



Original Article

Institutional Mediation and Teacher Engagement: A Contextual Model for E-Learning Uptake in Uganda's Universal Secondary Education Schools

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Digital Competence.*

This study, titled "Institutional Mediation and Teacher Engagement: A Contextual Model for E-Learning Uptake in Uganda's Universal Secondary Education Schools," investigates the strategies employed by teachers to overcome barriers to e-learning adoption within low-resource educational settings. Specifically, it explores how teachers in Kampala-based USE schools adapt to infrastructural, institutional, and pedagogical challenges, and proposes a contextual model to guide future integration efforts. Guided by the overarching objective to identify teacher-led strategies for navigating e-learning challenges, the study employed a convergent parallel mixed-methods design, combining quantitative data from 393 teachers and qualitative insights from 10 headteachers across all USE schools in Kampala City. Data were collected through structured questionnaires and semi-structured interviews, with rigorous procedures to ensure validity, trustworthiness, and triangulation. The findings reveal that teachers employed a combination of personal, peer-based, and institutionally facilitated strategies, including the use of personal devices, offline content sharing, peer mentorship, rotational scheduling, and community-supported ICT resource mobilisation. Despite their creativity and adaptability, these coping mechanisms were often fragmented, inconsistent, and dependent on individual initiative rather than system-wide planning. Qualitative insights underscored the critical role of empathetic leadership, flexible budgeting, and informal CPD structures in supporting these grassroots innovations. Drawing on Constructivism, Connectivism, Technology-Mediated Learning Theory (TMLT), and the Unified Theory of Acceptance and Use of Technology (UTAUT), the study developed the Institutionally Mediated E-Learning Uptake Model (IMELUM). This model highlights the dynamic interplay between infrastructural readiness, leadership support, teacher competence, and institutional culture as key mediators of sustainable e-learning engagement. The study concludes that while teacher-led coping strategies are commendable, they are insufficient without systemic institutional support, strategic policy alignment, and sustained investment. It recommends formalising grassroots innovations into national digital education frameworks, strengthening school-level professional

development, and incentivising collaborative partnerships. Suggested directions for further research include: evaluating the long-term impact of peer mentorship on e-learning competence, assessing the role of institutional leadership in sustaining digital transformation, and investigating scalable funding models for ICT integration in secondary schools.

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INTRODUCTION

E-learning has gained increasing global recognition as a catalyst for expanding access to education, enhancing instructional flexibility, and addressing infrastructural limitations in both developed and developing contexts (Peck, 2025; Bashir & Lapshun, 2025). In Uganda, particularly under the Universal Secondary Education (USE) policy, the promise of e-learning is especially relevant given the persistent constraints of overcrowded classrooms, limited physical infrastructure, and uneven teacher deployment. Although digital technologies have been introduced to complement conventional instruction, uptake in USE schools remains limited—despite central Uganda being relatively well-resourced in terms of connectivity and ICT infrastructure (Kemp, 2024; UCC, 2024). This paradox raises critical questions about the conditions and lived realities shaping teachers' engagement with e-learning tools.

While prior research in Uganda has explored technical barriers and platform-based trials (Walekhwa et al., 2022; Komuhangi et al., 2022), limited attention has been paid to the experiences of academic staff, their perceptions, coping strategies, and pedagogical adaptations in using digital technologies. Moreover, much of the African literature has concentrated on higher education contexts (Kisanjara & Maguya, 2024), leaving secondary-level implementation underexamined. In Kampala, where digital infrastructure is relatively advanced, the low uptake of e-learning suggests that infrastructural availability alone does not guarantee meaningful integration. This underscores the need to move beyond hardware-centric explanations toward a more nuanced, human-centred understanding of how institutional and personal dynamics influence adoption.

To address this gap, the current study critically investigates the lived experiences of teachers in USE schools in central Uganda, with a particular focus on how they engage with, adapt to, and

navigate the opportunities and constraints of e-learning. The analysis is framed through a multi-theoretical lens combining constructivism (Piaget, 1973; Vygotsky, 1978), connectivism (Siemens, 2005), technology-mediated learning theory (Bower, 2019), and the Unified Theory of Acceptance and Use of Technology (UTAUT) (Venkatesh et al., 2003). These theories collectively illuminate the interplay between individual agency, social collaboration, technological affordances, and institutional factors that shape e-learning behaviours in school environments.

Drawing on empirical data and grounded in these theoretical perspectives, this study culminates in the development of the **Institutionally Mediated E-Learning Uptake Model (IMELUM)**, a conceptual model that explains how teacher engagement with e-learning is influenced by the dynamic interaction of infrastructural readiness, leadership support, professional development, and institutional culture. IMELUM offers a structured framework for understanding the conditions under which e-learning can transition from sporadic use to sustained pedagogical transformation in USE schools. By centring teacher experience and institutional context, the study contributes to more targeted strategies for improving e-learning uptake and sustainability in secondary education systems across low-resource settings.

LITERATURE REVIEW

Theoretical Review

This study was anchored in four complementary theories—Constructivism, Connectivism, Technology-Mediated Learning (TML) Theory, and the Unified Theory of Acceptance and Use of Technology (UTAUT)—which together provide a comprehensive framework for understanding e-learning uptake in Universal Secondary Education (USE) schools in Central Uganda. These theories were deliberately chosen to capture the interplay of individual, institutional, pedagogical, and technological factors shaping adoption.

