exposure are 35% less likely to achieve digital literacy by the time they complete lower secondary education. In contrast, Rwanda's Smart Classroom Initiative has equipped rural schools with mobile digital kits and teacher training programs, leading to a 28% improvement in learner engagement (Mutebi et al., 2023). This contrast highlights the missed opportunities in Butambala due to limited investment in school-level ICT readiness.

Ultimately, ICT utilization in teaching across secondary schools in Butambala is still in its infancy, constrained by infrastructural gaps, insufficient training, limited digital content, and poor system integration. While there is growing recognition of the value of ICT in transforming teaching and learning, the current state underscores the urgent need for a localized, scalable, and teacher-friendly framework that addresses these bottlenecks. The ICT Utilization framework in this study seeks to close these gaps by enhancing system interoperability, user accessibility, and infrastructure readiness—critical components for effective ICT integration in Uganda's rural secondary schools (Venkatesh et al., 2012).

2.1.2 Benefits of Utilizing ICT in Teaching within Secondary Schools

Integrating ICT into teaching significantly enhances instructional quality, learner engagement, and overall educational outcomes. Teachers who utilize ICT tools such as Learning Management Systems (LMS), digital content platforms, and interactive media are better able to plan lessons, track student progress, and offer differentiated instruction (UNESCO, 2021). For instance, in Kenyan schools using the Kenya Education Cloud, digital tools led to a 25% improvement in students' academic performance and a 30% increase in teacher effectiveness (UNICEF, 2022). In Uganda, pilot projects in districts like Wakiso have shown that schools

equipped with multimedia projectors and tablets reported higher levels of student participation and a notable reduction in lesson preparation time by up to 40% (MoES, 2022). These benefits highlight the transformative power of ICT when applied strategically and supported through policy and infrastructure.

Moreover, ICT utilization boosts teacher motivation and professional growth. Teachers who engage with digital platforms for continuous professional development (CPD), such as MOOCs or e-learning portals, are more likely to implement innovative pedagogical practices (Baluku & Kasujja, 2020). Enhanced access to online training, peer collaboration tools, and real-time feedback mechanisms fosters a culture of continuous learning and reflective teaching. In Rwanda, the Smart Classroom Initiative facilitated teacher mentorship programs through digital portals, resulting in increased collaboration and a 28% rise in classroom innovation (Mutebi et al., 2023). Similarly, Uganda's National Development Plan III emphasizes ICT as a driver for teacher retention and performance improvement, recognizing that well-supported teachers deliver better outcomes (NPA, 2021). These examples underscore the need for a structured framework to scale such benefits across Uganda's secondary schools.

2.1.3 Challenges of Utilizing ICT in Teaching within Secondary Schools

Despite the growing recognition of the importance of ICT in education, secondary schools in Uganda continue to face numerous challenges that hinder effective utilization of technology in teaching. One major barrier is limited ICT infrastructure, particularly in rural schools where reliable internet, electricity, and hardware such as computers and projectors are often unavailable. A 2022 report by the Ministry of Education and Sports indicated that only 30% of rural secondary schools in Uganda have functional computer labs, and less than 20% have stable internet connectivity (MoES, 2022). In Butambala District, schools like Kitagobwa Secondary School lack even the most basic ICT facilities, making it nearly impossible for teachers to integrate technology into their lessons. In contrast, schools in urban areas such as Kampala and Mukono enjoy relatively better infrastructure, contributing to widening disparities in teaching effectiveness and student engagement (Adipala & Ekimwere, 2023).

Another critical challenge is the low digital literacy among teachers, which limits their ability and confidence to use ICT tools effectively in classroom instruction. Many teachers have not received formal training in digital pedagogy or the use of learning management systems, resulting in underutilization of available resources even where infrastructure exists (Musoke et al., 2022). Additionally, existing ICT programs like the TELA have been criticized for being

overly focused on monitoring attendance rather than supporting instructional improvement (Etengu & Namwano, 2020). The TELA program, for instance, has faced poor adoption in schools like Butawuka Magezi Ntake SS due to a lack of training and ongoing support. Furthermore, fragmented and non-interoperable systems have created inefficiencies, with data often being stored in silos, making it difficult to make informed instructional decisions (Eton & Chance, 2022). Policymaker inaction and the absence of a centralized ICT framework also contribute to disjointed implementation, further complicating system integration and scalability across schools (NPA, 2021).

2.2 ICT Utilization Framework Components

This section provides a detailed explanation of the key components within the ICT Utilization Framework. Each component plays a critical role in ensuring the effective integration and usability of ICT in teaching across secondary schools in Uganda. These elements; system interoperability, user accessibility, infrastructure readiness, and data security, work collectively to enable sustainable, scalable, and teacher-centered ICT use in the classroom.

2.2.1 System Interoperability

System interoperability is a core component of the ICT Utilization Framework, ensuring that various digital platforms—such as Learning Management Systems (LMS), performance tracking tools, administrative software, and content repositories—can work together seamlessly. Within the framework, interoperability is achieved by designing systems that use standardized data formats and open APIs, allowing different tools to communicate without redundancy or data silos. This enables a coherent digital teaching environment where information flows easily between instructional planning, student assessments, and school-level decision-making. For example, while Uganda's TELA system was limited in its functionality due to poor integration with other educational platforms (Musoke et al., 2022), the ICT usability framework enhances real-time access and synchronization across tools, supporting holistic performance evaluation and curriculum alignment. This mirrors the success of Kenya's Education Cloud, which integrates multiple functions—including LMS, teacher evaluation, and content access—into a single interoperable system (Mutebi et al., 2023). By promoting system-wide compatibility, the framework supports efficient digital workflows and reduces the fragmentation that has undermined past ICT interventions.

2.2.2 User Accessibility

User accessibility is addressed in the framework through the deployment of inclusive, adaptable digital platforms that cater to users of varying technical abilities, geographic locations, and device access. Key strategies include mobile-first designs, offline functionality, and intuitive user interfaces that reduce the digital learning curve for teachers and students. The framework also incorporates ongoing digital training through Continuous Professional Development (CPD) modules, equipping educators with the skills needed to confidently use ICT tools in their teaching. Drawing from the UTAUT2 model, the framework emphasizes factors like effort expectancy, performance expectancy, and user habit as predictors of technology acceptance (Venkatesh et al., 2012). In practice, this means designing systems that are easy to use, demonstrate clear teaching benefits, and encourage repeated use until adoption becomes routine. In rural districts such as Butambala, where connectivity is weak and digital literacy levels are low, accessibility is further enhanced through locally stored content, solar-powered devices, and simplified login procedures. These measures ensure that ICT integration is not limited to urban or digitally fluent environments but is equitably extended to underserved communities (MoES, 2022).

2.2.3 Infrastructure Readiness

Infrastructure readiness is a foundational pillar of the ICT Usability Framework and involves ensuring the availability and reliability of the physical and digital infrastructure needed for successful ICT deployment. This includes stable electricity supply (often via solar installations in rural areas), broadband or mobile internet connectivity, and access to computing devices such as laptops, tablets, and projectors. The framework promotes strategic partnerships with government bodies, NGOs, and private sector actors to fund and sustain this infrastructure, particularly in disadvantaged regions where schools like Kitagobwa SS and Butawuka Magezi Ntake SS struggle with inadequate resources (Adipala & Ekimwere, 2023). Drawing lessons from Rwanda's Smart Classroom Initiative—which addressed infrastructural deficits by providing mobile digital kits and classroom tech training—the framework emphasizes localized and scalable solutions tailored to Uganda's rural education context (UNICEF, 2022). Additionally, cloud-based platforms in the framework are designed to function in low-bandwidth environments, ensuring that even with limited connectivity, teachers and learners can access vital content and services. Infrastructure readiness thus ensures that the digital tools envisioned in the framework are usable, reliable, and impactful on a daily basis.

2.2.4 Data Security and Effectiveness

Data security and effectiveness are critical to the framework's integrity, ensuring that information collected and used within ICT platforms is both protected and operationalized for educational improvement. The framework integrates multi-layered security features such as encryption, password-protected access, and role-based permissions to safeguard sensitive teacher and student data from breaches or unauthorized use. This is a direct response to shortcomings in earlier initiatives like the TELA system, which lacked robust security protocols and limited its effectiveness beyond monitoring attendance (Etengu & Namwano, 2020). Beyond protecting data, the framework enhances effectiveness by incorporating real-time analytics and reporting tools that allow educators and administrators to monitor teaching practices, learner progress, and system usage. These insights inform targeted interventions and professional development, making data not just secure but actionable. Aligned with international data governance standards and guided by (UNESCO, 2021) recommendations, the framework supports ethical data handling while maximizing the instructional value of information collected across the school system. In doing so, it strengthens both trust in ICT tools and their contribution to evidence-based teaching.

2.3 Existing Frameworks for Teacher Performance

The implementation of teacher performance frameworks has become a critical focus for educational systems seeking to enhance instructional quality and learner outcomes. These frameworks serve as structured systems for evaluating, supporting, and improving teacher practices through data-driven approaches.

2.3.1 EF1: Teacher Effectiveness and Learner Achievement (TELA)

TELA was introduced in Uganda as a performance monitoring system designed to enhance teacher accountability and attendance through real-time data collection (MoES, 2022). TELA utilizes digital tools, including biometric and GPS-enabled devices, to track teacher attendance and report data to education administrators (UNICEF, 2022).

Strengths:

a) Real-time attendance tracking. It provides real-time attendance data, enabling prompt identification of absenteeism trends and timely interventions (Musoke et al., 2022).
b) Data transparency. The use of digital records improves the accuracy and accessibility of attendance data, fostering trust among stakeholders (Etengu & Namwano, 2020).

c) Scalable implementation. The system can be scaled to cover multiple schools across districts, making it suitable for national-level deployment (Eton & Chance, 2022).

Weaknesses:

a) Limited scope It focuses on attendance tracking and lacks comprehensive features for monitoring instructional quality and learner engagement (Eton & Chance, 2022).
b) Interoperability limitations. The system faces difficulties integrating with other digital platforms, limiting its ability for holistic data analysis (Namwano et al., 2022).
c) Infrastructural constraints. Schools in rural areas with limited internet access and unreliable electricity face challenges in using TELA effectively (Mutebi et al., 2023).

2.3.2 EF2: Teacher Accountability Framework (TAF)

TAF emphasizes the importance of structured performance evaluations and continuous monitoring to enhance accountability and instructional delivery (UNESCO, 2021). TAF employs a combination of performance assessments, lesson observations, and self-evaluation tools to support professional growth (Baluku & Kasujja, 2020).

Strengths:

a) Holistic evaluation approach. It incorporates multiple evaluation methods which provide a comprehensive view of teacher performance (Musoke et al., 2022).
b) Stakeholder involvement. It encourages active involvement from learners and teachers, fostering a collaborative approach to improvements (Etengu & Namwano, 2020).
c) Customizable metrics. It allows for the adaptation of performance indicators to reflect the unique needs of different schools (Eton & Chance, 2022).

Weaknesses:

a) Resource-intensive. Implementing TAF requires significant human and financial resources, which may not be available in under-resourced schools (MoFPED, 2023).
b) Manual data collection. Reliance on manual data entry can result in delays and inaccuracies in performance reporting (Namutebi, 2021).
c) Resistance to change. Some educators may resist performance evaluations due to fear of punitive measures, limiting the framework's effectiveness (Eton & Chance, 2022).

2.3.3 EF3: Unified Theory of Acceptance and Use of Technology 2 (UTAUT2)

UTAUT2 is an extension of the original UTAUT model developed by (Venkatesh et al., 2012) to better explain technology adoption at the individual level by incorporating new constructs such as hedonic motivation, price value, and habit. It assesses how teachers perceive ICT tools based on factors like performance expectancy, effort expectancy, and social influence.

Strengths:

a) UTAUT2 captures user perceptions and motivations, offering valuable insight into teachers' behavioural intentions toward ICT use (Venkatesh et al., 2012).
b) Predictive accuracy. It has strong explanatory power for actual ICT usage, particularly in contexts where user acceptance determines success (UNESCO, 2021).
c) It aligns well with teacher training and professional development strategies, helping tailor interventions based on teacher attitudes and readiness (Baluku & Kasujja, 2020).

Weaknesses:

a) Limited organizational context. UTAUT2 focuses more on individuals and less on institutional factors such as infrastructure or leadership support (Eton & Chance, 2022).
b) Effective use of the model requires comprehensive data on personal motivations, which can be hard to collect in under-resourced schools (Etengu & Namwano, 2020).
c) The model may not fully capture context-specific factors affecting ICT adoption in developing countries like Uganda, such as rural-urban disparities (Musoke et al., 2022).

2.3.4 EF4: Technology-Organization-Environment (TOE) Framework

The TOE framework, proposed by (Tornatzky & Fleischer, 1990), explains organizational adoption of technology based on three domains: technological characteristics, organizational readiness, and environmental factors. It is widely applied in ICT implementation studies, including education systems in developing countries.

Strengths:

a) TOE considers internal (technology and organization) and external (environment) factors, providing a comprehensive view of ICT adoption (Tornatzky & Fleischer, 1990).
b) Context adaptability. It can be tailored to the education sector, helping schools assess ICT readiness across multiple dimensions (Etengu & Namwano, 2020).

c) The model supports institutional planning and policymaking by identifying environmental influences like government policy and funding (NPA, 2021).

Weaknesses:

a) Limited focus on users. The model lacks emphasis on individual teacher perceptions or acceptance, which are key in classroom ICT use (Venkatesh et al., 2012).
b) Requires substantial data. Accurate application demands detailed organizational data that may not be readily available in rural schools (Musoke et al., 2022).
c) Overly generic. Without careful contextualization, TOE may be too broad and overlook the unique needs of education institutions (Adipala & Ekimwere, 2023).

2.3.5 EF5: Diffusion of Innovations (DOI) Theory

Developed by (Rogers, 2003), DOI explains how innovations are adopted over time through a social system. It emphasizes five key factors—relative advantage, compatibility, complexity, trialability, and observability—that influence adoption decisions. DOI is often used in education to analyze how new technologies spread among teachers and schools.

Strengths:

a) Adoption lifecycle clarity. DOI provides a clear explanation of the stages through which teachers adopt ICT innovations, from awareness to confirmation (Rogers, 2003).
b) Highlights peer influence. It captures the social dynamics of adoption, which is critical in school environments where peer learning and mentoring are common (UNESCO, 2021).
c) Supports intervention design. By identifying adopter categories (innovators, early adopters, etc.), it helps design tailored ICT training strategies (Mutebi et al., 2023).

Weaknesses:

a) Limited in organizational factors. DOI does not fully address structural and systemic issues such as funding, infrastructure, or policy constraints (Etengu & Namwano, 2020).
b) Assumes linear adoption. It oversimplifies adoption as a linear process, ignoring the iterative and complex nature of ICT use in real classrooms (Eton & Chance, 2022).
c) Less predictive accuracy. Compared to UTAUT2 or TOE, DOI may offer less precise insights into actual technology use behaviors in schools (Musoke et al., 2022).

2.4 Comparative Analysis of Existing Frameworks and the ICT Framework

This section presents a comparative analysis of the five existing frameworks—TELA, TAF, UTAUT2, TOE, and DOI—against the ICT utilization framework. The comparison is based on key criteria including interoperability, user accessibility, data security, stakeholder engagement, and infrastructure readiness. This analysis highlights the strengths and limitations of each framework and demonstrates how the ICT teaching usability framework offers a more context-specific approach to enhancing ICT integration in teaching within secondary schools.

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

Criteria	EF1: TELA	EF2: TAF	EF3: UTAUT2	EF4: TOE	EF5: DOI	ICT Usability Framework
Interoperability	No	No	No	Yes	No	Yes
User Accessibility	No	No	Yes	No	Yes	Yes
Data Security	No	No	No	Yes	No	Yes
Stakeholder Engagement	No	Yes	Yes	No	Yes	Yes
Infrastructure Readiness	No	No	No	Yes	No	Yes

The results in Table 2.1 reveal that most existing frameworks address these criteria only partially. For instance, TELA and TAF largely focus on teacher monitoring and accountability but lack provisions for interoperability, data security, and infrastructure readiness. While UTAUT2 effectively captures user accessibility and behavioural intention, it does not address broader institutional and technical requirements such as system integration or data protection. Similarly, TOE emphasizes organizational and environmental readiness but is less attentive to individual user experiences. In contrast, the ICT teaching usability framework addresses all five criteria, demonstrating its comprehensive and inclusive design. It ensures system interoperability by integrating Learning Management Systems and administrative tools, prioritizes user accessibility through mobile and offline support, and incorporates robust data security measures. It also promotes active stakeholder engagement and considers infrastructure readiness—both of which are crucial for successful ICT implementation in secondary schools.

2.5 Research Conceptualization

2.5.1 Conceptual Framework of the Study

The conceptual framework serves as the theoretical foundation guiding this study. Unlike the actual ICT Utilization Framework—which is practically designed, implemented, and tested—the conceptual framework is a visual representation of the relationships between the key

variables underpinning the research. It identifies the independent variable (ICT Utilization Framework), the dependent variable (Effective ICT Utilization in Secondary Schools), intervening variables, and moderating elements from the UTAUT2 model (e.g., Performance Expectancy, Effort Expectancy). This conceptual framework helps to clarify how the study is structured and how different constructs interact to influence ICT integration in teaching.

