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Challenges Faced by Private Chartered Universities in the Integration of Smart Technology

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Abstract: *This study investigated the challenges faced by selected private chartered universities in Kenya in integrating smart technologies into teaching and learning. Specifically, the study examined infrastructural, technical, financial, institutional, pedagogical, and human-related barriers influencing technology adoption from the perspectives of students, lecturers, and university administrators. The study adopted a concurrent mixed-methods approach using descriptive, comparative, and correlational research designs. Quantitative data were collected from 270 students and 64 lecturers using structured questionnaires, while qualitative data were obtained through interviews with Deputy Vice Chancellors (Academic Affairs), Directors of Quality Assurance, Heads of Information and Communication Technology (ICT), classroom observations, and document analysis. Quantitative data were analyzed using descriptive statistics, whereas qualitative data were analyzed thematically and integrated with the quantitative findings during interpretation. The findings indicate that smart technology integration is constrained by multiple interconnected challenges, including inadequate access to digital devices, unstable power supply, insufficient technical support, limited financial resources, weak institutional governance, inconsistent professional development, and varying levels of digital competence among lecturers and students. Although private chartered universities have made notable progress in adopting digital technologies, persistent institutional and human capacity constraints continue to limit the realization of sustainable digital transformation. The study concludes that successful smart technology integration requires coordinated investment in infrastructure, institutional leadership, continuous professional development, sustainable financing, and stakeholder participation. The findings provide evidence to inform university leaders and policymakers in strengthening institutional strategies for digital transformation in higher education.*

Keywords: *Smart technology integration, digital transformation,institutional challenges, educational technology, private chartered universities, Kenya*

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1. Introduction

The rapid advancement of digital technologies has fundamentally transformed higher education by changing the ways universities deliver teaching, learning, research, and institutional administration. Emerging technologies such as artificial intelligence, learning management systems, cloud computing, virtual laboratories, learning analytics, mobile applications, and collaborative digital platforms have expanded opportunities for improving educational quality, institutional efficiency, and learner engagement. Universities across the world are therefore investing heavily in digital transformation initiatives aimed at developing flexible, learner-centred, technology-enhanced educational environments that prepare graduates for the digital economy (UNESCO, 2023).

However, the successful integration of smart technologies extends beyond the acquisition of digital

infrastructure. Sustainable digital transformation depends on the interaction of technological, institutional, financial, organizational, pedagogical, and human factors that collectively determine whether available technologies are effectively utilized. Many universities possess modern technological infrastructure but continue to experience low levels of technology utilization because of inadequate institutional support, insufficient digital competencies, limited financial investment, weak governance structures, and resistance to organizational change (Bond et al., 2024; OECD, 2023). Consequently, technology integration has increasingly become recognized as a multidimensional institutional process rather than merely a technological undertaking.

Globally, universities continue to encounter diverse challenges in implementing digital transformation strategies. While institutions in Europe, North America, and parts of Asia have achieved significant progress through sustained investment in infrastructure, policy development, and professional capacity building, many institutions still struggle with maintaining continuous technological upgrades, supporting faculty development, and ensuring equitable student access to digital learning resources (European Commission, 2021). Recent international evidence further demonstrates that successful digital transformation requires strong institutional leadership, coherent governance frameworks, adequate financing, and continuous monitoring and evaluation of technology initiatives (Bond et al., 2024).

Across Africa, universities accelerated digital transformation during the COVID-19 pandemic by expanding online learning systems, virtual classrooms, digital libraries, and cloud-based educational platforms. Although these initiatives improved educational continuity, they also exposed persistent challenges related to unreliable internet connectivity, inadequate ICT infrastructure, insufficient technical support, limited financial resources, and unequal access to digital devices among students and academic staff (UNESCO, 2023). Studies conducted in African universities further indicate that technology integration remains uneven because institutional investments in digital infrastructure are often not accompanied by comparable investments in professional development, institutional governance, and sustainable technical support systems (Czerniewicz et al., 2020; Mtebe & Raphael, 2021).