Constructivism, advanced by Piaget (1973) and Vygotsky (1978), emphasises learners' active role in creating knowledge through interaction. In this study, it illuminated how students engaged with self-directed tasks and collaborative activities on platforms such as Zoom and WhatsApp, and how teachers designed interaction-rich e-learning experiences. Vygotsky's social dimension directly resonated with the Ugandan USE context, where peer collaboration and teacher scaffolding are essential to sustaining engagement in resource-limited classrooms.

Connectivism, introduced by Siemens and Downes (2005), extended this analysis to networked learning, explaining how USE students accessed information from multiple sources and how teachers served as knowledge nodes within these digital networks (Jailani et al., 2023; Alam, 2023). This framework was especially useful in assessing interoperability of platforms and the facilitation of networked learning in environments where both formal and informal digital resources coexisted.

Technology-Mediated Learning (TML) Theory (Bower, 2019) focused on the mediating role of technology in teaching and learning by enabling content delivery, interaction, and feedback. Within USE schools, it offered insights into how teachers integrated e-learning into lesson planning, assessment, and feedback despite infrastructural challenges (Masagazi et al., 2024). However, because TML emphasises functionality over socio-behavioural conditions, it required supplementation from UTAUT. UTAUT (Venkatesh et al., 2003) was therefore applied to explain behavioural intentions and actual use, focusing on performance expectancy, effort expectancy, social influence, and facilitating conditions. In the Ugandan USE context, it clarified how teachers' perceptions of usefulness, ease of use, and institutional support influenced their willingness and confidence to adopt ICT in everyday teaching. By bridging motivational, infrastructural, and institutional dimensions, UTAUT addressed the limitations of

the other three frameworks. Whereas previous Ugandan studies, such as Atukunda et al. (2024), concentrated on university-level e-learning satisfaction, this study deliberately extended theoretical application to secondary schools, thereby filling a contextual and educational-level gap. By combining the four perspectives, it constructed a holistic lens through which to interpret how teachers and students navigate e-learning in under-resourced yet digitally evolving school systems.

Strategic Actions for Dealing with Barriers to E-Learning Uptake

Extant research has proposed diverse strategies to overcome barriers to e-learning (Liu et al., 2019; Wang et al., 2019; Roque-Hernández et al., 2024; Suen & Hung, 2024; Turk et al., 2024). However, most of these insights derive from higher education in technologically advanced settings, leaving secondary schools in low-resource contexts underexplored. This study, therefore, examined how such strategies manifest in USE schools, situating them within the realities of limited infrastructure, teacher capacity, and institutional support.

Turk et al. (2024) demonstrated the value of peer study groups and multimodal resources in U.S. universities, while Roque-Hernández et al. (2024) emphasised instructor–student interaction as critical for overcoming asynchronous challenges. Yet, both studies overlooked the resource and cultural constraints facing Ugandan USE schools. Similarly, Suen and Hung (2024) and Wang et al. (2022) highlighted the promise of synchronous tools such as Zoom, but such assumptions of stable connectivity are less applicable in Uganda, where bandwidth and electricity are often unreliable.

Other strategies, such as enhancing teacher presence (Chew, 2022; Yuyun, 2023), increasing parental involvement (Stevens & Borup, 2015; Andrada & Barrot, 2025), and continuous teacher training (Bada et al., 2020; Eze et al., 2020), have also been

documented. Nonetheless, these studies either focused on non-African contexts or on university-level educators, leaving secondary-level realities unaddressed. The current study, therefore, investigated how teachers in USE schools adapt such strategies in practice, especially given their limited ICT competencies and restricted access to training opportunities. Finally, institutional support and resourcing remain decisive. Recommendations for subsidising ICT and improving infrastructure (Pavela et al., 2015; Kibuku et al., 2020; Abera et al., 2023) often presume financial adequacy, which is rarely the case in Ugandan secondary schools. By examining institutional readiness, allocation of resources, and their impact on teacher and student experiences, this study addressed a critical institutional and technological gap.

In summary, while global scholarship offers a wide range of strategies for enhancing e-learning, most have been tested in resource-rich university settings. By contextualising these strategies within Ugandan USE schools and examining both teacher and student perspectives, this study contributes new insights into contextually viable approaches for promoting sustainable e-learning uptake in secondary education.

MATERIALS AND METHODS

Sample Size and Selection

The qualitative component of the study involved a purposive sample of ten headteachers. This number was guided by the principle of data saturation, defined as the point at which no new themes or insights emerge from additional interviews (Hennink & Kaiser, 2022). The interviews were designed to elicit detailed, contextually grounded perspectives that aligned with the study objectives. Data analysis was conducted concurrently with data collection to monitor thematic saturation, which ultimately confirmed the adequacy of the sample size (Guest, Namey, & Chen, 2020; Saunders et al., 2019). For the quantitative component, the sample comprised teachers drawn from a finite population

of 393. The sample size was statistically determined using Yamane's (1967) formula, which is widely used for calculating sample size from known populations. This approach ensured representativeness and minimised sampling error. With respect to school selection, a universal sampling strategy was employed to include all ten Universal Secondary Education (USE) schools within Kampala City. This method is suitable for small populations and ensures that each unit is given equal consideration (Kamalloo et al., 2022; Abbas et al., 2023). These schools were targeted on the basis of their participation in Uganda's UCUSAF programme, which supports the rollout of e-learning through investments in ICT laboratories, digital content, teacher training in ICT-integrated pedagogy, and improved internet connectivity (Partridge, 2023; Kituyi et al., 2024; Ministry of Education and Sports, 2024; UCC, 2024).