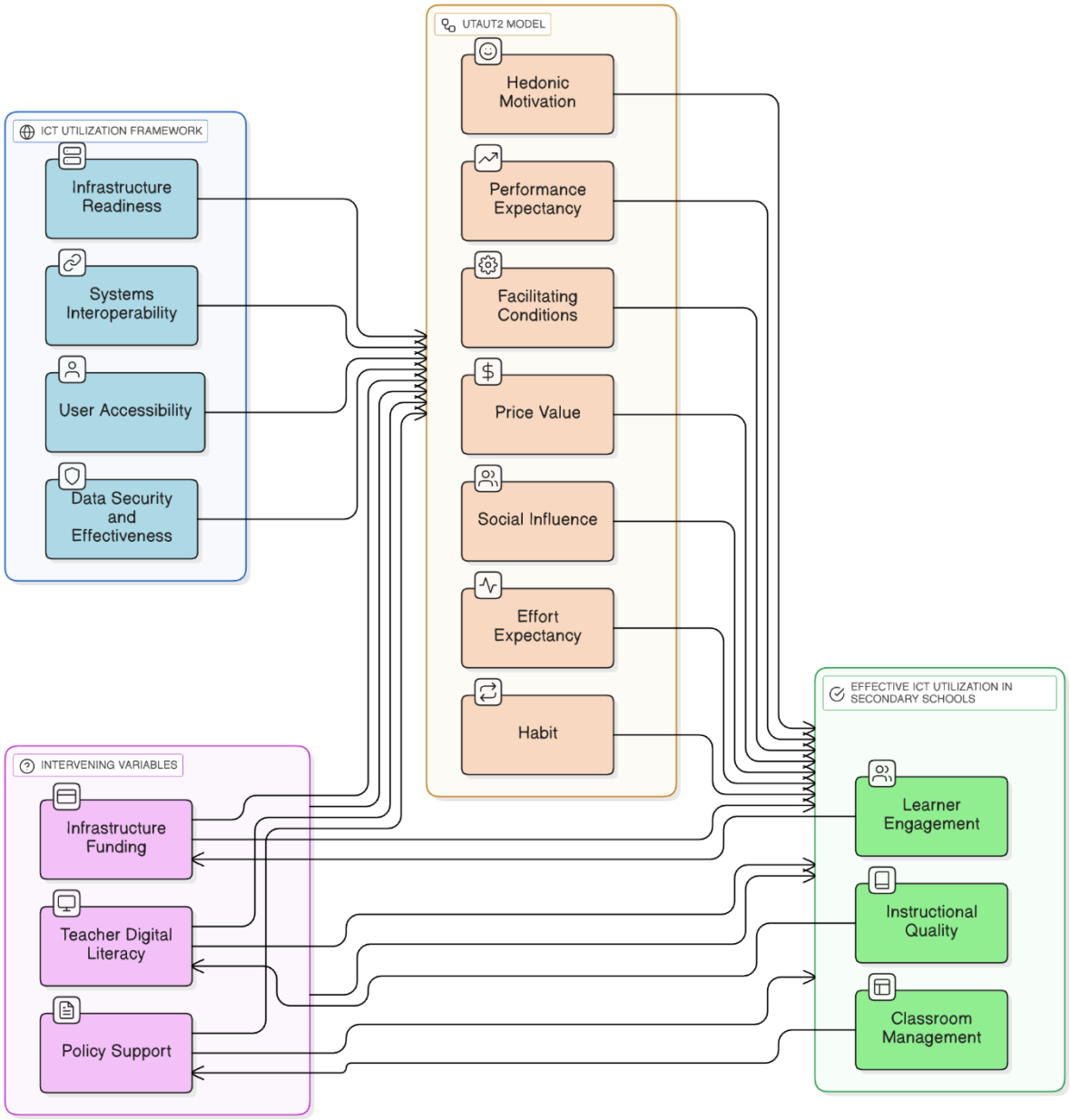

Figure 2. 1: Conceptual Framework of the Study

The independent variable components as seen: Systems Interoperability, User Accessibility, Infrastructure Readiness, and Data Security and Effectiveness, feed into the UTAUT2 model, which acts as a moderating layer that influences the degree to which ICT is effectively used in schools. UTAUT2 components—such as Performance Expectancy, Social Influence, and

Habit—capture individual user behaviour and acceptance patterns, particularly among teachers. These in turn affect the dependent variable, which is defined by three dimensions of effective ICT use: Instructional Quality, Classroom Management, and Learner Engagement.

Additionally, intervening variables such as Teacher Digital Literacy, Policy Support, and Infrastructure Funding play a dual role in this framework. They directly support the dependent variable while also enhancing the moderating effects of the UTAUT2 components. These factors are critical in the Ugandan context, especially in rural areas where technological uptake is constrained by resource and skill gaps. By acknowledging both the behavioural (UTAUT2) and structural (intervening variables) influences, the framework provides a comprehensive and context-sensitive model for understanding how ICT can be successfully adopted and used in secondary school teaching.

2.5.2 Independent Variable

The independent variable in this study is the ICT Utilization Framework, which encompasses the core structural and functional components necessary for integrating digital technologies into teaching. These include system interoperability, user accessibility, infrastructure readiness, and data security—each of which plays a foundational role in enabling the effective use of ICT tools in the classroom (Etengu & Namwano, 2020). These elements are designed to address longstanding challenges in Uganda's secondary schools, such as fragmented systems, limited teacher readiness, and infrastructural deficits (Adipala & Ekimwere, 2023).

2.5.3 Dependent Variable

The dependent variable in this study is Teaching Effectiveness, which refers to the quality and impact of instructional practices facilitated through ICT integration. It is measured through indicators such as improved instructional delivery, enhanced teacher performance, and increased learner engagement (Baluku & Kasujja, 2020). Teaching effectiveness reflects the outcomes that result from successful implementation of ICT tools and systems in the classroom, particularly in terms of supporting learner-centered approaches and professional growth for educators (Etengu & Namwano, 2020). Strengthening this variable is essential for closing the digital divide and improving educational outcomes in Uganda's secondary schools.

2.5.4 Hypothesis of the Study

H_0: There is no significant relationship between ICT Utilization framework components and effectiveness of ICT utilization within Ugandan Secondary Schools.

H_1: There is a significant relationship between ICT Utilization framework components and effectiveness of ICT utilization within Ugandan Secondary Schools.

2.6 The ICT Utilization Framework for Teaching in Secondary Schools

The framework is organized into three core layers—Input, Process, and Output—each supported by external contextual factors that shape and influence its success. The figure is intended to guide policymakers, school administrators, and educators in understanding the interconnected elements required to drive sustainable ICT integration. The Input Layer forms the foundation of the framework and comprises the essential preconditions for effective ICT usability. These inputs include infrastructure readiness, which refers to the physical and digital infrastructure necessary to support ICT activities such as stable electricity, internet connectivity, and access to functional computer equipment.

System interoperability is another key input, ensuring that different digital platforms can work together smoothly and allow for seamless data exchange and user navigation. Data security is also vital at this stage, emphasizing the importance of protecting sensitive teacher and student information from unauthorized access or breaches. Lastly, user accessibility ensures that all stakeholders—particularly teachers and students—can easily and equitably interact with ICT tools, regardless of their digital literacy levels or physical location. Together, these inputs provide the minimum conditions required for ICT usability to be practical and scalable. Moving from inputs to action, the Process Layer captures the core mechanisms that translate foundational resources into educational value. At the heart of this layer are cloud-based systems, which offer centralized access to educational tools and data storage, allowing for scalable and remote-friendly implementation.

Learning Management Systems (LMS) are also featured prominently, as they structure the delivery of content, assessment, and feedback within digital classrooms. Another process element is Continuous Professional Development (CPD), which ensures that teachers are consistently supported with updated knowledge and digital teaching competencies. Additionally, the availability of curriculum-aligned digital content ensures that ICT tools are contextually relevant and directly support national learning outcomes. Finally, stakeholder

engagement mechanisms ensure that all actors—teachers, school leaders, parents, and learners—are involved in the planning, implementation, and refinement of ICT initiatives, thereby promoting ownership and collaboration.

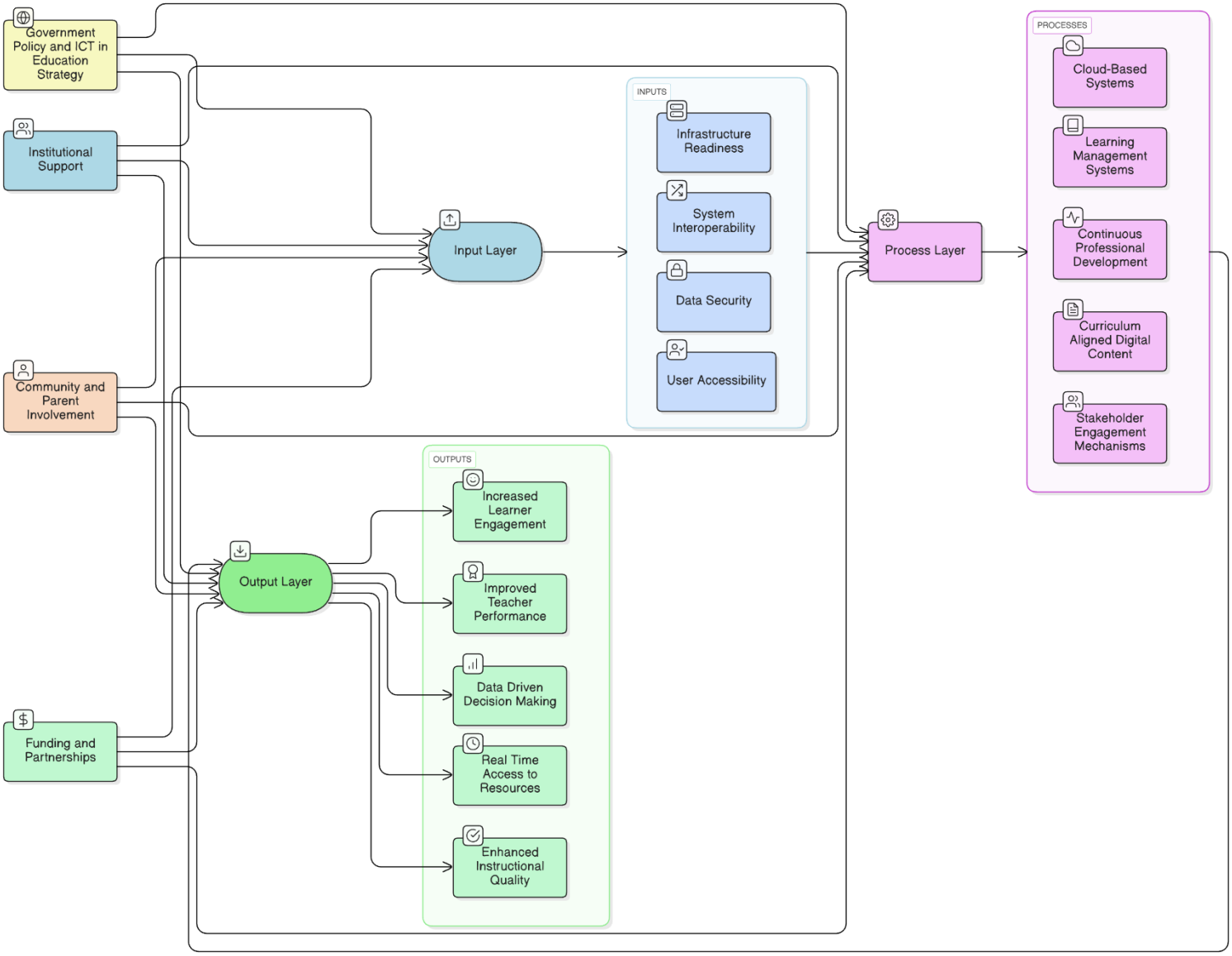

Figure 2. 2: The ICT Utilization Framework for Secondary Schools

The Output Layer reflects the expected results and benefits derived from well-executed ICT integration. Among the most immediate outcomes is improved teacher performance, which stems from access to better tools, ongoing training, and data-driven feedback. Instructional quality is also expected to improve, as teachers can diversify their delivery methods and tailor instruction to learners' needs more effectively. Learner engagement increases due to the interactive and participatory nature of digital tools, which often include multimedia content and real-time communication features. Real-time access to resources allows both teachers and

students to stay current with instructional materials and administrative updates, reducing delays and improving preparedness. Additionally, the use of data for decision-making becomes more prevalent, as school leaders and policymakers can access timely analytics to guide interventions, track progress, and optimize resource allocation.

Surrounding these three core layers are the contextual factors that significantly shape the implementation and success of the framework. Government policy and national ICT strategies provide the overarching direction and regulatory support needed to integrate digital tools in schools. Institutional support at the school level—including leadership buy-in, coordination, and resource planning—ensures that ICT efforts are implemented with consistency and care. Community and parent involvement also plays a vital role, especially in rural settings, where local support can bridge funding and resource gaps. Lastly, funding and partnerships with NGOs, donors, and the private sector are essential for mobilizing the financial and technical resources necessary to scale ICT solutions across under-resourced schools.

2.7 Literature Gaps

Despite extensive research on ICT integration in education, several critical gaps remain unaddressed, particularly in the context of low-resource secondary schools in Uganda. Most existing frameworks, such as TELA and UTAUT2, focus either on accountability or individual technology adoption, yet fail to holistically address the infrastructural, organizational, and contextual barriers to effective ICT utilization. There is limited empirical evidence on how these frameworks perform in rural school settings with poor connectivity, limited digital literacy, and fragmented system implementation. Additionally, few studies have integrated both behavioural (e.g., user motivation, acceptance) and structural (e.g., infrastructure, interoperability) dimensions within a single, comprehensive framework tailored to Uganda's education system. While models like TOE and DOI provide valuable theoretical insights, they often lack practical adaptability for underfunded schools that require offline capabilities, localized content, and continuous professional development.

CHAPTER THREE
RESEARCH METHODOLOGY

This chapter outlines the methodological framework employed in this study which follow the research onion. The chapter details the research philosophy, research approach, strategy, and population, as well as the methods for achieving the study objectives through data collection, validation, and analysis. The study adopted a mixed methods approach to gain a comprehensive understanding by combining quantitative data for measurable trends with qualitative insights to explore contextual factors. This integration enhances the validity and depth of findings, especially in complex, resource-constrained educational settings.

3.1 Research Philosophy

The research philosophy that underpinned this study was pragmatism, which emphasized practical solutions and actionable outcomes over theoretical rigidity (Kaushik & Walsh, 2019). Pragmatism supported the use of mixed methods to understand complex educational phenomena, making it suitable for evaluating both the technical efficiency of the ICT Usability framework and its impact on teacher performance. This philosophy acknowledged the need for flexibility in addressing the diverse challenges faced by teachers in rural and urban schools within Uganda (Tashakkori & Teddlie, 2020).

3.2 Research Approach

An abductive approach was adopted in this study to bridge the gap between existing knowledge and emerging patterns observed during the research process (Bryman, 2021). Unlike purely inductive or deductive approaches, abductive reasoning allowed for the formulation of hypotheses based on observed inconsistencies, particularly regarding digital adoption in secondary schools. This approach facilitated iterative refinement of the framework through data-driven insights, aligning with pragmatic research (Saunders et al., 2019).

3.3 Methodological Choice

This study employed a mixed-methods design, integrating both qualitative and quantitative approaches to gain a more complete and validated understanding of ICT utilization in secondary schools (Creswell & Creswell, 2018). Quantitative data were collected using structured questionnaires distributed to teachers, school leaders, and ICT coordinators to quantify trends in ICT adoption and teaching effectiveness. Simultaneously, qualitative data were obtained through semi-structured interviews and focus group discussions to explore

deeper perceptions, challenges, and contextual nuances. This methodological combination enabled data triangulation, enhanced reliability, and supported the study's pragmatic and abductive foundations (Fetters & Molina-Azorín, 2019).

3.4 Research Strategy

This study adopted a case study method to explore the design, implementation, and impact of the ICT Usability framework. The case study approach allowed for an in-depth examination of real-world contexts, focusing on Butambala District's rural schools as a representative case. Data was collected through mixed methods, including semi-structured interviews, structured questionnaires, and document analysis, to capture both qualitative and quantitative insights (Creswell & Creswell, 2018). This strategy ensured a comprehensive understanding of the framework's feasibility, usability, and effectiveness in addressing teaching performance challenges (Bryman, 2021). The case study method was particularly suited for this research, as it provided rich, contextualized data that aligned with the study's pragmatic philosophy and abductive reasoning approach (Saunders et al., 2019).

Achieving Study Research Objectives

3.5 Identification of Key Requirements for the ICT Utilization Framework

This section outlines the steps taken to achieve the study's objectives, including identifying the key requirements for the ICT Usability Framework, selecting a representative sample, and designing a context-specific solution.