In Kenya, the higher education sector has embraced national digital transformation initiatives through the Kenya National ICT Policy, the Digital Economy Blueprint, the Competency-Based Curriculum reforms, and institutional digital learning strategies. Private chartered universities have increasingly adopted learning management systems, virtual learning environments, digital libraries, smart classrooms, and cloud-based administrative systems to improve educational quality and institutional effectiveness. Nevertheless, successful implementation continues to be constrained by infrastructural limitations, financial challenges, inconsistent institutional policies, inadequate technical support, and varying levels of digital competence among lecturers and students (Commission for University Education [CUE], 2022; Ministry of Education, 2023).

Although previous studies have examined technology adoption, digital literacy, faculty readiness, and e-learning implementation in higher education, comparatively fewer studies have comprehensively investigated the multidimensional challenges influencing smart technology integration within private chartered universities in Kenya. Existing literature has largely emphasized individual aspects such as infrastructure, technology acceptance, or digital competence while providing limited empirical evidence regarding the interaction between infrastructural, institutional, financial, pedagogical, technical, and human-related barriers. Consequently, university leaders have limited context-specific evidence to guide institutional decision-making and strategic planning for sustainable digital transformation.

This study therefore investigated the challenges faced by selected private chartered universities in Kenya in integrating smart technologies into teaching and learning. Specifically, the study examined students' and lecturers' perceptions of the infrastructural, institutional, financial, technical, pedagogical, and psychological barriers influencing technology integration while incorporating qualitative evidence from university administrators and classroom observations. The findings contribute to the growing body of knowledge on digital transformation in higher education and provide practical recommendations for strengthening institutional readiness and promoting sustainable smart technology integration within private universities.

1.1 Research Question

The study was guided by the following research question:

What challenges do private chartered universities face in the integration of smart technology?

The study addressed the following specific questions:

1. What infrastructural challenges affect smart technology integration in selected private chartered universities in Kenya?

2. Literature Review

2.1 Concept of Challenges in Smart Technology Integration

Smart technology integration refers to the systematic adoption and effective use of digital technologies to enhance teaching, learning, research, assessment, communication, and institutional management within higher education. These technologies include learning management systems (LMS), artificial intelligence (AI), cloud computing, virtual and augmented reality, learning analytics, mobile technologies, digital libraries, virtual laboratories, and collaborative online platforms. While these technologies have significantly transformed higher education globally, their successful integration remains dependent on the interaction of technological, organizational, financial, pedagogical, and human factors (Bond et al., 2024; UNESCO, 2023).

Challenges in smart technology integration encompass the barriers that hinder institutions from realizing the full educational benefits of digital technologies. These challenges may be infrastructural, organizational, financial, pedagogical, technical, psychological, or policy-related. Rather than existing independently, these barriers interact to influence institutional readiness, faculty adoption, student participation, and overall digital transformation. OECD (2023) argues that higher education institutions frequently underestimate the complexity of digital transformation by focusing primarily on infrastructure acquisition while neglecting governance, professional development, institutional culture, and stakeholder engagement.

Contemporary literature increasingly conceptualizes technology integration as an ecosystem rather than a purely technological intervention. According to UNESCO (2023), successful digital transformation requires simultaneous investment in technological infrastructure, institutional leadership, policy implementation, human capacity development, sustainable financing, and continuous monitoring. Consequently, weaknesses in any component of the institutional ecosystem may reduce the effectiveness of technology integration regardless of the sophistication of the technologies deployed.

Within African higher education, the complexity of technology integration is further compounded by contextual challenges such as unreliable electricity, inadequate internet infrastructure, financial constraints, shortages of qualified ICT personnel, and unequal access to digital devices among students (Czerniewicz et al., 2020; Mtebe & Raphael, 2021). These challenges highlight the need for comprehensive institutional strategies that address technological, organizational, and human dimensions simultaneously rather than independently.