Data Quality and Error Control

To ensure the validity of the quantitative instrument, both content validity and confirmatory factor analysis were employed. Content validity was assessed through expert review, whereby three specialists in e-learning evaluated each questionnaire item for relevance. Items were rated as either relevant (R) or irrelevant (IR), and the Content Validity Index (CVI) was computed accordingly. A CVI score exceeding 0.7 was considered acceptable, in line with standards suggested by Yusoff (2019) and Madadzadeh and Bahariniya (2023). Where necessary, questionnaire items were revised to enhance validity. For the qualitative data, trustworthiness was established through adherence to the four criteria outlined by Lincoln and Guba: credibility, transferability, dependability, and confirmability (Forero et al., 2018; Mattick et al., 2018; Stahl & King, 2020; Hayashi et al., 2021). Techniques such as triangulation, peer debriefing, and audit trails were applied to enhance the reliability and robustness of the findings.

Data Collection and Analysis

Data were collected using two main instruments: a semi-structured interview guide for the qualitative component and a structured questionnaire for the quantitative component. The mixed-methods approach enabled the triangulation of insights, enhancing the depth and credibility of findings. Quantitative data were analysed using both descriptive and inferential statistical techniques. Descriptive measures included means, medians, and standard deviations to summarise the variables. Inferential tests such as t-tests, chi-square tests, and analysis of variance (ANOVA) were employed to explore group-level differences. Multiple regression analysis was conducted to examine predictive relationships between variables. In addition, exploratory factor analysis was used to verify the construct validity of the questionnaire, following best practices outlined by Kamal et al. (2022). Qualitative data were analysed using thematic analysis, an approach particularly suited for identifying recurring patterns and meanings in textual data (Masagazi *et al.*, 2024; Renjith et al., 2021; Im et al., 2023). The analysis followed a systematic process involving data familiarisation, coding, theme development, and refinement.

Ethical Considerations

Ethical approval for the study was obtained from the Uganda Christian University Research Ethics Committee (UCUREC) – UCUREC-2024-909, which reviewed and approved the Informed Consent Form, Community Engagement Plan, and Risk Management Plan. Following this approval, the Uganda National Council for Science and Technology (UNCST) - SS4059ES granted national clearance to proceed with the study. Subsequent to ethical clearance, the researcher formally engaged with all selected USE schools in Kampala City. Permissions were sought from school authorities prior to data collection, and informed consent was obtained from all participants. Participation was voluntary, and confidentiality and anonymity were

assured throughout the research process in accordance with established ethical guidelines.

RESULTS AND DISCUSSION

This section presents the empirical findings of the study, organised into **quantitative** and **qualitative** components. The results aim to illuminate the lived experiences and coping strategies of academic staff in USE schools in Central Uganda in response to challenges encountered in e-learning uptake. These findings directly informed the development of the **Institutionally Mediated E-Learning Uptake Model (IMELUM)** by revealing how institutional

inputs and teacher-level agency interact to shape engagement with digital instruction.

Quantitative Analysis of Coping Strategies

Table 1 below summarises the descriptive statistics of coping mechanisms adopted by teachers in response to technical, infrastructural, and managerial challenges associated with e-learning. These mechanisms were examined through indicators such as individual resourcefulness, prior exposure to digital tools, requisitioning behaviour, and perceptions of institutional responsiveness.

Table 1: Descriptive Statistics of Reported Coping Mechanisms among Teachers (N = 393)

Variable	Mean	Std. Dev
I have received adequate prior exposure to e-learning	2.61	1.30
I personally support e-learning as the best solution	2.65	1.32
Improving internet connectivity is a must	2.58	1.32
Improving the speed of the internet is necessary	2.62	1.31
I use a personal device when school ICT is down	2.65	1.29
I use a personal modem/Wi-Fi when the school internet is down	2.67	1.31
I requisition the inputs I need to teach	2.70	1.37
School management solves queries about e-learning quickly	2.66	1.30

Source: Primary data

Descriptive analysis of these items revealed a **moderate level of endorsement** across all coping strategies. For instance, teachers moderately agreed that they had received some level of prior exposure to e-learning (M = 2.61, SD = 1.30), though the standard deviation suggests variability in access and preparedness. Similarly, the endorsement of e-learning as a viable solution (M = 2.65, SD = 1.32) indicated a mildly positive attitude among educators, despite the systemic constraints faced.

Responses also reflected clear **infrastructural concerns**, with moderate agreement on the necessity of improving internet connectivity (M = 2.58, SD = 1.32) and speed (M = 2.62, SD = 1.31). These items point to structural barriers that must be addressed for any long-term e-learning intervention to succeed, an insight foundational to IMELUM's focus on **infrastructure readiness** as a core input.

Teachers demonstrated adaptive behaviours in response to technological breakdowns. The use of personal devices (M = 2.65, SD = 1.29) and personal internet sources (M = 2.67, SD = 1.31) revealed that educators often **substituted institutional inadequacies with private resources**, showing a degree of personal agency and digital resilience, key themes represented in IMELUM's **mediating constructs** of digital competence and individual support networks.

Additionally, the act of **requisitioning instructional inputs** (M = 2.70, SD = 1.37) and the perceived **responsiveness of school management** (M = 2.66, SD = 1.30) underscored a moderate level of engagement with institutional processes. These behaviours reflect a **partnership dynamic** between staff and leadership, aligning with IMELUM's emphasis on **leadership support** and **institutional culture** as enablers of e-learning engagement.