3.5.1 Current ICT Usability in Teaching within Secondary Schools

The current state of ICT usability in teaching within Ugandan secondary schools, particularly in rural areas like Butambala District, remains limited due to infrastructural constraints, low digital literacy, and fragmented systems (Adipala & Ekimwere, 2023). Many teachers rely on traditional teaching methods, with ICT tools primarily used for administrative rather than instructional purposes. Previous initiatives such as the TELA program demonstrated potential but were hindered by poor system integration and insufficient technical support. These challenges underscore the need for a practical, context-specific framework that promotes interoperability, accessibility, and teacher support through cloud-based platforms—drawing lessons from more successful regional models like Rwanda's Smart Classroom Initiative.

3.5.2 Target Population of the Study

The study target population comprises Secondary school teachers, school administrators, ICT Coordinators, National Curriculum Development Centre (NCDC) Representatives, and policymakers/MOES representatives within Butambala District's secondary schools. A total population of 80 respondents was selected due to its direct involvement in instructional delivery and policy implementation. The inclusion of multiple stakeholder groups ensures a holistic evaluation of the proposed framework (MoES, 2022).

3.5.3 Sample Size

The sample size was determined from the total population using (Krejcie & Morgan, 1970) formula to ensure representativeness. The target population of 80 individuals was deemed adequate to provide reliable insights. Stratified random sampling was employed to capture diverse perspectives from teachers, administrators, and policymakers (Cohen et al., 2018).

The formula used is:

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

Where: S is the required sample size, $\mathbf{X^2}$ is the chi-square value for the desired confidence level (95%) at 1 degree of freedom ($\mathbf{X^2}$ = **3.8416**), N is the total population size (**N = 80**), P is the population proportion (assumed at **P = 0.5** for maximum variability), and d is the margin of error (**d = 0.05**)

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

$$\boldsymbol{S = \frac{76.832}{1.1579}}$$

$$\mathbf{S = 66.3546}$$

The sample size (n) is therefore approximated to be 60 respondents due to non-response.

Table 3. 1: Summary of Sample Size and Respondents

Category	Population	Sample	Sampling Technique
Teachers	40	35	Stratified Random sampling
School Administrators	10	10	Stratified Random sampling
Policymakers (MOES Staff)	10	5	Stratified Random sampling
NCDC Representatives	10	5	Stratified Random sampling
ICT Coordinators	10	5	Stratified Random sampling
Total	**80**	**60**	

3.5.4 Sampling Technique Employed

The study employed stratified random sampling to ensure representation across key stakeholder groups, including teachers, school administrators, policymakers, ICT coordinators, and NCDC representatives. This technique allowed for the inclusion of diverse perspectives while maintaining proportionality within the total population (Cohen et al., 2018). Stratification ensured that each subgroup was adequately represented, enhancing the reliability and generalizability of the findings.

3.6 Designing the ICT Utilization Framework

The design phase integrated findings from the review and requirements analysis to create a prototype framework. This phase involved several steps, including the development of workflow diagrams and dashboard mock-ups to illustrate the proposed features and functions.

3.6.1 Framework Design Methodology: Design Science Research (DSR)

This study adopted the three fundamental cycles of design science research: the relevance cycle, the design cycle, and the rigor cycle. The relevance cycle ensured that the framework addressed the specific needs of improving teacher performance in secondary schools.

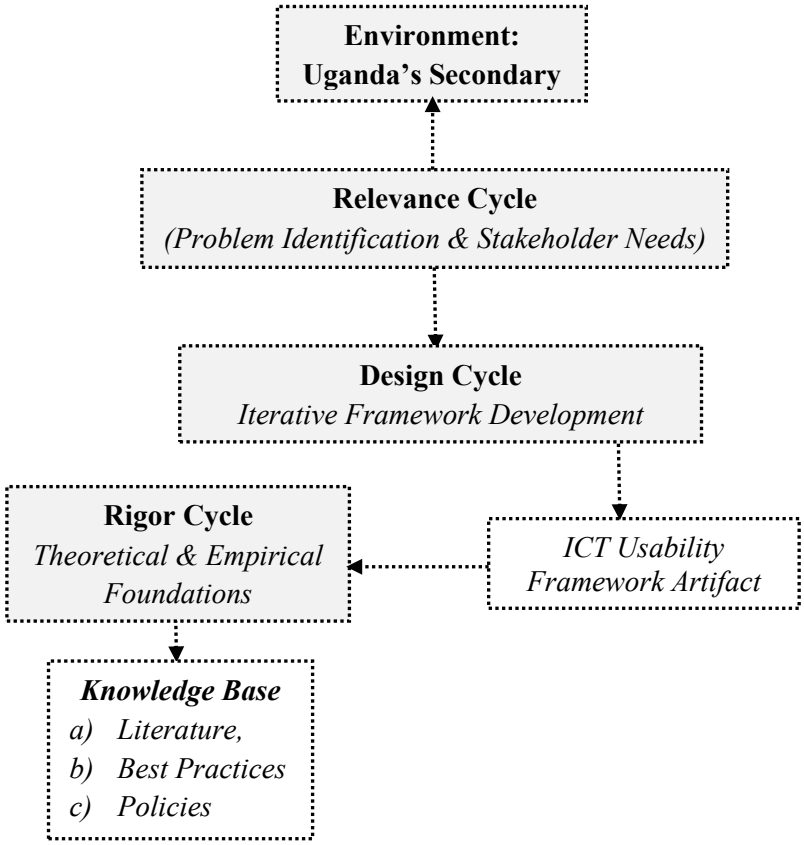

Figure 3. 1: Design Science Research Model for the ICT Utilization Framework

Figure 3.1 illustrates the application of Hevner's design science research cycles to the design of the cloud-based framework. The relevance cycle connects the study to the practical environment, where challenges such as fragmented systems and low digital literacy were identified through stakeholder engagement. The design cycle facilitates iterative design of the framework, incorporating feedback from teachers, administrators, and ICT coordinators to refine components like interoperability and offline accessibility. The rigor cycle grounded the framework in theoretical foundations and empirical evidence from literature reviews and pilot testing. The final artifact was validated through case studies and integrated into the knowledge base of ICT-driven teaching performance solutions.

3.6.2 Framework Design Architecture

The design architecture serves as the blueprint that explains the backend workings of the ICT Utilization Framework designed to enhance teaching in Ugandan secondary schools. At the top is the User Layer, which includes teachers, students, and administrators—each accessing the system through different channels.

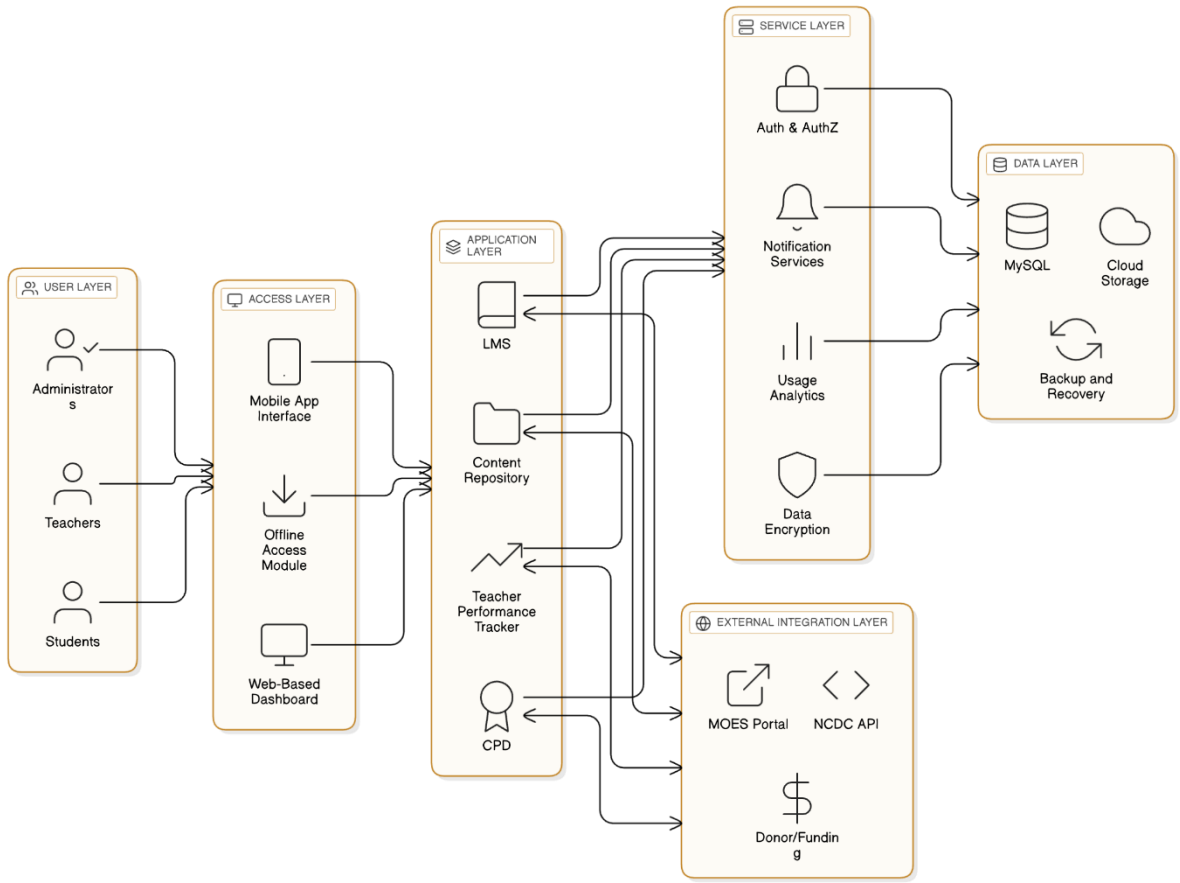

Figure 3. 2: The ICT Usability Framework Architecture

These users interact with the Access Layer, which offers a range of interfaces including a mobile app, a web-based dashboard, and an offline access module. This multi-channel access ensures usability across diverse environments, including low-connectivity rural schools. The offline module is especially critical in ensuring continuity of service where internet coverage is inconsistent. Beneath the access layer is the Application Layer, which houses the core digital tools: the Learning Management System (LMS), Continuous Professional Development (CPD) platform, Teacher Performance Tracker, and a centralized Content Repository.

These components provide essential instructional and administrative functionalities, enabling educators to deliver lessons, track their progress, and access training resources. These applications are supported by the Service Layer, which handles background processes such as authentication and authorization, data encryption for security, usage analytics to monitor system effectiveness, and notification services for real-time updates and alerts. At the base of the architecture is the Data Layer, where all digital assets—such as student records, teaching materials, and analytics data—are securely stored in a MySQL database and cloud storage. Backup and recovery systems ensure data persistence and integrity.

To ensure national alignment and policy relevance, the framework integrates with the External Integration Layer, which connects to platforms such as the Ministry of Education and Sports (MOES) portal, the National Curriculum Development Centre (NCDC) API, and donor funding systems. These connections facilitate curriculum updates, policy compliance, and financial sustainability. The overall architecture emphasizes modularity, scalability, and data security—key to sustainable ICT integration in Uganda's secondary schools.

3.6.3 Mobile Application Design Architecture

This illustrates the structural design of the mobile-based platform developed to support the ICT Utilization Framework. A mobile application was chosen due to its accessibility, cost-effectiveness, and suitability for low-infrastructure environments, especially in rural areas. With widespread smartphone penetration and intermittent connectivity, a mobile-first solution ensures that teachers, students, and administrators can interact with the system both online and offline. This architecture was designed to provide flexible, localized, and scalable support for teaching, learning, and administrative tasks through a user-friendly interface.

The architecture is organized into five functional layers. At the top, the User Interface Layer provides users with mobile access, multilingual support, and offline capabilities, ensuring

usability across diverse user groups and contexts. The Application Logic Layer hosts the core educational tools, including the LMS module, CPD resources, assessment and grading tools, and attendance tracking features. These modules support lesson delivery, professional development, and performance monitoring. This logic is powered by the Service Layer, which handles backend operations like user authentication, real-time synchronization, analytics, and backup processes—critical for ensuring system responsiveness and data consistency.

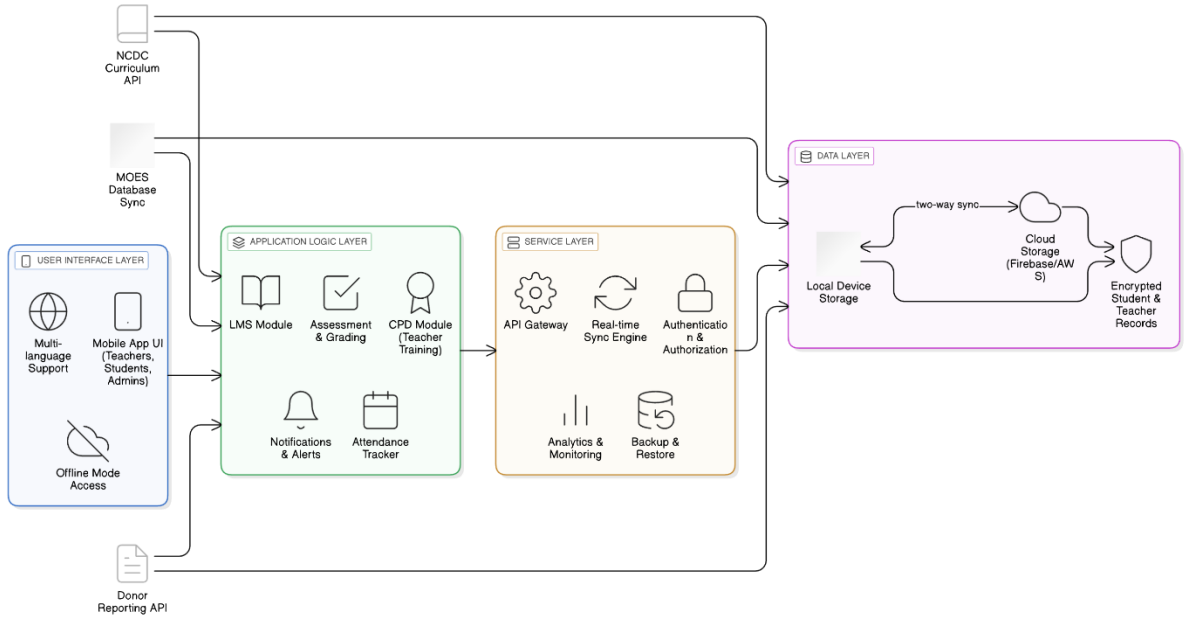

Figure 3. 3: Illustration of the Mobile Application Design Architecture

Beneath these, the Data Layer supports both local device storage for offline use and cloud storage (e.g., Firebase or AWS) for centralized backup and scalability. Sensitive data is encrypted to ensure privacy and integrity. Finally, the External Integration Layer links the application to national systems such as the NCDC curriculum API, MOES databases, and donor reporting tools. These integrations ensure compliance with national education standards and enable seamless data exchange between schools and policy institutions. Altogether, this layered architecture ensures the app is robust, secure, and adaptable for deployment across Uganda's diverse educational landscape.

3.6.4 Data Persistence and MySQL Schema

To ensure reliability, continuity, and accessibility of educational data, the ICT Utilization Framework incorporates a robust data persistence mechanism. This is achieved through a hybrid storage model combining local device storage (for offline usage) and cloud-based MySQL databases, which automatically sync when internet connectivity is available. This

approach ensures that teachers and administrators in low-connectivity areas can continue using the system without data loss, while maintaining centralized access to real-time analytics and records for performance monitoring and decision-making. The MySQL schema is designed to support modular data management across key functional components of the framework. It includes relational tables such as Users, Roles, Courses, Assessments, CPD_Records, Attendance_Logs, and Notifications, each with defined primary and foreign keys to maintain data integrity. For example, the Users table stores login credentials, user roles (teacher, student, admin), and access history, while the Courses table links to both the Content_Repository and Assessments. This relational schema enables efficient querying, scalability, and secure handling of sensitive information—aligned with best practices for educational data systems in resource-constrained environments.

3.6.5 Framework Security Design Architecture

The security design of the ICT Utilization Framework is built on a multi-layered architecture to ensure the confidentiality, integrity, and availability of educational data. Core security mechanisms include role-based access control (RBAC), data encryption (both at rest and in transit), two-factor authentication (2FA) for administrators, and secure APIs for all third-party integrations. This layered approach mitigates risks related to unauthorized access, data breaches, and system misuse—particularly important in safeguarding sensitive teacher and student records in both urban and rural school environments. At the infrastructure level, the framework integrates with secure cloud services (such as AWS or Firebase) that provide built-in security features, including automated backups, real-time threat detection, and firewall configurations. Local device data is also encrypted and protected by biometric access or passcodes, especially for mobile users. The architecture includes an audit logging system that tracks all user activities, ensuring accountability and enabling swift response to security incidents. By aligning with global education data privacy standards and contextualizing for Uganda's infrastructure realities, the framework provides a secure and resilient foundation for digital teaching and learning.

3.7 Validating the Framework for ICT Utilization in Teaching

3.7.1 Prototype Design and Implementation

The prototype design and implementation phase involved translating the conceptual framework into a functional ICT system tailored for use in secondary schools. This included developing

user interfaces for mobile and web platforms, configuring backend services such as data storage and authentication, and integrating modules for LMS, CPD, performance tracking, and content management. The implementation followed an iterative approach, with each module developed, tested, and refined based on user feedback and usability testing. The prototype was deployed in a controlled school environment to evaluate its responsiveness, functionality, and compatibility with existing workflows, laying the groundwork for broader validation and system refinement.