2.2 Infrastructure and Technological Challenges

Infrastructure constitutes the foundation upon which smart technology integration is built. Effective digital learning environments require reliable internet connectivity, stable electricity supply, modern computer laboratories, smart classrooms, learning management systems, cloud computing infrastructure, digital libraries, and compatible user devices. Without these foundational resources, universities are unable to sustain technology-enhanced teaching and learning regardless of institutional commitment or policy intentions (Ifenthaler & Yau, 2020).

International evidence consistently identifies inadequate digital infrastructure as one of the most significant barriers to technology integration. Bond et al. (2024) observe that universities with robust ICT infrastructure demonstrate higher levels of technology adoption, improved instructional innovation, and stronger institutional resilience than institutions with limited digital capacity. Similarly, the European Commission (2021) emphasizes that reliable technological infrastructure forms the cornerstone of successful digital education ecosystems.

Despite increasing investment in digital infrastructure, many universities continue to experience infrastructure-related challenges. Frequent internet interruptions, insufficient bandwidth, outdated hardware, software incompatibility, and inadequate maintenance reduce lecturers' ability to implement technology-enhanced instruction effectively. Such challenges become particularly significant during online assessments, virtual laboratories, synchronous learning sessions, and collaborative digital activities where stable connectivity is essential (OECD, 2023).

African universities continue to experience more pronounced infrastructural limitations. Czerniewicz et al. (2020) found that although universities rapidly expanded online learning during the COVID-19 pandemic, many institutions struggled with unstable internet services, inadequate bandwidth, and unreliable electricity. Similarly, Mtebe and Raphael (2021) reported that universities in East Africa frequently experience infrastructure constraints that reduce the effectiveness of learning management systems and digital instructional platforms.

In Kenya, digital infrastructure has improved considerably following implementation of the Kenya National ICT Policy and the Digital Economy Blueprint. Many private chartered universities have invested in wireless internet connectivity, institutional learning management systems, smart classrooms, and digital libraries. Nevertheless, the Commission for University Education (2022) acknowledges that disparities remain across institutions in terms of ICT infrastructure, maintenance capacity, equipment availability, and digital accessibility. Consequently, infrastructure continues to

influence the quality and sustainability of technology-enhanced learning.

2.3 Institutional Governance and Policy Challenges

Institutional governance plays a central role in determining the success of smart technology integration. Effective governance provides strategic leadership, establishes institutional priorities, allocates resources, develops implementation policies, and coordinates digital transformation initiatives across university departments. Universities with coherent governance structures are generally more successful in integrating technology because institutional policies provide clear direction, accountability, and coordination mechanisms (European Commission, 2021).

Institutional leadership has increasingly become recognized as a critical determinant of digital transformation. According to UNESCO (2023), university leaders influence technology integration by establishing strategic visions, promoting organizational change, allocating financial resources, and creating supportive institutional cultures that encourage innovation. Where institutional leadership is weak or inconsistent, technology initiatives often become fragmented, poorly coordinated, and unsustainable.

Previous studies have identified several governance-related barriers affecting technology integration, including absence of institutional ICT policies, weak implementation frameworks, bureaucratic procurement procedures, limited stakeholder participation, and inadequate monitoring systems (Bond et al., 2024). OECD (2023) further argues that universities frequently develop digital policies without establishing effective implementation mechanisms, resulting in considerable disparities between institutional plans and actual practice.

Within Africa, governance challenges are compounded by centralized decision-making structures and limited institutional autonomy in resource allocation. Czerniewicz et al. (2020) observed that many universities lacked coherent institutional strategies for digital transformation despite rapid investments in online learning technologies during the COVID-19 pandemic. Similar findings have been reported in East African universities, where institutional leadership frequently prioritizes infrastructure acquisition while giving comparatively less attention to governance systems, monitoring mechanisms, and stakeholder engagement (Mtebe & Raphael, 2021).