Coping Strategies Employed by Teachers in Response to E-learning Challenges

The quantitative findings revealed that teachers in USE schools employed a range of coping strategies to address persistent technical, infrastructural, and managerial barriers to e-learning. As summarised in Table 1, all coping indicators received **moderate levels of agreement**, with mean scores ranging between 2.58 and 2.70. These results suggest that while the coping mechanisms were neither weak nor highly robust, they represented meaningful efforts by teachers to navigate a difficult digital teaching landscape.

To begin with, **prior exposure to e-learning** was reported at a moderate level ($M = 2.61$, $SD = 1.30$), indicating that while most teachers had interacted with digital platforms, few had received comprehensive training. **Importantly**, this limited exposure was supplemented through informal, community-driven initiatives. For example, *“The Ministry’s CPD sessions are irregular, so we rely heavily on peer-led initiatives. Occasionally, I bring in alumni working in tech to train our staff”* (HTA01). Similarly, HTC03 explained that *“CPD workshops opened teachers’ minds to the usefulness of LMS platforms... improving their confidence with troubleshooting”*. These insights highlight the emergence of internal peer-learning systems as compensatory mechanisms for gaps in formal training.

Moreover, teachers expressed moderate support for e-learning as a pedagogical solution ($M = 2.65$, $SD = 1.32$). This attitude, while not overwhelmingly enthusiastic, reflected an evolving acceptance of digital methods. *As HTB02 noted, “Before CPDs, many teachers avoided tech. Now they at least try, especially after learning from colleagues during sessions”*. This transition from avoidance to experimentation was reinforced by learner engagement strategies, such as WhatsApp-based communication. For instance, *“Teachers create WhatsApp groups to engage students outside class. One teacher even shared pre-recorded audio notes*

with learners who missed class” (HTE05). These reflections demonstrate how shifts in mindset have gradually translated into practical engagement.

In addition, teachers exhibited a high level of **resourcefulness** in managing technological shortcomings. The data revealed that personal device use ($M = 2.65$, $SD = 1.29$) and reliance on personal internet access ($M = 2.67$, $SD = 1.31$) were common coping approaches. This was clearly illustrated by HTA01, who observed, *“Teachers are very resourceful—they download content at night when the internet is cheaper and use Bluetooth to share with colleagues”*. Likewise, HTC03 remarked, *“Most teachers carry personal phones with educational apps... even showing short clips from YouTube using their own data”*, reflecting a deep personal investment in maintaining instructional continuity.

Furthermore, proactive behaviours such as requisitioning materials were reported frequently ($M = 2.70$, $SD = 1.37$), signifying teachers' engagement with institutional processes to access needed resources. This was evident in the account of HTA01: *“We worked closely with the PTA and community leaders to purchase solar panels and a few secondhand laptops”*. Similarly, HTB02 explained, *“We collected voluntary teacher contributions to repair old computers”*, while HTI09 noted, *“We pooled funds from co-curricular savings to fix the school’s broken laptops”*. These narratives underscore how collective agency and local networks were leveraged to address resource deficits.

Equally important, school leadership played a role in enabling or constraining these efforts. Quantitatively, the responsiveness of school management scored a mean of 2.66 ($SD = 1.30$), pointing to moderate support. This was complemented by qualitative testimony that revealed emotionally supportive and participatory leadership styles. HTA01 reflected: *“I’m always present during ICT-related activities, and I try to model digital use myself. When teachers see me*

trying, they gain confidence too". HTD04 added, *"I create room for experimentation and protect teachers from blame when digital tools fail"*, while HTB02 emphasised, *"I encourage risk-taking and reassure staff that failure is part of learning. That attitude has reduced tech-related anxiety"*. These accounts highlight how empathetic leadership can build a psychologically safe environment that encourages innovation.

Taken together, both the quantitative indicators and supporting qualitative evidence point to a hybrid model of coping—one that relies on both **personal agency** and **institutional adaptability**. Teachers were not merely passive recipients of constraints but demonstrated a persistent effort to sustain e-learning through creative, context-sensitive strategies. Their actions, ranging from using private devices to facilitating peer learning and mobilising school-level resources, represent the kind of grassroots resilience that the **Institutionally Mediated E-Learning Uptake Model (IMELUM)** seeks to explain.

Ultimately, these findings affirm that coping strategies in USE schools are shaped by an interplay between infrastructural readiness, leadership support, digital competence, and collaborative culture. They illustrate how, in the face of adversity, teachers leverage both individual initiative and institutional support systems, highlighting the critical need for integrated, context-aware models such as IMELUM in designing sustainable e-learning interventions.

Adaptive Responses to Technological Infrastructure Limitations

In light of the persistent technological limitations that characterise many USE schools, teachers demonstrated a wide range of adaptive strategies aimed at sustaining instructional delivery. These responses combined both digital and analogue solutions, reflecting a pragmatic understanding of resource constraints and a deep commitment to maintaining pedagogical continuity.

To begin with, teachers adopted **improvisational and low-tech workarounds** to compensate for unreliable internet and limited access to devices. As HTA01 described, *"Teachers are very resourceful—they download content at night when the internet is cheaper and use Bluetooth to share with colleagues. We even print out digital materials when devices are few"*. Similarly, HTB02 noted, *"Teachers often prepare printed notes from e-resources. When the internet is down, they improvise with offline backups stored on flash drives"*. These testimonies reveal a pattern of thoughtful anticipation and flexible adaptation, rooted in real-world constraints.