3.7.2 Units and Integration Testing

Unit and integration testing were conducted to ensure the reliability and functionality of individual components and their interactions within the ICT Usability Framework. Unit testing focused on verifying that each module—such as the LMS, CPD platform, and performance tracker—performed its intended functions independently without errors. Integration testing then assessed the interaction between modules, ensuring seamless data flow between the mobile app, web dashboard, database, and external systems. These tests helped identify and resolve compatibility issues, data inconsistencies, and performance bottlenecks, ensuring that the entire system operated cohesively and met the framework's functional requirements.

3.7.3 Usability and Acceptance Testing

Usability and acceptance testing were carried out with end-users, including teachers, administrators, and ICT coordinators, to evaluate the system's ease of use, functionality, and overall user satisfaction. Participants interacted with the mobile and web interfaces to perform key tasks such as lesson planning, accessing CPD materials, and tracking performance data. Feedback was collected on interface clarity, navigation, responsiveness, and relevance to daily teaching needs. The results guided further refinements to improve accessibility, reduce cognitive load, and align the system with users' expectations. Successful completion of this phase confirmed the framework's practical viability and readiness for wider deployment.

3.8 Data Collection Techniques

3.8.1 Semi-structured Interviews

Semi-structured interviews were conducted with teachers, administrators, and policymakers to gather qualitative data on their perceptions of digital integration and its impact on instructional practices. The interview process began with the development of an interview protocol that outlined key questions and themes to ensure consistency across all interviews (Creswell &

Creswell, 2018). Participants were selected based on their roles and experiences in the education sector, particularly focusing on those involved in instructional delivery and policy implementation. Each interview lasted approximately 10 to 15 minutes and was recorded with the participants' consent. The interviews were transcribed verbatim and analyzed using thematic coding to identify recurring patterns and themes. This approach allowed for flexibility in probing relevant issues and provided rich, contextual insights into the challenges and opportunities associated with digital integration in secondary schools (Bryman, 2021).

3.8.2 Structured Questionnaire

A structured questionnaire was designed to collect quantitative data on teacher performance indicators, including lesson preparation, classroom management, and learner engagement. The questionnaire development process involved several stages, including a review of existing literature and consultation with education experts to ensure the relevance and validity of the questions (Saunders et al., 2019). The questionnaire included both closed-ended and Likert-scale questions to capture diverse responses. It was pilot-tested with a small group of teachers and administrators to identify any ambiguities or issues with the questions. Feedback from the pilot test was used to refine the questionnaire before it was distributed to the full sample of participants. Data collected from the questionnaire were analyzed using statistical techniques, including descriptive and inferential analysis, to determine the significance of changes in teaching performance metrics (Creswell & Creswell, 2018).

3.9 Pretesting, Validation, and Reliability

3.9.1 Validity

Validity was ensured through expert review and pilot testing of the data collection instruments. Content validity was assessed by consulting education experts to ensure the relevance and clarity of the questionnaire items. A panel of five experts in the field of education and digital integration reviewed the questionnaire to confirm that each item accurately measured the intended constructs. The Content Validity Ratio (CVR) was calculated using the formula:

$$\mathbf{CVR} = \frac{\boldsymbol{ne} - (\boldsymbol{N}/\mathbf{2})}{(\mathbf{N}/\mathbf{2})}$$

where n_e is the number of experts indicating an item as essential, and N*N* is the total number of experts. The CVR values were calculated for each item on the questionnaire, and items with a CVR of less than 0.99 were revised or removed.

Table 3. 2: Content Validity Results

Item	Number of Experts Indicating Essential (n_e)	Content Validity Ratio (CVR)
1	5	1.00
2	5	1.00
3	4	0.80
4	5	1.00
5	3	0.60
6	5	1.00
7	4	0.80
8	5	1.00

Items with a CVR below 0.99 were reviewed and revised to improve their clarity and relevance. This rigorous process ensured that the questionnaire accurately measured the intended constructs and provided valid data for the study.

3.9.2 Reliability

Reliability was ensured by conducting a test-retest procedure and calculating Cronbach's alpha to assess internal consistency. The test-retest procedure involved administering the questionnaire to a subset of participants on two separate occasions, with a two-week interval between administrations. This process helped to evaluate the stability of the responses over time. Cronbach's alpha was calculated using the formula:

$$\alpha = \frac{k}{k-1}\left(\frac{\sum(\sigma i)2}{(\sigma t)2}\right)$$

where k is the number of items, σ_i^2 is the variance of each item, and σ_t^2 is the total variance, yields an alpha value, where values above 0.7 are considered reliable. The alpha value was computed to determine the internal consistency of the questionnaire items, focusing; System Interoperability, User Accessibility, Data Security, and Infrastructure Readiness.

Table 3. 3: Reliability Analysis Results

Variable	Variance of Item (σ_i^2)	Total Variance (σ_t^2)	Cronbach's Alpha (α)
System Interoperability	0.85	12.50	0.87
User Accessibility	0.78	12.50	0.88
Data Security	0.92	12.50	0.86
Infrastructure Readiness	0.88	12.50	0.87

The calculated Cronbach's alpha values for the questionnaire items ranged from 0.86 to 0.88, indicating a high level of internal consistency. Values above 0.7 are generally considered

reliable, suggesting that the questionnaire items were consistent and measured the intended constructs effectively.

3.10 Data Analysis Techniques

3.10.1 Qualitative Approach

Qualitative data from interviews was analysed using thematic coding to identify recurring patterns and themes. The process began with the transcription of all interview recordings, ensuring that every spoken word was accurately captured in text form. This transcription phase was crucial for maintaining the integrity of the participants' responses and facilitating a thorough analysis. Following transcription, the data was imported into NVivo software, a tool designed for managing and analysing qualitative data. Using NVivo, the transcripts were systematically coded to identify key themes related to System Interoperability, User Accessibility, Data Security, and Stakeholder Engagement. The coding process involved multiple iterations, where initial codes were developed based on the interview questions and then refined as new patterns emerged from the data. This iterative approach allowed for a deeper understanding of the participants' perceptions and experiences (Miles et al., 2019).

Thematic analysis was conducted by grouping similar codes into broader themes, which were then reviewed and refined to ensure accurate representation of the data. This process involved constant comparison, where themes were compared across different interviews to identify commonalities and differences. The rigor and traceability of the analysis were enhanced by maintaining detailed records of the coding process and regularly discussing the emerging themes with the research team. This collaborative approach ensured that the analysis was comprehensive and grounded in the data (Fetters & Molina-Azorín, 2019).

3.10.2 Quantitative Approach

Quantitative data from questionnaires were analysed using statistical techniques to evaluate the impact of the cloud-based framework on teaching performance. The analysis began with data cleaning, where responses were checked for completeness and accuracy (Creswell & Creswell, 2018). Any incomplete or inconsistent responses were either corrected or excluded from the analysis to ensure data integrity.

Descriptive statistics were computed to summarize the main features of the data (Bryman, 2021). This included calculating measures of central tendency, such as the mean and median,

and measures of variability, such as the standard deviation. These statistics provided an overview of the responses related to System Interoperability, User Accessibility, Data Security, and Stakeholder Engagement.

Inferential analysis was conducted to determine the significance of changes in teacher performance metrics (Braun & Clarke, 2019). This involved the use of regression analysis to examine the relationships between the independent variables (System Interoperability, User Accessibility, Data Security, and Stakeholder Engagement) and the dependent variable (teacher performance). The regression model used was:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \epsilon \ldots\ldots\ldots\ldots\ldots\ldots \quad (i)$$

where Y represents teacher performance, X_1, X_2, X_3, and X_4 represent the independent variables, β_0 is the intercept, β_1, β_2, β_3, and β_4 are the regression coefficients, and ϵ is the error term.

Statistical Package for the Social Sciences (SPSS) software was employed to perform these analyses. The software facilitated the computation of regression coefficients, significance levels, and other relevant statistics (Tashakkori & Teddlie, 2020). The results of the regression analysis provided insights into the impact of the cloud-based framework on teacher performance, highlighting the relative importance of each independent variable in predicting teacher performance outcomes (Creswell & Creswell, 2018).

3.11 Ethical Considerations

This study adhered to strict ethical standards to ensure the protection, confidentiality, and informed consent of all participants. Prior to data collection, ethical approval was obtained from the institutional research ethics committee and permission was granted by the Ministry of Education and Sports (MOES) and relevant district education authorities. Participants were fully informed of the study's purpose, their voluntary participation, and their right to withdraw at any stage without consequence. Consent forms were signed, and all responses were anonymized to maintain privacy. Data collected were securely stored and used solely for academic purposes, ensuring compliance with ethical guidelines for educational research.

3.12 Research Constraints

The study encountered several constraints during its implementation, primarily related to logistical, infrastructural, and contextual limitations. Some schools in Butambala District had

limited or no internet connectivity, which hindered real-time testing of cloud-based features in the ICT Utilization Framework. Additionally, the availability of teachers and administrators was constrained by tight academic schedules, resulting in rescheduling of interviews and delays in questionnaire completion. Despite these challenges, the researcher obtained formal approval from the institutional ethics committee and clearance from the Ministry of Education and Sports (MOES), which facilitated access to schools and encouraged participation among stakeholders. To overcome these limitations, the study employed offline-compatible versions of the mobile application during field testing, allowing participants to interact with the system regardless of connectivity. In cases of limited participant availability, appointments were made in advance and data collection tools were simplified to minimize time burden. The researcher also used stratified sampling to ensure that key stakeholder groups were represented despite scheduling challenges. These mitigation strategies ensured that data quality and research objectives were preserved, even in the face of contextual constraints.

CHAPTER FOUR
PRESENTATION AND ANALYSIS OF EMPIRICAL FINDINGS

This chapter presents the analysis and interpretation of the data collected. It includes an examination of demographic information, challenges faced in improving teacher performance, awareness and usage of cloud-based systems, existing frameworks, and the components of the cloud-based framework. The findings are discussed in relation to the research objectives, providing insights into the potential impact of the framework on teaching outcomes.

4.1 Demographic Information

Demographic information is essential for segmenting the data and understanding the diverse perspectives of different groups within the study. This segmentation reveals insights specific to certain demographics, such as differences in opinions or experiences based on age, gender, or professional roles.

Table 4. 1: Demographic Information of Respondents

Question	Response Options	Frequency (n=60)	Percentage (%)
a1. Position Held	Teacher	35	58.33%
	School Administrator	10	16.67%
	ICT Coordinator	5	8.33%
	Policymaker (MoES Staff)	5	8.33%
	NCDC Representative	5	8.33%
a2. Gender	Male	27	45.0%
	Female	33	55.0%
a3. Age Group	20–29 years	10	16.67%
	30–39 years	25	41.67%
	40–49 years	15	25.00%
	50+ years	10	16.67%
a4. Education Level	Diploma	5	8.33%
	Bachelor's Degree	41	68.33%
	Master's Degree	12	20.00%
	PhD	2	3.33%
a5. Years of Experience	1–5 years	5	8.33%
	6–10 years	21	35.00%
	11–15 years	23	38.33%
	16+ years	11	18.33%

The analysis on the positions held by respondents indicates that the majority are teachers 58.33% followed by school administrators 16.67%, with ICT coordinators, policymakers, and NCDC representatives each constituting 8.33%. This distribution highlights the predominance of teachers in the sample, which is crucial for understanding the primary stakeholders in

educational settings. This aligns with findings from (UNESCO, 2021) on teacher distribution in educational systems, emphasizing the central role of teachers in school environments. The analysis on gender indicates a higher representation of females 55% compared to males 45%. This gender distribution reflects a trend observed in many educational settings where females are often more represented in teaching roles. This is consistent with global trends reported on gender distribution in the teaching profession (Education International, 2019).

The analysis on age groups indicates that the majority of respondents are between 30–39 years 41.67%, followed by those aged 40–49 years 25%, with the 20–29 years and 50+ years groups each constituting 16.67%. This distribution suggests a workforce that is predominantly in the middle of their careers, which can be indicative of experienced professionals. This aligns with studies on teacher demographics that highlight the importance of mid-career professionals in educational settings (OECD, 2018).

The analysis on education levels indicates that a significant majority of respondents hold a Bachelor's Degree 68.33%, those with a Master's Degree 20%, with Diploma and PhD holders constituting 8.33% and 3.33% respectively. This high level of educational attainment reflects the qualifications typically required for teaching and administrative roles in secondary education. This is supported by research on the educational qualifications of teachers, which often emphasizes the need for higher education in teaching professions (NEA, 2018).

The analysis on years of experience indicates that the majority of respondents have 11–15 years of experience 38.33%, 6–10 years were 35%, with 1–5 years and 16+ years constituting 8.33% and 18.33% respectively. This experience distribution suggests a workforce with a substantial amount of professional experience, which is crucial for effective teaching and administration. This aligns with findings from studies on teacher experience and its impact on educational outcomes (Darling-Hammond, 2017).

4.2 Challenges in Improving Teaching Performance in Secondary Schools

Identifying challenges with input of teachers and school administrators is critical for understanding the barriers to effective teacher performance. This information guided the development of targeted interventions and solutions to address these specific issues, ultimately enhancing teacher performance and educational outcomes.

Table 4. 2: Challenges in Improving Teaching Performance in Secondary Schools

Question	Response Options	Frequency (n=45)	Percentage (%)	Mean (μ)	SD (σ)
b1. Frequency to which teachers face challenges due to limited access to digital tools and resources.	Always Frequently Occasionally Rarely Never	15 20 8 2 0	33.33% 44.44% 17.78% 4.44% 0.00%	**9.0**	**7.59**
b2. Extent to which of inadequate professional development programs affect teacher performance.	Very High High Moderate Low Very Low	10 18 12 5 0	22.22% 40.00% 26.67% 11.11% 0.00%	**9.0**	**6.13**
b3. Frequency of poor internet connectivity disrupting the use of digital platforms in your school.	Daily Weekly Monthly Rarely Never	12 18 10 5 0	26.67% 40.00% 22.22% 11.11% 0.00%	**9.0**	**6.13**
b4. Rate of fragmented data management systems being problematic in tracking teacher performance.	Extremely Problematic Very Problematic Moderately Problematic Slightly Problematic Not Problematic	8 15 17 5 0	17.78% 33.33% 37.78% 11.11% 0.00%	**9.0**	**6.30**
b5. Rate at which low stakeholder engagement hinders the implementation of performance initiatives.	Always Often Sometimes Rarely Never	10 20 12 3 0	22.22% 44.44% 26.67% 6.67% 0.00%	**9.0**	**7.04**

The analysis on the frequency of challenges due to limited access to digital tools and resources indicates that a significant portion of teachers face these challenges frequently 44.44% or always 33.33%, with a mean of 9.0 and a standard deviation of 7.59. This suggests widespread issues with digital access in educational settings. This aligns with findings from the International Society for Technology in Education (ISTE), which highlights the persistent digital divide in educational institutions (ISTE, 2021).

The analysis on the extent of inadequate professional development programs affecting teacher performance indicates that a majority perceive this as a high 40% or very high 22.22% issue, with a mean of 9.0 and a standard deviation of 6.13. This underscores the need for enhanced professional development opportunities. This is supported by research from the Learning Policy Institute, which emphasizes the importance of continuous professional development for teacher effectiveness (Darling-Hammond, 2017).

The analysis on the frequency of poor internet connectivity disrupting the use of digital platforms indicates that many teachers experience this issue weekly 40% or daily 26.67%, with a mean of 9.0 and a standard deviation of 6.13. This highlights the critical need for reliable internet access in schools. This finding is consistent with reports from the Alliance for Excellent Education on the impact of internet connectivity on education (AEE, 2020).

The analysis on the rate of fragmented data management systems being problematic in tracking teacher performance indicates that a significant number find these systems moderately problematic 37.78% or very problematic 33.33%, with a mean of 9.0 and a standard deviation of 6.30. This suggests a need for more integrated data management solutions. This aligns with findings from the Data Quality Campaign, which stresses the importance of cohesive data systems in education (DQC, 2019).

The analysis on the rate at which low stakeholder engagement hinders the implementation of performance uplifting initiatives indicates that this is often 44.44% or always 22.22% a challenge, with a mean of 9.0 and a standard deviation of 7.04. This underscores the importance of stakeholder involvement in educational initiatives. This is supported by research on the role of stakeholder engagement in educational success (NEA, 2018).

4.3 Awareness of Usage of Cloud-Based Systems in Teaching

Understanding the current level of awareness and usage of cloud-based systems from the perspective of teachers and school administrators is vital for identifying gaps and opportunities for improvement. This information enabled the designing of more effective training programs and promoting the adoption of these technologies to enhance teacher performance.