In Kenya, the Commission for University Education (2022) emphasizes that universities should establish comprehensive ICT governance frameworks that integrate technology planning with institutional quality assurance, strategic management, and academic programme delivery. However, implementation remains uneven across institutions because governance capacity, leadership commitment, and institutional resources vary considerably among universities.

2.4 Financial and Resource Constraints

Sustainable smart technology integration requires continuous financial investment beyond the initial acquisition of technological infrastructure. Universities must allocate resources for hardware replacement, software licensing, internet services, cloud computing subscriptions, cybersecurity, technical support, staff development, equipment maintenance, and periodic technological upgrades. Consequently, financial sustainability remains one of the most important determinants of long-term digital transformation (OECD, 2023).

International studies consistently report that insufficient financial investment limits institutional capacity to sustain technology-enhanced learning. Bond et al. (2024) argue that successful digital transformation requires universities to view technology investment as a continuous institutional commitment rather than a one-time capital expenditure. Similarly, UNESCO (2023) recommends that governments and higher education institutions establish sustainable financing models that support continuous technological innovation and capacity development.

Financial constraints are particularly evident in developing countries where competing institutional priorities often reduce available resources for digital transformation. Universities may acquire sophisticated technologies through donor support or project funding but subsequently struggle to finance maintenance, software renewal, staff training, and infrastructure expansion. As a result, many digital initiatives experience declining effectiveness after initial implementation (Ifenthaler & Yau, 2020).

African universities continue to experience considerable financial limitations affecting technology integration. Mtebe and Raphael (2021) reported that inadequate ICT budgets, shortages of technical personnel, and dependence on external funding significantly constrain institutional digital transformation across East Africa. Similarly, Czerniewicz et al. (2020) observed that many universities faced substantial financial pressures while attempting to sustain online learning during the COVID-19 pandemic.

In Kenya, universities increasingly face financial challenges arising from declining enrolment, reduced government funding, and rising operational costs. These financial pressures often limit investment in

technological infrastructure, equipment maintenance, software licensing, and professional development. Consequently, the Commission for University Education (2022) recommends that institutions strengthen financial planning and diversify funding sources to support sustainable digital transformation.

2.5 Human Capacity, Professional Development, and Resistance to Change

The effectiveness of smart technology integration depends substantially on the knowledge, skills, attitudes, and confidence of both lecturers and students. Even where technological infrastructure is readily available, limited digital competence may reduce technology utilization and instructional innovation. Human capacity therefore represents one of the most important determinants of successful digital transformation (Ertmer & Ottenbreit-Leftwich, 2010).

Professional development enables lecturers to acquire the technological and pedagogical competencies necessary for integrating digital tools into teaching and learning. Contemporary faculty development extends beyond basic ICT literacy to include instructional design, digital assessment, artificial intelligence, learning analytics, collaborative technologies, and discipline-specific digital pedagogy. Universities that institutionalize continuous professional development generally demonstrate higher levels of technology integration and educational innovation (Tondeur et al., 2021).

Nevertheless, resistance to technological change remains a persistent challenge. Lecturers may perceive emerging technologies as complex, time-consuming, disruptive to established instructional practices, or insufficiently supported by institutional leadership. Such perceptions reduce willingness to experiment with innovative teaching approaches, particularly where technical assistance and continuous training are limited (Ertmer & Ottenbreit-Leftwich, 2010).

Student readiness similarly influences technology integration. Successful participation in digital learning requires adequate digital literacy, access to compatible devices, technological self-efficacy, and positive attitudes toward online learning. Students with limited digital competence often experience anxiety, reduced engagement, and difficulty adapting to technology-enhanced learning environments (van Laar et al., 2020).

Across Africa, shortages of qualified ICT personnel, inadequate staff development, and unequal student access to digital technologies continue to limit technology integration (UNESCO, 2023). In Kenya, the Commission for University Education (2022) and the Ministry of Education (2023) emphasize that strengthening digital competencies among lecturers and students remains essential for achieving sustainable higher education digital transformation.