In addition, the strategic use of personal devices and data reflected a willingness to absorb individual costs to uphold the instructional process. HTC03 explained, *"Most teachers carry personal phones with educational apps. They use these creatively—even showing short clips from YouTube using their own data"*. In more constrained environments, low-bandwidth solutions such as SMS were employed. As HTD04 explained, *"Some teachers use basic SMS to communicate homework. It's not fancy, but it works when online platforms fail"*. Collectively, these insights highlight the **blended nature** of e-learning in low-resource contexts, where teachers fluidly navigate between digital tools and analogue methods.

Moreover, proactive planning emerged as a key strategy to manage infrastructure gaps. Several teachers described **pre-downloading content** and using it during lessons. HTE05 elaborated, *"Some rely on offline teaching videos downloaded ahead of time. Others use TV shows or radio segments to supplement lessons, especially in subjects like English"*, while HTF06 stated, *"Most have learned to keep backup lessons in notebooks. That way, when power or internet fails, they still deliver lessons without disruption"*. These actions illustrate the critical role of foresight and strategic preparedness in mitigating the risks posed by technological breakdowns.

Beyond individual planning, **collaborative and rotational access models** were reported to maximise shared resources. As HTA01 detailed, *“We have a rotation schedule for the school’s two projectors. Teachers also use their phones during lessons and plug them into speakers to reach large classes”*. Similarly, HTJ10 noted, *“We run scheduled usage slots for digital tools. Everyone knows when it’s their turn to use what, which avoids conflict”*. These practices not only ensured equitable access but also fostered a culture of shared responsibility.

Equally significant were the practices of content-sharing and digital collaboration. HTC03 observed, *“We have one reliable laptop per department. Teachers coordinate through WhatsApp to schedule and avoid conflicts”*, while HTB02 added, *“Each department has a shared folder. Teachers plan ahead and download what they need to avoid last-minute disappointments”*. These examples reflect a growing reliance on **asynchronous planning** and team coordination.

To extend the life cycle of limited digital tools, teachers created **shared repositories and backup systems**. HTD04 noted, *“We keep a pool of lesson plans and digital materials in a shared flash disk. It’s our low-tech workaround for access problems”*, echoed by HTI09: *“We keep a lesson bank on a central flash drive. When one device fails, another teacher can quickly continue the lesson”*. These strategies ensured continuity and reduced vulnerability to single-point failures.

Furthermore, teachers leveraged mobile platforms for extended engagement. HTE05 shared, *“Teachers create WhatsApp groups to engage students outside class. One teacher even shared pre-recorded audio notes with learners who missed class”*, while HTG07 remarked, *“We have introduced a shared Google Drive folder. Teachers upload learning materials weekly so others can access them anytime”*. These digital ecosystems not only enhanced access but also expanded the boundaries of the classroom.

Finally, **co-teaching and team-based approaches** were adopted to reduce stress and optimise limited resources. HTF06 explained, *“They share devices and even combine classes occasionally to use the projector”*, and HTH08 added, *“They form teaching pairs—one manages the tech, while the other focuses on delivery. This strategy has reduced stress”*. These examples underscore a **collective model of resilience** built around cooperation and flexibility.

Taken together, these qualitative insights illuminate the **complex, adaptive behaviours** that teachers have developed in response to technological limitations. Within the **UTAUT framework**, these behaviours enhance both **effort expectancy** and **performance expectancy**, reinforcing teachers’ willingness to continue engaging with e-learning despite systemic barriers.

Teacher Capacity and Competence in E-learning Uptake

Teacher capacity and competence emerged as central factors influencing e-learning uptake in USE schools. Faced with uneven access to formal training programs, many educators developed **peer-led, grassroots strategies** to build digital literacy and pedagogical confidence. These responses not only compensated for institutional gaps but also reflected strong professional agency and collaborative resilience.

To begin with, teachers in multiple schools reported engaging in **informal mentorship and peer-to-peer learning structures**. These interactions often occurred during regular school routines and were deeply embedded in collegial culture. For example, HTA01 noted, *“Our senior ICT teacher mentors others. Sometimes during break time, teachers gather to demonstrate how to create Google Forms or upload videos. It’s informal but effective”*. Similarly, HTB02 described an organised model: *“We established ‘tech buddies’—each new or struggling teacher is paired with someone more experienced in e-learning”*. These strategies

enabled knowledge transfer in ways that were context-sensitive, low-cost, and sustainable.

In addition, many schools institutionalised collaborative digital learning through regular peer-learning forums. HTC03 shared, *“Monthly peer-learning sessions are now a tradition. Teachers demonstrate how they deliver content using digital tools”*, while HTD04 explained, *“Every week, we dedicate 30 minutes during staff briefing to share new digital tricks or tips”*. These recurring events suggest a deliberate attempt to normalise e-learning practices within staff culture and school operations.

Moreover, teachers initiated innovative and culturally relevant learning spaces that encouraged experimentation without the pressure of formal evaluation. HTE05 stated, *“We organise a peer-led ‘Tech Thursday’ where one teacher presents a skill each week. It has helped bridge confidence gaps”*. Likewise, HTF06 remarked, *“Teachers here are collaborative. They informally meet in the evenings to solve tech-related challenges together”*. These informal settings not only promoted competence but also fostered mutual encouragement and social learning.