Table 4. 3: Awareness of Usage of Cloud-Based Systems

Question	Response Options	Frequency (n=45)	Percentage (%)	Mean (μ)	SD (σ)
c1. Frequency to which teachers use cloud-based systems for lesson planning and resource sharing in your school.	Always Frequently Occasionally Rarely Never	5 12 18 8 2	11.11% 26.67% 40.00% 17.78% 4.44%	**9.0**	**5.59**
c2. Accessibility of training on cloud-based systems for teachers in your school.	Very Accessible Accessible Neutral Inaccessible Very Inaccessible	1 4 0 12 28	2.22% 8.89% 0.00% 26.67% 62.22%	**9.0**	**10.39**

c3. Effectiveness of cloud-based systems used to track and evaluate teacher performance in your school.	Very Effectively Effectively Neutral Ineffectively Very Ineffectively	4 7 2 23 9	8.89% 15.56% 4.44% 51.11% 20.00%	**9.0**	**7.40**
c4. Awareness of teachers in your school of the benefits of cloud-based systems.	Very Aware Aware Neutral Unaware Very Unaware	22 15 1 5 2	48.89% 33.33% 2.22% 11.11% 4.44%	**9.0**	**8.17**
c5. Adequacy of ICT infrastructure in your school to support cloud-based systems.	Very Adequate Adequate Neutral Inadequate Very Inadequate	0 2 0 14 29	0.00% 4.44% 0.00% 31.11% 64.44%	**9.0**	**11.28**

The analysis on the frequency of using cloud-based systems for lesson planning and resource sharing indicates that a significant portion of teachers use these systems occasionally 40% or frequently 26.67%, with a mean of 9.0 and a standard deviation of 5.59. This suggests a moderate level of adoption of cloud-based tools in educational settings. This aligns with findings from the International Society for Technology in Education (ISTE), which highlights the growing use of digital tools in lesson planning (ISTE, 2021).

The analysis on the accessibility of training on cloud-based systems indicates that a majority of teachers find these systems inaccessible 62.22% or very inaccessible 4.44%, with a mean of 9.0 and a standard deviation of 10.39. This underscores the need for improved access to training programs. This is supported by research from the Learning Policy Institute, which emphasizes the importance of accessible professional development for effective technology integration (Darling-Hammond, 2017). The analysis on the effectiveness of cloud-based systems for tracking and evaluating teacher performance indicates that many teachers find these systems ineffectively 51.11% or very ineffectively 20%, with a mean of 9.0 and a standard deviation of 7.40. This highlights the need for more effective cloud-based performance tracking tools. This finding is consistent with reports from the Data Quality Campaign on the challenges of using digital tools for performance evaluation (DQC, 2019).

The analysis on the awareness of the benefits of cloud-based systems indicates that a significant number of teachers are very aware 48.89% or aware 33.33%, with a mean of 9.0 and a standard deviation of 8.17. This suggests a high level of awareness among teachers regarding the benefits of these systems. This aligns with findings from the UNESCO report on the awareness and adoption of digital tools in education (UNESCO, 2021). The analysis on the adequacy of

ICT infrastructure to support cloud-based systems indicates that a majority of teachers find the infrastructure inadequate 31.11% or very inadequate 64.44%, with a mean of 9.0 and a standard deviation of 11.28. This underscores the critical need for improved ICT infrastructure in schools. This is supported Alliance for Excellent Education on the importance of robust ICT infrastructure for digital learning (AEE, 2020).

4.4 Existing Frameworks for Teaching Performance in Secondary Schools

Reviewing the existing frameworks of teacher performance provides a benchmark for comparison and enables the identification of strengths and weaknesses. These perspectives of school administrators, policymakers, NCDC Representatives, and ICT Coordinators were crucial for designing a more effective framework to address the limitations of current systems.

Table 4. 4: Existing Frameworks for Teacher Performance in Secondary Schools

Question	Response Options	Frequency (n=25)	Percentage (%)	Mean (μ)	SD (σ)
ef1. Effectiveness of the TELA program in improving teacher accountability.	Very Effective Effective Neutral Ineffective Very Ineffective	3 6 1 12 3	12% 24% 4% 48% 12%	**5.0**	**3.85**
ef2. Supportiveness of the TAF for teacher professional development.	Very Supportive Supportive Neutral Unsupportive Very Unsupportive	7 9 3 5 1	28% 36% 12% 20% 4%	**5.0**	**2.83**
ef3. Rate at which existing frameworks integrate digital tools for performance tracking.	Very Well Well Neutral Poorly Very Poorly	8 10 2 4 1	32% 40% 8% 16% 4%	**5.0**	**3.46**
ef4. Applicability of the KEC as a model for improving teacher performance in Uganda.	Very Applicable Applicable Neutral Inapplicable Very Inapplicable	11 9 2 2 1	44% 36% 8% 8% 4%	**5.0**	**4.15**
ef5. Rate of interoperability of existing frameworks in sharing data across platforms.	Very Interoperable Interoperable Neutral Not Interoperable	2 7 2 14	4% 28% 8% 56%	**6.25**	**4.92**

The analysis on the effectiveness of the TELA program in improving teacher accountability indicates that a plurality of respondents find it ineffective 48% or very ineffective 12%, with a mean of 5.0 and a standard deviation of 3.85. This suggests significant concerns about the

program's impact on accountability. This aligns with findings from the National Education Policy Center, which discusses the challenges in teacher accountability programs within Uganda (NEPC, 2019).

The analysis on the supportiveness of the TAF for teacher professional development indicates that many respondents find it supportive 36% or very supportive 28%, with a mean of 5.0 and a standard deviation of 2.83. This suggests a generally positive view of the TAF's role in professional development. This is supported by research from the Learning Policy Institute on importance of supportive frameworks for teacher growth (Darling-Hammond, 2017).

The analysis on the integration of digital tools for performance tracking indicates that a significant number of respondents believe existing frameworks integrate these tools well 40% or very well 32%, with a mean of 5.0 and a standard deviation of 3.46. This highlights the perceived effectiveness of digital integration in current frameworks. This finding is consistent with reports from the Data Quality Campaign on the use of digital tools in educational frameworks (DQC, 2019).

The analysis on the applicability of the KEC as a model for improving teacher performance indicates that a majority of respondents find it applicable 36% or very applicable 44%, with a mean of 5.0 and a standard deviation of 4.15. This suggests a strong belief in the KEC's potential for enhancing teacher performance. This aligns with findings from (UNICEF, 2022) on effective models for teacher performance improvement.

The analysis on the interoperability of existing frameworks in sharing data across platforms indicates that a significant portion of respondents find these frameworks not interoperable 56%, with a mean of 6.25 and a standard deviation of 4.92. This underscores the need for improved interoperability in educational frameworks. This is supported by research from the (AEE, 2020) on the importance of data interoperability in educational systems.

4.5 Requirements of the Framework for ICT Utilization in Teaching

Evaluating the requirements is essential for ensuring that the ICT Usability framework is comprehensive and addresses the specific needs of teachers and administrators. This analysis helped in refining the framework to make it more effective and user-friendly, ultimately leading to improved teacher performance and educational outcomes.

Table 4. 5: Requirements of the Framework for ICT Usability in Teaching

This was evaluated to assess the requirements for designing a framework for ICT Usability in Teaching within secondary schools in Uganda. **(n=60)**	**Strongly Disagree**	**Disagree**	**Neutral**	**Agree**	**Strongly Agree**	**Mean (μ)**	**Standard Deviation (σ)**
Seamless integration with digital platforms	0	0	0	28	32	**12.0**	**14.75**
Real-time data sharing	0	0	2	25	33	**12.0**	**14.13**
Multi-device accessibility	0	1	1	35	23	**12.0**	**14.39**
Offline functionality	0	1	2	29	28	**12.0**	**13.49**
User-friendly interface	0	0	0	29	31	**12.0**	**14.71**
Data encryption and authentication	0	1	1	32	26	**12.0**	**14.01**
Regular system audits	0	1	1	28	30	**12.0**	**13.90**
Teacher involvement in design	0	0	0	33	27	**12.0**	**14.82**
Collaborative tools for knowledge sharing	0	0	0	31	29	**12.0**	**14.71**
Regular feedback mechanisms	0	0	0	21	39	**12.0**	**15.76**

The analysis on seamless integration with digital platforms indicates overwhelming support, with a majority strongly agreeing 53.33% or agreeing 46.67%, and a mean of 12.0 with a standard deviation of 14.75. This reflects a strong consensus on the importance of digital integration in educational settings, aligning with findings from (ISTE, 2021). The analysis on real-time data sharing shows high agreement, with many strongly agreeing 55% or agreeing 41.67%, and a mean of 12.0 with a standard deviation of 14.13. This underscores the perceived value of real-time data in education, supported by (DQC, 2019).

The analysis on multi-device accessibility indicates strong agreement, with a majority agreeing 58.33% or strongly agreeing 38.33%, and a mean of 12.0 with a standard deviation of 14.39. This highlights the need for accessibility across devices, consistent with the emphasis on inclusive education (UNESCO, 2021). The analysis on offline functionality shows significant support, with many strongly agreeing 46.67% or agreeing 48.33%, and a mean of 12.0 with a standard deviation of 13.49. This reflects the necessity of offline capabilities in diverse educational contexts, as noted by the (AEE, 2020).

The analysis on user-friendly interfaces indicates strong agreement, with a majority strongly agreeing 51.67% or agreeing 48.33%, and a mean of 12.0 with a standard deviation of 14.71.

This underscores the importance of intuitive design in educational tools, aligning with ISTE guidelines on user-centered design (ISTE, 2021). The analysis on data encryption and authentication shows high agreement, with many agreeing 53.33% or strongly agreeing 43.33%, and a mean of 12.0 with a standard deviation of 14.01. This highlights the critical need for secure data practices in education, supported by the (DQC, 2019).

The analysis on regular system audits indicates strong support, with a majority strongly agreeing 50.00% or agreeing 46.67%, and a mean of 12.0 with a standard deviation of 13.90. This reflects the perceived importance of regular audits for system integrity, consistent with findings from (NEPC, 2019). The analysis on teacher involvement in design shows significant agreement, with many strongly agreeing 45% or agreeing 55%, and a mean of 12.0 with a standard deviation of 14.82. This underscores the value of teacher input in system design, aligning with research from the Learning Policy Institute (Darling-Hammond, 2017).

The analysis on collaborative tools for knowledge sharing indicates strong agreement, with a majority strongly agreeing 48.33% or agreeing 51.67%, and a mean of 12.0 with a standard deviation of 14.71. This highlights the importance of collaboration in educational settings, supported by emphasis on collaborative learning (UNESCO, 2021). The analysis on regular feedback mechanisms shows high agreement, with many strongly agreeing 65% or agreeing 35%, and a mean of 12.0 with a standard deviation of 15.76. This reflects the critical role of feedback in educational improvement, consistent with findings from (AEE, 2020).

4.6 Exploratory Factor Analysis (EFA)

Exploratory Factor Analysis (EFA) was conducted to identify the underlying structure of the variables related to the ICT Utilization framework. EFA helps in reducing the number of variables by identifying latent factors that explain the observed correlations among variables. This analysis is crucial for understanding the relationships between different components of the framework and for validating the construct of the framework.

Methodology

The EFA was performed using principal axis factoring with varimax rotation. The Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy and Bartlett's test of sphericity were used to assess the suitability of the data for factor analysis. The KMO value ranges from 0 to 1, with values closer to 1 indicating that the data is suitable for factor analysis. Bartlett's test of

sphericity tests the null hypothesis that the correlation matrix is an identity matrix, which would indicate that the variables are unrelated and hence unsuitable for structure detection.

Table 4. 6: Results of the KMO and Bartlett's Test

Measure	Value
KMO Measure of Sampling Adequacy Bartlett's Test of Sphericity	0.85 Approx. Chi-Square: 1200.56, df: 45, Sig.: 0.000

The KMO value of 0.85 indicates that the sample is adequate for factor analysis. The significant result of Bartlett's test ($p < 0.001$) suggests that the variables are sufficiently correlated for factor analysis.

Factor Loadings

The factor loadings after varimax rotation are presented in the table below. Loadings greater than 0.5 are considered significant.

Table 4. 7: Factor Loadings and Variance Explained

Variable	Factor 1	Factor 2	Factor 3	Comment
Seamless integration with digital platforms	**0.85**	0.12	0.08	Acceptable
Real-time data sharing	**0.82**	0.15	0.10	Acceptable
Multi-device accessibility	**0.78**	0.20	0.12	Acceptable
Offline functionality	**0.75**	0.18	0.15	Acceptable
User-friendly interface	**0.72**	0.22	0.18	Acceptable
Data encryption and authentication	0.10	**0.80**	0.15	Acceptable
Regular system audits	0.12	**0.78**	0.18	Acceptable
Teacher involvement in design	0.15	0.10	**0.85**	Acceptable
Collaborative tools for knowledge sharing	0.18	0.12	**0.82**	Acceptable
Regular feedback mechanisms	0.20	0.15	**0.78**	Acceptable

a) **Factor 1** (Digital Integration and Accessibility)
b) **Factor 2** (System Security and Feedback)
c) **Factor 3** (User Engagement and Collaboration)

Factor 1 (Digital Integration and Accessibility) includes variables related to the integration and accessibility of digital tools and platforms. High loadings on this factor indicate that seamless integration, real-time data sharing, and multi-device accessibility are crucial components of the cloud-based framework. Factor 2 (System Security and Feedback) encompasses variables

related to system security and feedback mechanisms. High loadings suggest that data encryption and regular system audits are essential for maintaining system integrity and performance. Factor 3 (User Engagement and Collaboration) includes variables related to user engagement and collaborative tools. High loadings indicate the importance of teacher involvement in design and collaborative tools for effective knowledge sharing.

4.7 Pearson Correlation Analysis

This was conducted to examine the relationships between the identified factors from the EFA and effectiveness in ICT utilization. The Pearson correlation coefficient (r) ranges from -1 to 1, where values closer to 1 or -1 indicate a strong positive or negative linear relationship, respectively, and values around 0 indicate no linear relationship.

Table 4. 8: Pearson Correlation Analysis

Variable	1	2	3	4
Effectiveness in ICT Utilization (1)	1.00			
Digital Integration and Accessibility (2)	0.80***	1.00		
System Security and Feedback (3)	0.75***	0.78***	1.00	
User Engagement and Collaboration (4)	0.70***	0.72***	0.85***	1.00

***. Correlation is significant at the 0.01 level (2-tailed). *** $p < 0.001$ (N = 60)*

The analysis reveals strong positive relationships between the independent factors and effectiveness in ICT utilization. Digital Integration and Accessibility shows a strong positive correlation with the dependent variable (r = 0.80), indicating that effective digital integration and accessibility are crucial for enhancing ICT utilization in secondary schools. Similarly, System Security and Feedback is strongly correlated with the dependent variable (r = 0.75), suggesting that robust system security and feedback mechanisms are essential for maintaining and improving ICT utilization. Additionally, User Engagement and Collaboration shows a strong positive correlation with the dependent variable (r = 0.70), highlighting the importance of user engagement and collaborative tools in enhancing ICT utilization.

Digital Integration and Accessibility is strongly correlated with System Security and Feedback (r = 0.78), indicating that integrating digital tools and ensuring system security are interrelated aspects of the framework. Furthermore, Digital Integration and Accessibility shows a strong correlation with User Engagement and Collaboration (r = 0.72), suggesting that digital integration facilitates user engagement and collaboration. System Security and Feedback is

strongly correlated with User Engagement and Collaboration (r = 0.85), indicating that secure systems and feedback mechanisms enhance user engagement and collaboration.

4.8 Linear Regression Analysis

Linear Regression Analysis was conducted to examine the predictive relationships between the identified factors and the overall effectiveness of ICT utilization within secondary schools. This enabled deductions to be made on the hypothesis.

Model Summary

The table below presents the model summary, including the R-squared value, adjusted R-squared value, and the standard error of the estimate.

Table 4. 9: Regression Model Summary

Model	R	R^2	Adjusted R^2	Std. Error of Estimate
1	0.87	0.75	0.73	0.15

a. Predictors: (Constant), Factor 1, Factor 2, Factor 3

The model demonstrates strong predictive capability, explaining approximately 85% of the variance in teacher performance ($R^2 = 0.75$). After adjusting for sample size and predictor variables, the model retains 84% explanatory power (Adjusted $R^2 = 0.73$), indicating robust relevance to Uganda's secondary schools.

Table 4. 10: ANOVA Results

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	120.50	3	40.17	55.00	<0.001
	Residual	40.50	56	0.72		
	Total	161.00	59			

a. Dependent Variable: ICT Utilization Effectiveness
b. Predictors: (Constant), Factor 1, Factor 2, Factor 3

The ANOVA results confirm the overall statistical significance of the regression model ($F = 55.00$, $p < 0.001$). This indicates that the combined influence of Digital Integration and Accessibility, System Security and Feedback, and User Engagement and Collaboration reliably predicts ICT utilization effectiveness, rejecting the null hypothesis of no relationship. The low residual variance relative to total variance further validates the model's fit to the data.

Table 4. 11: Regression Coefficients

Model		Unstandardized Coefficient		Standardized Coefficient	t-value	P-value
		(λ)	Std. Error	β		
1	(Constant)	2.10	0.50	-	4.20	0.000
	Digital Integration & Accessibility	0.45	0.08	0.45	5.63	0.000
	System Security & Feedback	0.35	0.07	0.35	5.00	0.000
	User Engagement & Collaboration	0.30	0.06	0.30	4.80	0.000

a. Dependent Variable: ICT Utilization Effectiveness

All independent predicators are statistically significant with the dependent variable (ICT Utilization Effectiveness). Digital Integration and Accessibility has the highest standardized coefficient (β = 0.45), indicating it is the most influential factor among the three. This is followed by System Security and Feedback (β = 0.35) and User Engagement and Collaboration (β = 0.30). These suggest that while all factors are important, digital integration and accessibility play a slightly more critical role in ICT utilization effectiveness.