3. Methodology

This study adopted a concurrent mixed-methods research approach employing descriptive, comparative, and correlational research designs to investigate the challenges affecting the integration of smart technology in selected private chartered universities in Kenya. The mixed-methods approach enabled the researcher to collect and analyze quantitative and qualitative data simultaneously, thereby providing a comprehensive understanding of the institutional, infrastructural, financial, pedagogical, technical, and human-related factors influencing smart technology integration. The study targeted Deputy Vice Chancellors (Academic Affairs), Directors of Quality Assurance, Heads of Information and Communication Technology (ICT), lecturers, and students because of their complementary roles in institutional policy formulation, technology implementation, teaching, learning, and ICT support. Selected private chartered universities were purposively sampled based on their demonstrated engagement in digital transformation initiatives and implementation of smart technologies. Purposive sampling was used to select university administrators and ICT personnel, while stratified random sampling was employed to select lecturers and students from the participating universities. Data were collected using structured questionnaires administered to lecturers and students, semi-structured interview schedules for university administrators and ICT personnel, classroom observation checklists, and document analysis guides. The research instruments were validated through expert review and pilot testing, while the reliability of the questionnaires was established using Cronbach's Alpha coefficient. Quantitative data were analyzed using the Statistical Package for the Social Sciences (SPSS) to generate descriptive statistics, including means and standard deviations, as well as inferential statistics comprising Pearson correlation, independent samples *t*-tests, one-way analysis of variance (ANOVA), and multiple regression analysis where appropriate. Qualitative data were analyzed thematically, and the findings were integrated with the quantitative results during interpretation to provide a comprehensive understanding of the challenges affecting smart technology integration. Ethical approval and research authorization were obtained from the relevant authorities before data collection. Throughout the study, ethical principles of informed consent, voluntary participation, confidentiality, anonymity, and respect for participants' rights were strictly observed.

4. Results and Discussion

4.1 Students' Perceptions of Challenges Affecting Smart Technology Integration

This section presents students' perceptions of the challenges affecting the integration of smart technology in selected private chartered universities in Kenya. The findings are presented in Table 1.

Table 1: Students' Responses on Challenges Affecting Smart Technology Integration (N = 270)

Item	N	M	SD
Limited internet connectivity affects my ability to use smart technology effectively	270	2.34	1.10
I do not always have access to a suitable device (e.g., laptop, tablet) for smart learning	270	3.30	1.06
Power outages disrupt the use of smart technologies during learning sessions	270	3.23	1.07
Some classrooms are not well-equipped with smart tools or digital infrastructure	270	3.29	1.09
I have experienced technical issues with digital learning platforms or tools	270	3.21	1.04
There is not enough technical support available when I encounter problems with smart technology	270	3.36	1.04
I have not received enough training or orientation on how to use smart technologies effectively	270	3.26	1.05
Some lecturers are reluctant or slow to adopt smart technologies in their teaching	270	3.23	1.06
I sometimes struggle to keep up with technology-based lessons or assignments	270	3.31	1.09
Using unfamiliar digital tools makes me anxious or afraid of making mistakes	270	3.30	1.04
Negative past experiences with e-learning tools have affected my willingness to use them again	270	3.34	1.07
I find it difficult to focus during online or digitally enhanced classes	270	3.35	1.07
Overall Mean	**270**	**3.13**	**1.06**

The findings presented in Table 1 indicate that students experienced considerable challenges in the integration of smart technology, as reflected by an overall mean score of **3.13** (SD = **1.06**). Based on the four-point Likert scale used in this study, the overall mean falls within the agreement category, suggesting that students generally perceived multiple barriers affecting their effective utilization of smart technologies for learning. The relatively high standard deviation indicates moderate variation in students' experiences across the participating universities, implying that the nature and intensity of these challenges differ according to institutional capacity, programme characteristics, and available technological resources. These findings support UNESCO (2023), which argues that digital transformation in higher education is influenced not only by technological availability but also by institutional support systems, learner preparedness, and equitable access to digital resources. Similarly, the OECD (2023) observes that successful technology integration requires universities to address infrastructural, organizational, and human-related constraints simultaneously.