Further examples emphasised how professional development was embedded in everyday interactions. HTG07 noted, *“Peer-to-peer training has been our biggest asset. Even during morning assemblies, teachers sometimes share useful apps or tricks”*, while HTH08 added, *“They hold weekly lunch-and-learn sessions. No pressure, just informal sharing with snacks provided”*. These creative, low-stakes environments strengthened trust and broadened participation in digital learning initiatives.

Beyond daily interactions, mentorship and observation played an important role in strengthening teacher confidence. HTI09 reported, *“Teachers shadow one another during lessons. It’s an organic form of mentorship that has strengthened skills”*, while HTJ10 emphasised documentation: *“Every department maintains an*

‘e-learning tip logbook.’ Teachers update it after discovering new tricks”. These practices demonstrated a collective approach to knowledge retention and continuous improvement.

In parallel, formal Continuous Professional Development (CPD) also contributed to capacity building, albeit inconsistently. HTA01 observed, *“The Ministry’s CPD sessions are irregular, so we rely heavily on peer-led initiatives. Occasionally, I bring in alumni working in tech to train our staff”*, illustrating how external partnerships filled formal training gaps. HTB02 shared, *“We hosted a regional ICT workshop that really built momentum. It exposed our staff to tools beyond just PowerPoint and WhatsApp”*, indicating that well-structured training events had catalytic effects.

Furthermore, the transformative role of CPD was echoed across several schools. HTC03 noted, *“CPD workshops opened teachers’ minds to the usefulness of LMS platforms. It has also improved their confidence with troubleshooting”*, while HTD04 added, *“Before CPDs, many teachers avoided tech. Now they at least try, especially after learning from colleagues during sessions”*. These changes signal a shift in both mindset and skill level.

Additionally, internal and external initiatives complemented one another. HTE05 highlighted the benefit of government involvement: *“The district’s ICT unit offered a three-day training last term. Since then, we’ve seen teachers incorporate more multimedia content into their lessons”*. HTG07 reflected a similar impact: *“Continuous PD has exposed teachers to new tools like Edmodo and Padlet. They are now more adventurous with tech”*.

Schools also launched internal training structures to institutionalise CPD. HTF06 explained, *“The school arranges quarterly internal workshops where experienced teachers train others. This builds confidence over time”*, while HTH08 noted, *“The school hired an ICT assistant who doubles as a trainer. He offers drop-in sessions where*

teachers can get one-on-one help". These practices point to a strong administrative commitment to long-term capacity building.

Finally, flexible learning was facilitated through digital platforms. HTI09 shared, "*Training from the sub-county office was useful, though brief. We've built on it by encouraging teachers to watch free YouTube tutorials together*", and HTJ10 emphasised policy integration: "*We've integrated tech into CPD sessions. It's become routine to dedicate at least one hour to digital skills*".

Taken together, these insights reveal a multidimensional framework of competence development combining peer mentorship, routine sharing, formal CPD, and community-based training. Within the **UTAUT model**, these capacity-building efforts enhance both **effort expectancy** and **social influence**, making teachers more confident and willing to engage with digital tools. Lastly, the emphasis on ongoing learning directly supports the **Technology-Mediated Learning Theory (TMLT)**, where technology use is shaped by sustained exposure, training, and institutional encouragement.

DISCUSSION OF FINDINGS

Strategies Employed by Teachers to Address E-Learning Challenges

The objective of the study focused on identifying the strategies employed by teachers to navigate the multifaceted challenges associated with e-learning uptake. Quantitative findings indicate that teachers employed a combination of personal and institutional strategies to mitigate these barriers. Personal strategies included the use of personal devices, financing their own internet access, and improvising with offline teaching materials. On the institutional side, teachers often relied on peer support, requested ICT assistance from school management, or lobbied for access to shared resources. These strategies were often reactive, reflecting an immediate need to sustain teaching and

learning continuity under constrained circumstances.

However, internal consistency analysis (Cronbach's Alpha = 0.078) revealed that these coping strategies were highly fragmented and individualised rather than coordinated or systemic. This fragmentation aligns with Andrada and Barrot's (2025) findings that in low-resourced contexts, teacher resilience manifests through varied and uncoordinated coping paths. Further analysis showed that strategy adoption varied by teacher demographics: experienced and digitally literate teachers leaned toward self-driven coping, while newer and less experienced teachers preferred collaborative or institutional support. These trends mirror those identified by Wang et al. (2022) and Nyemike et al. (2022), highlighting the importance of individual readiness and context in shaping adaptive responses.

Qualitative data from headteachers provided critical insight into the ways schools supported, enabled, or depended upon these teacher-led strategies. Many institutional responses emphasised grassroots mobilisation and local partnerships. HTA01 shared, "*We've worked closely with the PTA and community leaders to purchase solar panels and secondhand laptops*," demonstrating how schools addressed power and equipment shortages through community-based resource mobilisation. Similarly, HTC03 reported tapping into alumni networks: "*One former student gave us refurbished tablets*." Other schools leveraged support from the private sector or even rival institutions. HTD04 revealed, "*We convinced a private school owner to share their learning platform temporarily*." These institutional strategies were rooted in local ingenuity, reflecting what Vygotsky's Constructivist Theory describes as context-responsive problem-solving shaped by the environment.