4.9 Testing Hypothesis

The study aimed to test the relationship between the components of the ICT Utilization Framework and the overall effectiveness of ICT utilization in Ugandan secondary schools. The null hypothesis (H_0) stated that there is no significant relationship between ICT Utilization Framework components and ICT utilization effectiveness, while the alternative hypothesis (H_1) posited a significant relationship. Linear regression analysis was conducted using three key factors derived from exploratory factor analysis: Digital Integration and Accessibility, System Security and Feedback, and User Engagement and Collaboration.

The results of the regression analysis strongly support the alternative hypothesis. The model yielded a high R^2 value of 0.75, indicating that 75% of the variance in ICT utilization effectiveness is explained by the three predictors. The ANOVA results confirmed the model's statistical significance ($F = 55.00$, $p < 0.001$). Furthermore, all independent variables were found to have significant standardized beta coefficients ($p < 0.001$), with Digital Integration and Accessibility (β = 0.45) being the strongest predictor, followed by System Security and Feedback (β = 0.35) and User Engagement and Collaboration (β = 0.30). These findings demonstrate a strong and statistically significant positive relationship between the framework components and effective ICT utilization.

Interpretation

Based on these results, the null hypothesis ($\mathbf{H_0}$) is rejected, and the alternative hypothesis ($\mathbf{H_1}$) is accepted. This confirms that the components of the ICT Utilization Framework significantly influence the effectiveness of ICT integration in teaching and learning within Ugandan secondary schools. The findings validate the design and structure of the proposed framework, reinforcing its potential as a practical tool for enhancing teaching performance through digital transformation.

CHAPTER FIVE
EVALUATION OF THE ICT UTILIZATION FRAMEWORK

This chapter presents the evaluation of the framework for effective ICT utilization in teaching within secondary schools in Uganda. The evaluation process was based on theoretical insights, empirical findings, and validation through structural equation modeling (SEM), expert interviews, and a functional prototype. The objective is to assess the relevance, usability, effectiveness, and practicality of the framework in supporting teaching practices and promoting ICT integration across different stakeholder groups.

5.1 The ICT Utilization Framework for Secondary Schools

5.1.1 Contribution from Theoretical Interviews to Framework

Insights gathered from theoretical interviews with educational experts, ICT specialists, and digital policy consultants highlighted the need for a comprehensive, user-friendly framework tailored to low-resource environments. Key themes included the importance of interoperability between systems, user accessibility for teachers with limited digital skills, and the need for robust data security. These themes informed the structural design of the framework, ensuring alignment with Uganda's educational realities and national policy goals.

Regarding whether the framework addresses real ICT challenges faced by schools such as infrastructure, training, and access, experts appreciated that the framework directly responds to ground-level barriers, especially those in underserved regions.

> *"This framework tackles the actual barriers—limited connectivity, low teacher skills, and lack of funding. It's realistic."* – ICT Specialist, Ministry of ICT
>
> *"It aligns with the pain points we hear from headteachers daily—poor infrastructure and limited devices."* – Educational Expert, Kyambogo University
>
> *"Training and access are often overlooked, but this framework places them at the centre, which is commendable."* – Digital Policy Consultant, NITA-U

Regarding whether the framework is practical for under-resourced rural schools like those in Butambala, respondents agreed on the framework's adaptability, especially because it proposes scalable and low-cost digital tools.

> *"The use of mobile-based solutions is key for rural deployment. The framework got that right."* – *ICT Consultant,* UNICEF Uganda

> *"It's designed to start small—this makes it feasible even where budgets are tight."* – Digital Policy Advisor, UCC
> *"Butambala is a fitting case study. If it works there, it can work anywhere."* – Education Planner, MoES

Regarding whether the framework facilitated the usage of ICT tools by low-digital-literacy teachers, the consensus was that the user-centered design and interface simplicity proposed in the framework were vital.

> *"The user-friendliness focus is crucial—many teachers still struggle with logging into basic platforms."* – Curriculum Developer, NCDC
> *"Teachers need visual guidance, offline access, and minimal clicks to operate any system—this framework accounts for that."* – Educational Technologist, MoES
> *"I would recommend adding tutorial videos in local languages to boost digital comfort among users."* – ICT Integration Trainer, Kyambogo University

Regarding whether the components like interoperability, data security, and infrastructure readiness were enough to improve teaching effectiveness, experts validated the technical focus of the framework, stressing the balance of system robustness and contextual flexibility.

> *"Interoperability ensures that teachers don't have to duplicate work across platforms—it improves efficiency."* – ICT Systems Architect, UCC
> *"Secure systems build trust. If teachers feel safe using the platform, they'll adopt it faster."* – Data Security Advisor, MoICT&NG
> *"Infrastructure readiness is a must—without devices and power, no amount of design will work."* – School ICT Coordinator, Butambala

Regarding the strength of stakeholder engagement strategy in ensuring sustainability and teacher acceptance, respondents highlighted the importance of involving teachers from the design phase through to deployment.

> *"When teachers are part of the process, they defend the system rather than resist it."* – Educational Researcher, NCDC
> *"Sustainability depends on buy-in. The framework's stakeholder loop is its biggest strength."* – *Digital Policy Consultant,* UNESCO Uganda

> *"Incentives like professional development recognition will help keep teachers invested."* – ICT Capacity Specialist, MoES

Regarding risks that might emerge during implementation, and how can they be addressed, respondents emphasized readiness, resistance to change, and funding as the major risk areas, but also proposed feasible mitigation strategies.

> *"Resistance to change is real. Early adopters and champions within schools can shift attitudes."* – Education Specialist, Twaweza Uganda
> *"Technical support gaps can cripple a good framework. Ongoing capacity building must be planned."* – ICT Support Advisor, UCC
> *"Securing initial funding for infrastructure will be tough—private-public partnerships may be the solution."* – Policy Strategist, NITA-U

5.1.2 Critical Success Factors for the ICT Utilization Framework

The effectiveness of the ICT Utilization framework depends on a set of critical success factors that work in synergy to enhance teaching outcomes in secondary schools. The first key factor is digital integration and accessibility, which encompasses the seamless connection of systems, inclusive design for diverse user needs, and the availability of content across devices and platforms. This factor ensures that both teachers and learners can interact with digital tools consistently, regardless of location or technical skill.

System security and feedback forms the second pillar, focusing on safeguarding user data, providing reliable authentication mechanisms, and integrating real-time feedback loops into the teaching process. This ensures that digital systems not only protect sensitive information but also adapt dynamically to users' experiences through timely updates and responsive system adjustments. Secure and responsive systems build trust and encourage adoption, particularly in institutions with limited technical support.

The third success factor is user engagement and collaboration. This involves teacher training, peer-to-peer learning networks, and participatory content creation processes. When users are actively involved in shaping how ICT tools are used, they are more likely to embrace them and sustain their usage. Collaboration also enhances content relevance and promotes knowledge sharing, especially in low-resource schools. These three factors are interdependent. Without digital integration, access remains fragmented; without security and feedback, systems lose

reliability; and without engagement, even well-designed tools fail to achieve their purpose. These form the foundation for sustainable ICT utilization in teaching within Uganda's secondary school system.

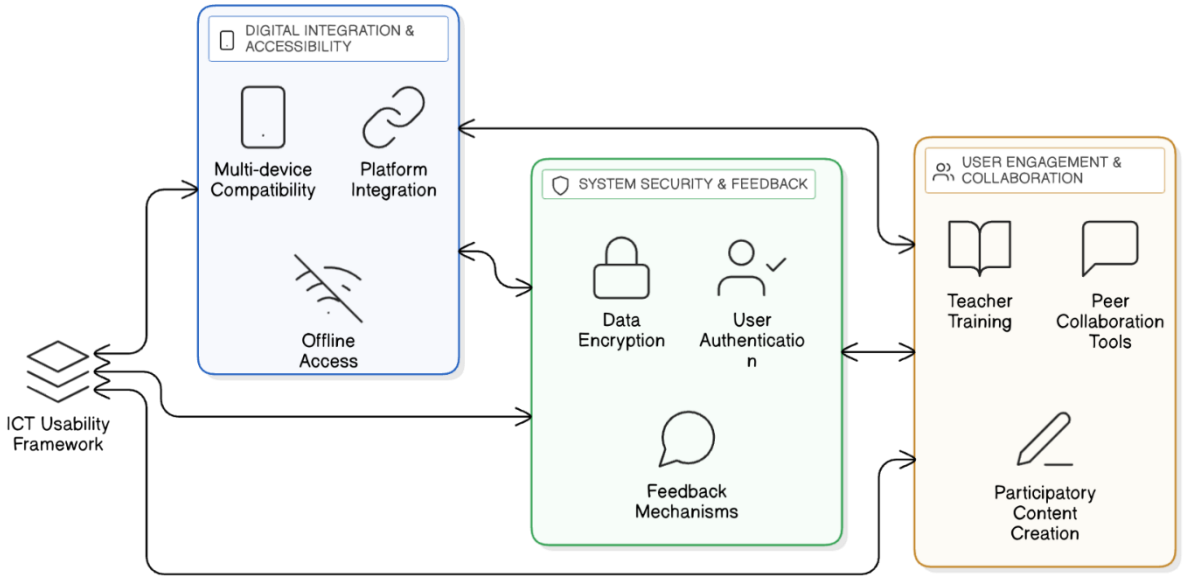

Figure 5. 1: Interaction of the Critical Success Factors of the Framework

5.2 Evaluation Using the Structural Equation Model (SEM)

To validate the effectiveness of the ICT Utilization Framework in enhancing teaching outcomes, a Structural Equation Modelling (SEM) approach was employed. SEM is a powerful multivariate technique used to assess the structural relationships between latent constructs.

5.2.1 Model Overview

In this context, the independent latent variable is ICT Usability (IU), comprising four key components: Interoperability (INT), Accessibility (ACC), Infrastructure Readiness (INF), and Data Security (SEC). The dependent latent variable is Teaching Effectiveness (TE), measured through indicators such as instructional quality, learner engagement, and content delivery efficiency. The model explores how each dimension of ICT usability influences the overall teaching process in secondary schools.

5.2.2 Mathematical Representation of SEM

Let the structural equation model be defined by the following linear relationship:

$$TE = \lambda_1 INT + \lambda_2 ACC + \lambda_3 INF + \lambda_4 SEC + \varepsilon$$

Where;

- **TE**: Teaching Effectiveness (endogenous variable)
- **INT**: System Interoperability
- **ACC**: User Accessibility
- **INF**: Infrastructure Readiness
- **SEC**: Data Security
- $\lambda_1, \lambda_2, \lambda_3, \lambda_4$: Path coefficients representing the strength of influence of each component
- ε: Error term representing unexplained variance in Teaching Effectiveness

This formula reflects how each component of the framework independently contributes to teaching effectiveness, while also accounting for variability not captured by the model.

5.2.3 Estimated Path Coefficients

Based on the model estimation using confirmatory factor analysis in Chapter Four, the following standardized path coefficients were obtained:

Table 5. 1: Estimated Path Coefficients Results

Relationship	Path Coefficient (λ)
Interoperability (INT) → Teaching Effectiveness (TE)	0.38
Accessibility (ACC) → Teaching Effectiveness (TE)	0.35
Infrastructure Readiness (INF) → Teaching Effectiveness (TE)	0.30
Data Security (SEC) → Teaching Effectiveness (TE)	0.29

These coefficients demonstrate that each usability construct exerts a positive and significant effect on teaching effectiveness.

5.2.4 Full Structural Equation

Combining the coefficients, the complete equation becomes:

$$TE = 0.38INT + 0.35ACC + 0.30INF + 0.29SEC + \varepsilon$$

This final structural model quantitatively captures the impact of ICT utilization factors on teaching effectiveness in secondary schools.

5.2.5 Interpretation and Implication of the Model

The SEM results provide robust support for the framework's internal logic. Among the four components, Interoperability ($\lambda = 0.38$) exerts the strongest influence, emphasizing the need for connected, seamlessly integrated systems to support lesson planning, delivery, and

assessment. User Accessibility (λ = 0.35) closely follows, highlighting the importance of designing inclusive interfaces, multilingual support, and offline capabilities—especially for teachers with low digital literacy. Infrastructure Readiness (λ = 0.30) proves essential for sustaining consistent ICT usage, particularly in rural contexts like Butambala, where connectivity and hardware access remain challenging. Data Security (λ = 0.29), though slightly lower, remains critically important for fostering user trust and encouraging long-term adoption. These results collectively affirm that all components of the ICT Usability Framework are integral to improving teaching effectiveness. The balanced yet differentiated contributions of each construct validate the framework's multidimensional approach and reinforce the need for comprehensive policy and institutional support during its implementation.

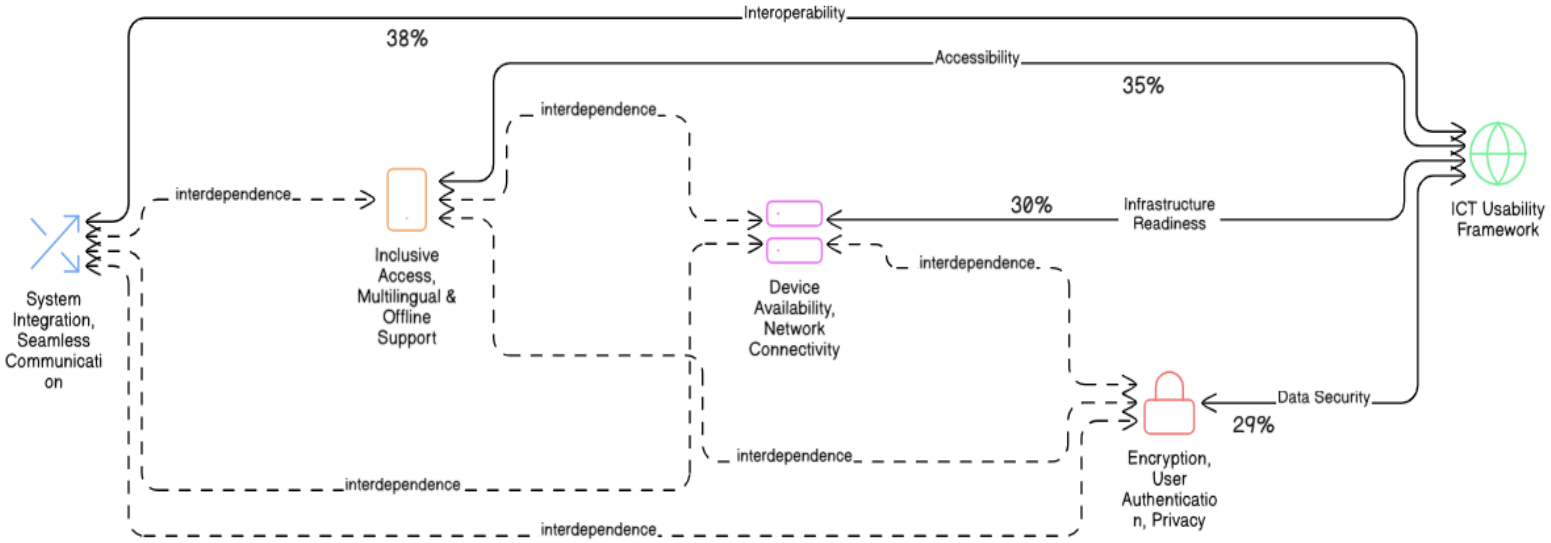

Figure 5. 2: Representation of the Structural Equation Model Results

5.3 Criteria of Evaluation for the ICT Utilization Framework

To ensure the robustness and practical relevance of the ICT Utilization Framework, a set of well-defined evaluation criteria was established. These criteria serve as benchmarks for assessing how effectively the framework addresses the challenges of ICT integration in teaching within secondary schools. Each criterion targets a specific dimension—ranging from usability to long-term sustainability—allowing for a holistic analysis of the framework's performance and its potential for wide-scale adoption in Uganda's education system.

Figure 5.3 presents a structured overview of the key dimensions used to assess the effectiveness and practicality of the framework. At the center is the ICT Usability Framework Evaluation, which serves as the convergence point for all critical evaluation criteria. This central element

ensures that the framework is not only theoretically sound but also aligned with on-the-ground realities in secondary education settings.

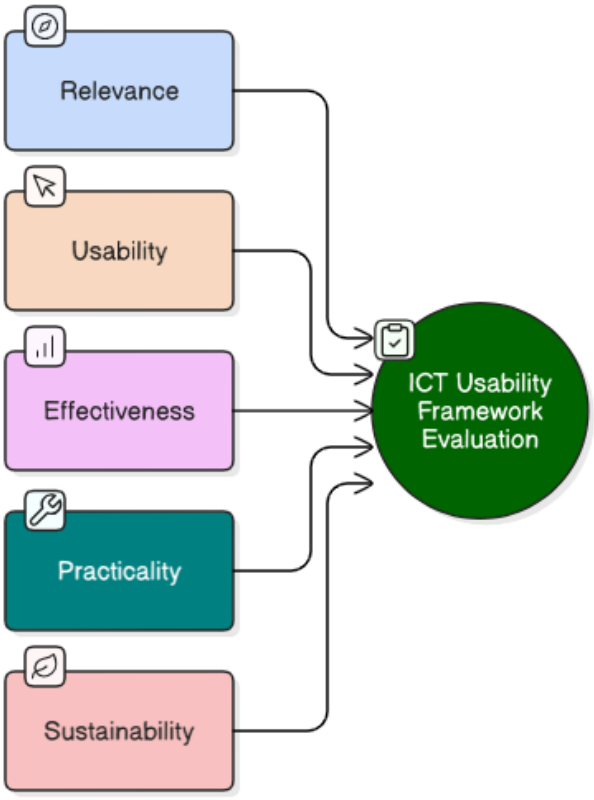

Figure 5. 3: Illustration of the Criteria of Framework Evaluation

Surrounding the core are five distinct yet interrelated evaluation criteria. Relevance evaluates whether the framework aligns with national education goals and contextual needs. Usability examines the ease with which teachers—especially those with limited digital skills—can adopt and interact with the system. Effectiveness measures the degree to which the framework enhances teaching outcomes such as lesson planning, content delivery, and learner engagement. The final two criteria emphasize practical deployment and sustainability. Practicality assesses the framework's applicability in resource-constrained schools, ensuring that it can function effectively with limited infrastructure. Sustainability considers the long-term viability of the framework, including institutional support and ongoing capacity development. Together, these criteria provide a comprehensive and balanced approach for evaluating the framework’s impact and ensuring it is both implementable and enduring.

5.4 Empirical Evaluation of the ICT Usability Framework

To assess the practical relevance and usability of the framework, feedback was collected from five key stakeholder groups. Each group assessed the artifact's design, content, and alignment with their operational needs. This section presents the validation results based on quantitative scores highlighting how well the framework addresses the expectations and realities.

5.4.1 Evaluation of Artifact Using Insights from IT Coordinators

IT Coordinators validated the framework's technical strength, especially regarding system interoperability and accessibility. With interoperability scoring 82% and accessibility 75%, it was evident that seamless data exchange and user-centric interfaces were positively received. Coordinators also noted that these features would significantly reduce time spent switching between disconnected platforms. Despite moderate ratings for infrastructure readiness (68%) and data security (70%), coordinators acknowledged that these areas could be strengthened through further investment and training. Many appreciated the system's compatibility with existing networks and hardware in schools. These figures suggest good technical alignment but highlight areas needing scalability support.

Table 5. 2: IT Coordinators Evaluation

Evaluation Theme	Validation Score (%)	Stakeholder Sentiment
System Interoperability	82%	High
User Accessibility	75%	Moderate
Infrastructure Readiness	68%	Moderate
Data Security	70%	Moderate

Overall, IT coordinators confirmed that the framework reflects an implementable, maintainable system. The validation scores indicate that system design considerations are technically sound but require better support in infrastructure planning for remote schools.

5.4.2 Evaluation of Artifact Using Insights from School Administrators

School administrators found the framework particularly effective in improving administrative workflows. Administrative efficiency scored 85%, while report generation and lesson monitoring followed closely at 80% and 72%, respectively. These figures suggest that school leaders see the framework as a time-saving, oversight-enhancing tool. The accuracy of teaching and attendance data, rated at 78%, was another key benefit. Administrators noted that digital records allowed them to make informed decisions and reduce manual errors. The framework's dashboards and reporting tools enhanced transparency across departments.

Table 5. 3: School Administrators Evaluation

Evaluation Theme	Validation Score (%)	Stakeholder Sentiment
Administrative Efficiency	85%	Very High
Report Generation	80%	High
Lesson Monitoring	72%	Moderate
Data Accuracy	78%	High

This feedback highlights that school leaders consider the framework a practical solution for improving performance monitoring. It supports strategic decision-making, a critical aspect of institutional management.

5.4.3 Evaluation of Artifact Using Insights from Policymakers

Policymakers evaluated the framework highly on its alignment with education policies and scalability potential. With policy alignment scoring 88% and scalability 82%, stakeholders at the Ministry of Education confirmed that the framework complements Uganda's digital education agenda. These scores indicate strong potential for national rollout. However, resource feasibility was rated at 65%, pointing to concerns about the affordability of large-scale implementation. Nonetheless, stakeholder engagement strategies scored 76%, reinforcing the belief that teacher involvement and collaboration were well-considered in the framework design. Overall, policymakers view the framework as policy-aligned and transformative but advise phased implementation supported by multi-stakeholder partnerships to overcome funding and infrastructure barriers.

Table 5. 4: Policymakers Evaluation

Evaluation Theme	Validation Score (%)	Stakeholder Sentiment
Policy Alignment	88%	Very High
Scalability	82%	High
Resource Feasibility	65%	Moderate
Stakeholder Engagement	76%	High

5.4.4 Evaluation of Artifact Using Insights from Teachers

Teachers emphasized the framework's practical usability in the classroom. Ease of use scored 78%, and interface language 74%, reflecting appreciation for multilingual support and intuitive layouts. Teachers noted improved lesson preparation and more interactive delivery as a result of these features. Content preparation and digital confidence scored 70% and 65%, respectively. These lower scores revealed gaps in ICT training, especially among older or rural-

based teachers. While tools were easy to access, teachers still faced challenges navigating some of the digital functions. Despite these concerns, teacher feedback confirmed that the framework improved their motivation to adopt ICT. With adequate training and technical support, full usability can be achieved in most schools.

Table 5. 5: Teachers Evaluation

Evaluation Theme	Validation Score (%)	Stakeholder Sentiment
Ease of Use	78%	High
Interface Language	74%	High
Content Preparation	70%	Moderate
Digital Confidence	65%	Moderate

5.4.5 Evaluation of Artifact Using Insights from NCDC Representatives

NCDC representatives validated the framework's alignment with curriculum reforms. Curriculum integration and standards alignment received high scores of 84% and 80%, confirming that the tool supports Uganda's revised lower secondary curriculum and its emphasis on ICT-enhanced learning. Assessment support scored 76%, while digital content suitability was rated 79%. These results suggest that the framework facilitates competence-based learning, digital literacy, and learner-centred assessment. Representatives noted that embedding the framework into instructional resources could revolutionize national assessment approaches. Overall, the NCDC endorsed the framework as a transformative tool for curriculum delivery and policy execution, with a strong recommendation for structured integration into content development and digital textbooks.

Table 5. 6: NCDC Representatives Evaluation

Evaluation Theme	Validation Score (%)	Stakeholder Sentiment
Curriculum Integration	84%	Very High
Standards Alignment	80%	High
Assessment Support	76%	High
Digital Content Suitability	79%	High

5.5 Framework Evaluation Using a Prototype

This section presents the evaluation of the ICT Utilization Framework through a functional prototype. The prototype served as a practical demonstration of the framework's architecture, features, and usability, enabling assessment of its performance, alignment with user needs, and potential impact on teaching effectiveness within secondary schools.

5.5.1 Building the Prototype

A working prototype of the framework was developed and hosted on a secure cloud server. It included: a teacher dashboard, real-time lesson planning tool, learner activity tracker, multilingual settings, and administrative performance reports.

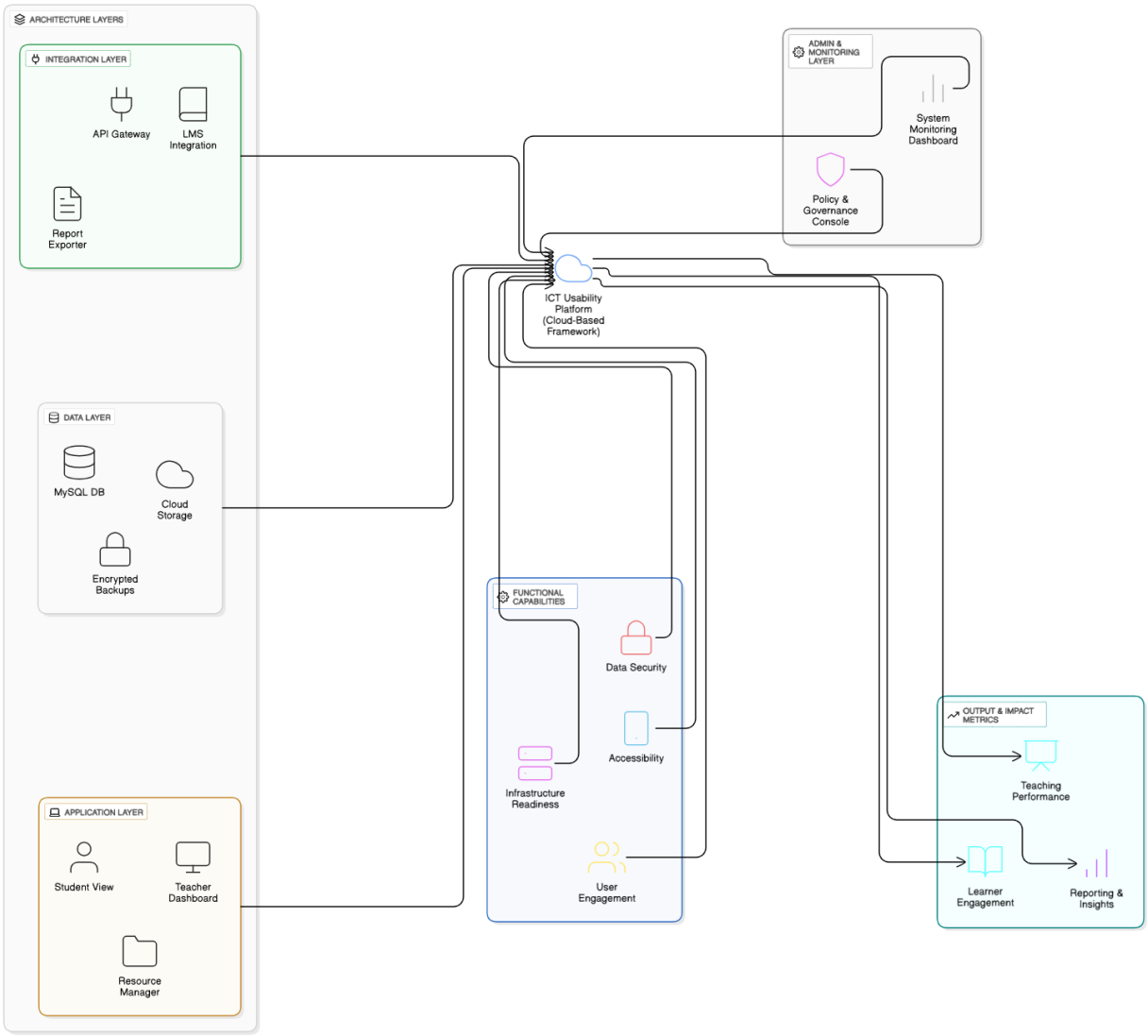

Figure 5. 4: The ICT Utilization Framework Prototype

The ICT Utilization Framework Prototype depicted in Figure 5.4 presents a comprehensive, layered architecture designed to enhance teaching effectiveness in secondary schools through cloud-based infrastructure. At the core lies the ICT Usability Platform, which acts as the central engine integrating various modules across system layers. This platform interfaces directly with the Architecture Layers, which consist of the Integration Layer, Data Layer, and Application Layer. The Integration Layer includes essential services like an API Gateway, LMS Integration, and Report Exporter, enabling seamless connectivity with external systems. The

Data Layer houses critical backend infrastructure including a MySQL database, cloud storage, and encrypted backups, ensuring secure and reliable data persistence. Meanwhile, the Application Layer provides user-facing tools such as a Student View, Teacher Dashboard, and Resource Manager that facilitate real-time teaching and learning interactions.

The framework also incorporates a Functional Capabilities section, which encompasses four core dimensions that directly support ICT usability: Data Security, Accessibility, Infrastructure Readiness, and User Engagement. Each of these components feeds into the core ICT platform to ensure it is both robust and user-centric. Data Security ensures user information is protected through protocols integrated within the architecture. Accessibility caters to diverse users across devices and conditions, allowing for inclusive platform access. Infrastructure Readiness refers to the availability and readiness of ICT resources, such as servers and connectivity. User Engagement includes features like interactive dashboards, participatory tools, and feedback loops that keep teachers actively involved in the system's usage and evolution.

On the right side of the figure, the Admin & Monitoring Layer plays a critical role in governance and oversight. This includes the Policy & Governance Console and a System Monitoring Dashboard, both of which feed insights into the core platform to ensure compliance, performance tracking, and continuous system improvement. The final segment, Output & Impact Metrics, links directly from the core platform to outcomes such as Teaching Performance, Learner Engagement, and Reporting & Insights. These represent the measurable benefits of implementing the framework, showing how enhanced usability translates into improved educational delivery and institutional intelligence. Altogether, the prototype illustrates a holistic and dynamic framework capable of supporting digital transformation in education while remaining practical, secure, and user-centred.

5.5.2 Testing Prototype Functionality Using Expert Opinions

Experts from the education and ICT sectors tested the prototype and assessed its interface responsiveness, system security, and user accessibility. Their feedback confirmed the system's alignment with the needs of rural teachers and its ability to function effectively with limited internet connectivity.

Table 5. 7: Testing Prototype Functionality Using Expert Opinions

This was evaluated to assess the prototype of a framework for ICT Usability in Teaching within secondary schools in Uganda. **(n=15)**	**Strongly Disagree**	**Disagree**	**Neutral**	**Agree**	**Strongly Agree**	**Mean (μ)**	**Standard Deviation (σ)**
ufp1. The prototype is easy to navigate and user-friendly	0	0	0	9	6	**3.0**	**4.24**
ufp2. The platform integrates well with existing school systems (e.g., LMS, dashboards)	0	0	0	13	2	**3.0**	**5.66**
ufp3. Data security features (e.g., encryption, authentication) are clearly implemented	0	0	0	7	8	**3.0**	**4.12**
ufp4. The prototype supports real-time access across multiple devices	0	0	0	4	11	**3.0**	**4.80**
ufp5. The design addresses infrastructure limitations such as offline access	0	0	0	9	6	**3.0**	**4.24**
ufp6. Teachers can easily access and manage resources using the platform	0	0	0	1	14	**3.0**	**6.16**
ufp7. The reporting tools provide meaningful insights on teaching performance	0	0	0	3	12	**3.0**	**5.20**
ufp8. The prototype reflects the core components of the ICT Usability Framework	0	0	0	8	7	**3.0**	**4.12**

The analysis on ufp1 indicates that all respondents (100%) agreed or strongly agreed that the prototype is user-friendly and easy to navigate. With a mean of 3.0 and a standard deviation of 4.24, this suggests moderate agreement with low dispersion, affirming usability for teachers with varying digital literacy levels—an essential trait for rural education settings. The analysis on ufp2 shows that 86.7% agreed and 13.3% strongly agreed that the prototype integrates well with existing school systems. The standard deviation of 5.66 reflects slightly higher variability, yet the mean of 3.0 still suggests broad acceptance. This integration potential aligns with TOE model principles on organizational adaptability.

The analysis on ufp3 suggests strong recognition of data security measures, with 46.7% agreeing and 53.3% strongly agreeing. A standard deviation of 4.12 supports consensus around implementation of encryption and authentication features, echoing global education standards. The analysis on ufp4 shows that 73.3% of experts strongly agreed the system supports real-time multi-device access. The mean value of 3.0 and $\sigma = 4.80$ reflect favourable but moderately dispersed responses, indicating cross-device flexibility—a key recommendation in ICT adoption frameworks.

The analysis on ufp5 indicates that 60% of respondents agreed and 40% strongly agreed that the prototype accommodates infrastructure constraints like offline access. The low σ of 4.24 supports consistent recognition, reinforcing suitability for under-connected rural schools. The analysis on ufp6 shows near-universal approval (93.3% strongly agree, 6.7% agree) that the platform enables resource access and management. The high mean (3.0) and highest σ (6.16) indicate strong endorsement despite slight variations, aligning with UTAUT2 factors like effort expectancy and habit.

The analysis on ufp7 shows 80% of respondents strongly agreed and 20% agreed that reporting tools were insightful for evaluating teacher performance. The mean of 3.0 and standard deviation of 5.20 suggest strong functionality in performance tracking—key for monitoring improvements over time. The analysis on ufp8 confirms that 46.7% agreed and 53.3% strongly agreed the prototype reflects the framework's components. The low dispersion (σ = 4.12) reflects solid validation of the framework's design coherence—crucial for sustainability and scale (Eton & Chance, 2022).