A pattern of strategic budget reallocation and stakeholder partnership also emerged. HTF06 repurposed part of the library budget to purchase a

projector, while HTJ10 redirected funds originally allocated for school trips to buy a Wi-Fi router. Some schools initiated fundraising events such as HTG07's dinner to procure projectors. Others, like HTG07 and HTE05, engaged vocational institutions and NGOs, which supplied both equipment and training support. These actions align with the **Technology-Mediated Learning Theory (TMLT)**, which emphasises the dynamic interplay between available tools and institutional strategy in shaping effective technology integration (Bower, 2019; Geletu & Seid, 2025). They also reflect Connectivist principles (Siemens, 2005), where knowledge and resources flow through decentralised and collaborative networks rather than formal hierarchies.

In parallel, teachers themselves demonstrated substantial resilience and adaptability in confronting technological limitations. Many improvised with hybrid solutions that merged digital and traditional tools. HTA01 described how *“teachers download content at night when the internet is cheaper and use Bluetooth to share it with colleagues,”* while HTB02 noted the use of printed notes and offline flash drives when internet access failed. These adaptive behaviours reflect the self-reliant spirit found in grassroots innovations and support the **Constructivist view** that educators draw from personal experience to craft workable solutions within their immediate environments (Vygotsky, 1978).

Collaborative coping mechanisms were also prominent. Teachers created rotational usage schedules for limited digital devices, shared lesson plans via flash drives, and co-taught classes to maximise projector use. As HTI09 described, *“They keep a lesson bank on a central flash drive. When one device fails, another teacher can quickly continue the lesson.”* HTF06 and HTH08 reported pairing teachers during lessons to manage technology, the other to lead instruction—a teamwork model that optimised both technical and pedagogical capacities. These cooperative strategies

mirror the **Connectivist** framework, wherein knowledge is socially constructed through distributed networks and collective problem-solving.

Notably, mobile-based communication tools such as WhatsApp were harnessed not only for instruction but also for coordination and mentorship. HTD04 shared, *“We use WhatsApp to model digital communication,”* while HTE05 highlighted how teachers use WhatsApp groups to share recorded audio lessons. These approaches reflect both formal and informal use of networks for knowledge exchange, an idea central to Connectivism. According to the **UTAUT model**, such collaborative environments contribute to enhanced effort expectancy and facilitate conditions that improve technology adoption (Venkatesh et al., 2003; Bayaga & du Plessis, 2024).

Another key theme that emerged was the role of **peer mentorship and informal professional development**. Teachers built internal capacity through knowledge sharing and collaborative learning sessions. HTA01 described *“break-time demonstrations on how to create Google Forms,”* while HTB02 noted the pairing of tech-savvy teachers with less experienced colleagues through “tech buddy” systems. HTC03 emphasised that *“monthly peer-learning sessions are now a tradition.”* These grassroots professional learning communities are consistent with **Social Constructivism**, which posits that learning is scaffolded through guided participation and interaction (Vygotsky, 1978).

Schools also formalised and institutionalised some of these efforts. HTG07 reported, *“We’ve introduced a shared Google Drive folder. Teachers upload materials weekly,”* while HTF06 described internal CPD workshops led by experienced teachers. HTJ10 revealed that CPD sessions routinely allocate time to e-learning skill development, signifying a sustained institutional commitment. These practices affirm that while coping initially emerged from necessity, many

schools are beginning to integrate teacher-led strategies into broader professional development structures. The **TMLT** and **UTAUT frameworks** both affirm that sustained competence building is key to overcoming technology-related anxiety and boosting adoption, especially when formal training is limited or inconsistent (Xue, Rashid & Ouyang, 2024).

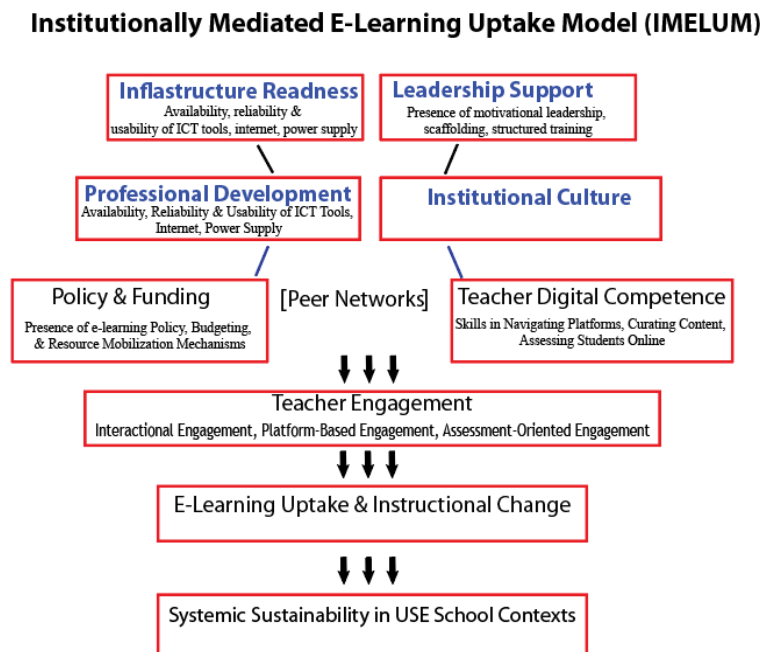
Moreover, partnerships with external stakeholders played a vital role in enhancing institutional coping capacity. HTD04 described how a UNESCO-sponsored ICT bootcamp “kickstarted” teachers’ digital adoption journeys, while HTG07 highlighted a Ministry of Education certification program that “increased teacher confidence.” Community support was equally pivotal. HTF06 received smartphone donations from parents, and HTI09 noted that diaspora members provided a backup generator. These collaborations expanded schools’ capacity and aligned with UTAUT’s **facilitating**

conditions construct, which underscores the importance of institutional support in influencing individual use of technology.

Conceptual Model for E-Learning Uptake in USE Schools

The Institutionally Mediated E-Learning Uptake Model (IMELUM) was developed to explain how e-learning engagement among teachers in Uganda’s Universal Secondary Education (USE) schools is shaped by the interaction between individual agency and institutional readiness. Grounded in UTAUT, Technology-Mediated Learning Theory (TMLT), Constructivism, and Connectivism, the model identifies key conditions, mediators, and engagement processes that influence adoption. IMELUM reflects a context-specific approach, accounting for infrastructure, leadership, policy, and professional development in resource-constrained environments.

Figure 1: Conceptual Flowchart of the Institutionally Mediated E-Learning Uptake Model (IMELUM)



Inputs (Foundational Conditions)

Infrastructure Readiness. E-learning uptake requires a basic threshold of digital readiness. This includes reliable electricity, internet connectivity, and access to devices such as laptops, projectors, or modems. Findings showed that even when teachers were motivated, e-learning was hindered by outages and equipment shortages. The model positions infrastructure as a non-negotiable foundation upon which other interventions must build.

Leadership Support. School leadership acts as a catalyst for technology adoption. When leaders model ICT use, encourage experimentation, and support training, they reduce resistance and enhance teacher confidence. IMELUM recognises leadership as a lever for motivation and institutional prioritisation, especially where infrastructure is limited.

Professional Development. Continuous professional development (CPD) equips teachers with the skills needed to move from basic ICT use to pedagogically integrated e-learning practices. IMELUM emphasises structured CPD, blending peer mentorship and formal training to improve instructional quality and teacher confidence.

Policy and Funding. The presence of clear e-learning policies and budgetary commitment at the school and national levels is essential for coordination and resource allocation. The model treats policy not as a static document, but as an operational driver that institutionalises support and fosters accountability.

Mediating Constructs

Teacher Digital Competence. Competence is not just about technical skills but also the ability to use digital tools effectively in teaching. IMELUM recognises that digital competence varies based on training, support, and exposure and that higher competence correlates with deeper platform engagement.

Institutional Culture. A school's openness to innovation and collaborative practices influences e-learning uptake. Where digital integration is normalised in planning and feedback, engagement improves. Conversely, rigid or indifferent cultures stall adoption.

Peer Networks. Informal collaboration through tech buddies, WhatsApp groups, and co-teaching emerged as a powerful support system. IMELUM elevates these networks as a parallel structure to formal CPD, highlighting their low-cost, high-impact potential.

Core Process: Teacher Engagement

IMELUM conceptualises teacher engagement in three dimensions:

- **Interactional Engagement:** Active teacher-student communication via platforms (e.g., messaging, video sessions).
- **Platform Engagement:** Uploading content, preparing lessons, and sharing resources online.
- **Assessment Engagement:** Using digital tools for giving feedback, monitoring learning, and grading.

These forms of engagement are interdependent and often fluctuate depending on the level of support, access, and training teachers receive.

Outcomes

E-learning Uptake. This refers to consistent, meaningful use of e-learning tools in teaching—not just platform availability. IMELUM treats uptake as a school-wide behaviour, rather than an isolated individual action.

Instructional Transformation. Teachers shift from using ICT as a substitute (e.g., typing notes) to more integrated and innovative practices (e.g., multimedia simulations, LMS use). IMELUM identifies this shift as critical for long-term change.

Sustainability Potential. The model concludes that sustainability relies on embedded leadership practices, policy alignment, and ongoing CPD. E-learning should be institutionalised, not dependent on external projects or short-term enthusiasm.

CONCLUSION AND RECOMMENDATIONS

Conclusion

In summary, the findings reveal that teachers in USE schools have embraced a range of personalised and institutional coping strategies in response to the numerous challenges facing e-learning adoption. While individual strategies like using personal devices or downloading content with personal data are commendable, they are insufficient in isolation. The strength of e-learning sustainability lies in coordinated, community-rooted, and institutionally supported frameworks. The integration of peer mentoring, resource pooling, creative budgeting, and stakeholder collaboration illustrates that even in low-resourced settings, adaptive and networked strategies can be mobilised to support digital transformation. However, the absence of systemic planning and long-term investment means that these innovations remain fragile. As the regression analysis suggested, coping strategies, though important, did not significantly predict e-learning adoption levels. Thus, for Uganda's USE schools to move from survival to sustainability, these strategies must be scaled, institutionalised, and embedded within broader national digital education policies.

Recommendations

To enhance the sustainability and effectiveness of grassroots e-learning strategies in USE schools, there is a need to formally recognise and institutionalise teacher-led initiatives such as the use of personal devices, offline content sharing, and self-funded internet access. Schools should be supported to scale up peer mentoring and informal support networks by integrating them into structured professional development programs. Furthermore, the creative approaches already

employed, such as community engagement, alumni involvement, and NGO partnerships, should be systematised through formal school development plans and incentivised by education authorities. Crucially, these efforts must be reinforced by national policy alignment and institutional support frameworks to ensure that locally driven innovations transition from temporary coping mechanisms to sustainable models for digital teaching and learning.

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