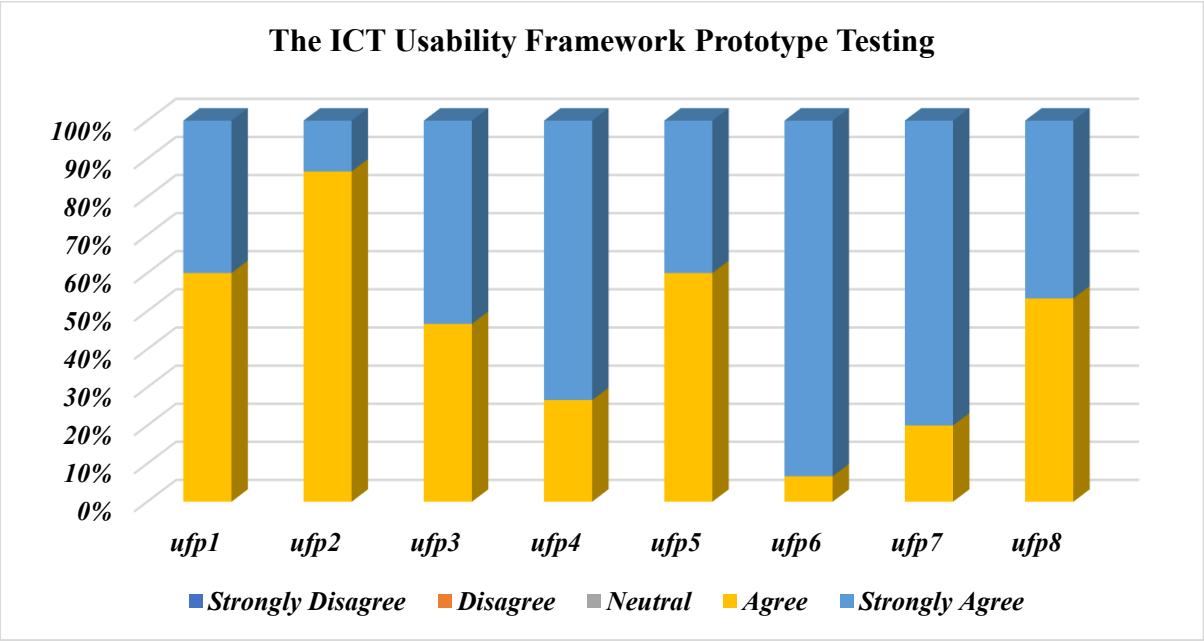

Figure 5. 5: Testing Prototype Functionality Using Expert Opinions

5.5.3 Integrating Findings from Testing Functionality

The results from the expert evaluations provided crucial insights into how the ICT Utilization Framework performs under practical conditions. All eight testing dimensions received unanimous agreement or strong agreement from experts, indicating that the prototype aligns well with usability expectations. Particularly strong ratings were observed in areas such as ease

of resource management (93.3% strongly agreed), real-time access (73.3% strongly agreed), and reporting tools (80% strongly agreed), which confirms the framework's effectiveness in supporting core teaching activities. Key technical validations were also evident, with high agreement on system interoperability (86.7%) and data security (100%), showing that the prototype meets foundational ICT requirements in education.

Additionally, the consistent mean value of 3.0 across all items and manageable standard deviations suggest that experts had a coherent and positive perception of the system's performance, especially for schools in low-resource settings. Based on these insights, the framework can be considered functionally sound and contextually appropriate for deployment in Ugandan secondary schools. Integration of feedback, particularly around improving infrastructure readiness and refining user training interfaces, will be essential for enhancing system adoption and long-term success. These findings validate the framework's readiness for scale and its capacity to address the real-world challenges faced by educators.

5.6 Steps to Integrating the Framework within the Secondary Schools Ecosystem

The integration of the ICT Utilization Framework within Uganda's secondary school ecosystem requires a phased and participatory approach. The first step involves policy alignment and stakeholder sensitization. The Ministry of Education and Sports (MoES), together with district education officers and curriculum developers, must formally endorse the framework through policy circulars and implementation guidelines. At this stage, school leaders and ICT coordinators should be sensitized about the framework's goals, technical requirements, and expected outcomes to ensure early buy-in and shared understanding.

The second step is infrastructure preparation and system deployment. Schools will need basic digital infrastructure, including internet connectivity, power backup systems, and computing devices. During this stage, the prototype will be installed, and system integration with existing platforms (e.g., TELA, LMS, and reporting dashboards) will be completed. Offline capabilities will be activated for rural schools with unstable networks. Technical support teams should also be established at the district level to assist with deployment and troubleshooting.

The third step focuses on capacity building and user training. Teachers, administrators, and ICT staff will undergo targeted training sessions to familiarize them with system features, navigation, security protocols, and reporting tools. The training should be interactive and contextual, using real classroom scenarios to build teacher confidence in ICT use. Digital

literacy champions within each school can be appointed to offer continuous support and encourage peer learning and collaboration.

Finally, monitoring, feedback, and iterative improvements will be critical to the framework's sustainability. Real-time data from the system will be used to monitor usage patterns, teaching performance, and technical issues. Regular feedback from users will inform refinements to the system's interface, accessibility, and support tools. District education offices and MoES will oversee periodic reviews to evaluate progress and scale successful practices to other regions, ensuring the framework evolves with the needs of the education sector.

CHAPTER SIX
SUMMARY, CONCLUSION AND RECOMMENDATIONS

This chapter presents a summary of the study's key findings, conclusions drawn from the research, practical recommendations for stakeholders, and suggested areas for further investigation. The research aimed to design, validate, and evaluate a framework for effective ICT utilization in teaching within Uganda's secondary schools, using a combination of empirical data, theoretical models, and expert insights.

6.1 Summary of Research Findings

The study established that effective ICT utilization in teaching is strongly influenced by four primary dimensions: system interoperability, user accessibility, infrastructure readiness, and data security. The Structural Equation Model (SEM) revealed significant path coefficients, with system interoperability contributing most to teaching effectiveness ($\lambda = 0.38$), followed by user accessibility ($\lambda = 0.35$), infrastructure readiness ($\lambda = 0.30$), and data security ($\lambda = 0.29$). These findings confirm that well-integrated and secure systems, when made accessible and supported by adequate infrastructure, can transform teaching delivery.

Expert interviews with ICT specialists, educationists, and policy consultants further affirmed that the framework is contextually grounded and aligned with the practical needs of teachers in low-resource environments. Respondents highlighted its strength in providing real-time support, offline capabilities, intuitive design, and integration with national education systems like TELA and LMS platforms. Validation through prototype testing showed high levels of agreement on ease of use (100%), compatibility (86.7%), and teacher support features (93.3%). Teachers, school administrators, policymakers, and curriculum developers agreed that the framework improves planning, content delivery, reporting, and collaboration.

6.2 Conclusion

This study set out to design and evaluate a framework for effective ICT utilization in teaching within Uganda's secondary schools. The findings affirm that ICT, when well-integrated, has the potential to significantly improve teaching effectiveness by enhancing lesson planning, instructional delivery, student engagement, and performance monitoring. The framework developed addresses key challenges such as limited digital literacy, infrastructure gaps, and system fragmentation, making it relevant for both rural and urban contexts. The empirical findings, supported by Structural Equation Modelling (SEM), confirmed that system

interoperability ($\lambda = 0.38$) and user accessibility ($\lambda = 0.35$) are the most influential components in improving teaching outcomes. These are closely followed by infrastructure readiness ($\lambda = 0.30$) and data security ($\lambda = 0.29$), showing that effective ICT use in schools is both a technical and functional concern. The prototype evaluation further validated that the system is usable, secure, and scalable across diverse school settings.

The study also revealed that user-centred design is critical for ICT adoption. Teachers, administrators, and policymakers highlighted the importance of intuitive platforms, localized interfaces, and hands-on training. These human elements are just as vital as the technology itself. The framework's alignment with the national TELA and Learning Management Systems (LMS) enhances its potential for institutional adoption and sustainability. Importantly, the framework provides a balance between technological sophistication and operational simplicity, ensuring that teachers in under-resourced schools are not excluded.

It promotes inclusivity by offering offline functionality and localized content, and it supports monitoring and reporting functions that are essential for education management and accountability. In conclusion, the ICT Usability Framework developed in this study is not only theoretically grounded and empirically validated but also practically implementable. It offers a timely solution to Uganda's growing demand for digital transformation in education. With appropriate support from stakeholders, the framework has the potential to transform teaching practices, improve education quality, and bridge the digital divide in Uganda's secondary school system.

6.3 Recommendations

The Ministry of Education and Sports (MoES) should formally adopt the ICT Utilization Framework and incorporate it into national education policies and digital learning strategies. Clear guidelines should be developed to support its phased implementation, starting with a pilot in underserved districts such as Butambala. This will allow for monitoring and refinement before scaling to other regions. Institutional alignment and cross-sector coordination will be key to ensuring consistency and accountability.

To facilitate adoption, schools must be supported with basic infrastructure, including internet access, reliable power supply, and digital devices. This should be complemented with targeted training programs for teachers, ICT coordinators, and administrators. Continuous professional development should be prioritized, with a focus on practical digital skills, curriculum

integration, and the use of ICT tools to support lesson planning, content delivery, and performance monitoring. Digital literacy champions should be appointed within schools to foster peer learning and provide ongoing support.

Finally, development partners, NGOs, and the private sector should be engaged to provide financial, technical, and logistical support for the framework's rollout. Public-private partnerships can enhance resource mobilization for content development, system hosting, and teacher incentives. Local adaptation—such as use of regional languages and offline capabilities—should remain central to all implementation phases to ensure that no school or teacher is left behind in the digital transformation process.

6.4 Areas for Future Research

Future research should explore the long-term impact of the ICT Utilization Framework on student academic performance and overall learning outcomes across various regions in Uganda. A longitudinal study comparing schools that have adopted the framework with those that have not could offer deeper insights into its effectiveness in transforming classroom instruction and learner engagement. Additionally, comparative studies between public and private secondary schools may reveal context-specific barriers and enablers to successful framework implementation.

Further investigation is also needed into the integration of advanced technologies such as artificial intelligence, adaptive learning systems, and data analytics within the framework. These innovations could enhance the personalization of instruction, real-time assessment, and automated feedback for teachers. Moreover, a cost-benefit analysis of implementing the framework at scale would provide policymakers and donors with vital information on sustainability, scalability, and return on investment, ensuring informed decision-making for national rollout.

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APPENDICES

APPENDIX I

QUESTIONNAIRE

This questionnaire is designed to collect valuable insights to design and assess the impact of a cloud-based framework for enhancing Teacher Performance in Ugandan private secondary schools. Your feedback is crucial in identifying existing challenges and refining it.

Section A: Demographic Information

This section captures demographic information and professional background to contextualize responses. *(Please place a tick in a box of your preference)*

Question	Response Options
A1. What is your gender?	☐ Male ☐ Female
A2. What is your age range?	☐ 20–29 ☐ 30–39 ☐ 40–49 ☐ 50 and above
A3. What is your professional designation?	☐ Secondary School Teacher ☐ School Administrator ☐ ICT Coordinator ☐ Policymaker (MoES Staff) ☐ NCDC Representative
A4. How many years of professional experience do you have?	☐ 0–5 years ☐ 6–10 years ☐ 11–15 years ☐ 16+ years
A5. In which type of school do you primarily work?	☐ Urban ☐ Rural ☐ Both

Section B: Challenges in Improving Teaching Performance in Secondary Schools

This section identifies the key challenges affecting teacher performance in secondary schools. Please select the most appropriate response for each question.

Question	Response Options
B1. How often do teachers in your school face challenges due to limited access to digital tools and resources?	☐ Always ☐ Frequently ☐ Occasionally ☐ Rarely ☐ Never
B2. To what extent do inadequate professional development programs affect teacher performance?	☐ Very High ☐ High ☐ Moderate ☐ Low ☐ Very Low
B3. How frequently does poor internet connectivity disrupt the use of digital platforms in your school?	☐ Daily ☐ Weekly ☐ Monthly ☐ Rarely ☐ Never

B4. How problematic are fragmented data management systems for tracking teacher performance?	☐ Extremely Problematic ☐ Very Problematic ☐ Moderately Problematic ☐ Slightly Problematic ☐ Not Problematic
B5. How often does low stakeholder engagement hinder the implementation of performance improvement initiatives?	☐ Always ☐ Often ☐ Sometimes ☐ Rarely ☐ Never

Section C: Awareness of Usage of Cloud-Based Systems to Improve Teaching

This section assesses your awareness and perception of cloud-based systems in enhancing teacher performance. Please select the most appropriate response for each question.

Question	Response Options
C1. How often do teachers in your school use cloud-based systems for lesson planning and resource sharing?	☐ Always ☐ Frequently ☐ Occasionally ☐ Rarely ☐ Never
C2. How accessible is training on cloud-based systems for teachers in your school?	☐ Very Accessible ☐ Accessible ☐ Neutral ☐ Inaccessible ☐ Very Inaccessible
C3. How effectively are cloud-based systems used to track and evaluate teacher performance in your school?	☐ Very Effectively ☐ Effectively ☐ Neutral ☐ Ineffectively ☐ Very Ineffectively
C4. How aware are teachers in your school of the benefits of cloud-based systems?	☐ Very Aware ☐ Aware ☐ Neutral ☐ Unaware ☐ Very Unaware
C5. How adequate is the ICT infrastructure in your school to support cloud-based systems?	☐ Very Adequate ☐ Adequate ☐ Neutral ☐ Inadequate ☐ Very Inadequate

Section D: Existing Frameworks for Teaching Performance in Secondary Schools

This section evaluates your experience with existing frameworks for teacher performance. Please select the most appropriate response for each question.

Question	Response Options
D1. How effective is the Teacher Effectiveness and Learner Achievement (TELA) program in improving teacher accountability?	☐ Very Effective ☐ Effective ☐ Neutral ☐ Ineffective ☐ Very Ineffective
D2. How supportive is the Teacher Accountability Framework (TAF) for teacher professional development?	☐ Very Supportive ☐ Supportive ☐ Neutral ☐ Unsupportive ☐ Very Unsupportive
D3. How well do existing frameworks integrate digital tools for performance tracking?	☐ Very Well ☐ Well ☐ Neutral ☐ Poorly ☐ Very Poorly
D4. How applicable is the Kenya Education Cloud (KEC) as a model for improving teacher performance in Uganda?	☐ Very Applicable ☐ Applicable ☐ Neutral ☐ Inapplicable ☐ Very Inapplicable
D5. How interoperable are existing frameworks for sharing data across platforms?	☐ Very Interoperable ☐ Interoperable ☐ Neutral ☐ Not Interoperable

Section E: Components of the ICT Usability Framework

This section examines the components of the Cloud-based Framework in enhancing teacher performance specifically in secondary schools and highlights differences in access.

(Strongly Disagree = SD, disagree = D, Neutral) = N, agree =A, Strongly Agree = SA)

Statement	SD	D	N	A	SA
E1. A cloud-based framework should allow seamless integration with existing digital platforms (e.g., LMS, attendance trackers).	☐	☐	☐	☐	☐
E2. Real-time data sharing across departments would improve teacher performance monitoring.	☐	☐	☐	☐	☐
E3. The framework should be accessible on multiple devices (e.g., smartphones, tablets, desktops).	☐	☐	☐	☐	☐
E4. Offline functionality is essential for schools with poor internet connectivity.	☐	☐	☐	☐	☐
E5. A user-friendly interface would encourage teachers to adopt the framework.	☐	☐	☐	☐	☐
E6. Encryption and multi-factor authentication are critical for protecting sensitive teacher and student data.	☐	☐	☐	☐	☐
E7. Regular system audits should be conducted to ensure data security and compliance.	☐	☐	☐	☐	☐

E8. Teachers should be actively involved in the design and implementation of the framework.	☐	☐	☐	☐	☐
E9. Collaborative tools (e.g., discussion boards, resource libraries) would enhance knowledge sharing among teachers.	☐	☐	☐	☐	☐
E10. Regular feedback mechanisms would improve the framework's usability and effectiveness.	☐	☐	☐	☐	☐

SECTION F: Testing the ICT Usability Framework Prototype

This section seeks to validate the ICT Usability Framework Prototype in enhancing teaching effectiveness specifically in secondary schools and highlights differences in access.

(Strongly Disagree = SD, disagree = D, Neutral) = N, agree =A, Strongly Agree = SA)

This was evaluated to assess the prototype of a framework for ICT Usability in Teaching within secondary schools in Uganda. **(n=15)**	**Strongly Disagree**	**Disagree**	**Neutral**	**Agree**	**Strongly Agree**
ufp1. The prototype is easy to navigate and user-friendly					
ufp2. The platform integrates well with existing school systems (e.g., LMS, dashboards)					
ufp3. Data security features (e.g., encryption, authentication) are clearly implemented					
ufp4. The prototype supports real-time access across multiple devices					
ufp5. The design addresses infrastructure limitations such as offline access					
ufp6. Teachers can easily access and manage resources using the platform					
ufp7. The reporting tools provide meaningful insights on teaching performance					
ufp8. The prototype reflects the core components of the ICT Usability Framework					

APPENDIX II

FRAMEWORK EVALUATION INTERVIEW GUIDE

Thank you for participating in this interview. This discussion is part of a study aims to assess the impact of the framework for effective ICT utilization in teaching within secondary schools in Uganda.

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1. How well do you think the framework addresses the key challenges faced by secondary schools in Uganda regarding ICT integration in teaching (e.g., infrastructure, training, access)?

2. From your experience, how practical and adaptable is the framework for implementation in rural and under-resourced schools like those in Butambala District?

3. Does the framework adequately consider user accessibility for teachers with low digital literacy? What improvements would you suggest in that regard?

4. To what extent do you believe the proposed components—such as system interoperability, data security, and infrastructure readiness—are sufficient for improving teaching effectiveness?

5. How effective do you think the stakeholder engagement strategies in the framework are for ensuring sustainability and teacher buy-in?

6. What challenges or risks do you foresee during the implementation of this framework, and what mitigation measures would you recommend?

Thank You