Infrastructure-related challenges emerged prominently in the findings. Students agreed that limited access to suitable digital devices (M = **3.30**, SD = **1.06**), inadequately equipped classrooms (M = **3.29**, SD = **1.09**), and frequent power outages (M = **3.23**, SD = **1.07**) significantly constrained their participation in technology-enhanced learning. These findings suggest that although universities have invested in digital technologies, the availability and reliability of supporting infrastructure remain insufficient to guarantee equitable learning opportunities. Limited ownership of laptops, tablets, and other compatible devices may restrict students' participation in online learning, digital assessments, virtual collaboration, and independent study. Similar findings have been reported

internationally, where inadequate digital infrastructure continues to hinder effective implementation of smart learning environments (Bond et al., 2024; Ifenthaler & Yau, 2020). Within Africa, Czerniewicz et al. (2020) found that unequal access to digital devices and unreliable electricity significantly affected students' participation in online learning during the COVID-19 pandemic. In Kenya, the Commission for University Education (2022) similarly recognizes infrastructure disparities and limited access to ICT resources as continuing barriers to digital transformation in higher education.

Interestingly, limited internet connectivity recorded the lowest mean score among the listed challenges (M = **2.34**, SD = **1.10**). This finding suggests that internet access may have improved across many private chartered universities, reflecting institutional investment in campus wireless networks and broadband infrastructure. Nevertheless, the comparatively lower rating does not imply that internet connectivity is no longer problematic but rather indicates that students considered device accessibility, classroom infrastructure, and power reliability to be more significant barriers to smart technology integration. This observation aligns with recent Kenyan studies indicating that while internet coverage has improved in many universities, challenges relating to affordability of devices and reliability of supporting infrastructure continue to influence students' learning experiences (Ministry of Education, 2023; CUE, 2022).

Technical support and institutional assistance also emerged as significant concerns. Students strongly agreed that inadequate technical support (M = **3.36**, SD = **1.04**) represented one of the greatest barriers to effective technology utilization. They also reported frequent technical problems with digital learning platforms (M = **3.21**, SD = **1.04**) and insufficient training or orientation on the use of smart technologies (M = **3.26**, SD = **1.05**). These findings indicate that technology acquisition alone does not guarantee effective utilization unless accompanied by responsive support services and continuous digital capacity building. Students experiencing difficulties with learning management systems, virtual classrooms, online assessments, or institutional portals may become discouraged when timely assistance is unavailable. Similar observations have been reported by UNESCO (2023), which emphasizes that sustainable digital transformation requires comprehensive technical support structures alongside continuous learner training. Within East Africa, Mtebe and Raphael (2021) likewise found that inadequate ICT support services significantly reduced the effectiveness of technology-enhanced learning in universities.

Pedagogical challenges were equally evident. Students perceived that some lecturers remained reluctant or slow to integrate smart technologies into classroom instruction (M = **3.23**, SD = **1.06**). In addition, respondents reported difficulty keeping pace with technology-based lessons and assignments (M = **3.31**, SD = **1.09**). These findings suggest inconsistencies in instructional practices across academic departments and indicate that technology integration is influenced by lecturers' pedagogical competencies, instructional confidence, and willingness to adopt innovative teaching approaches. Such inconsistencies may result in unequal learning experiences among students enrolled in different programmes or courses. Similar findings have been reported by Tondeur et al. (2021), who argue that lecturers' pedagogical beliefs and technological competence significantly influence classroom technology integration. Studies conducted in African universities have likewise shown that uneven faculty preparedness contributes to variations in students' digital learning experiences (Ng'ambi et al., 2020; Czerniewicz et al., 2020).

Psychological and behavioural challenges also featured prominently in the findings. Students indicated that unfamiliar digital tools created anxiety (M = **3.30**, SD = **1.04**), while previous negative experiences with e-learning technologies reduced their willingness to adopt similar systems in the future (M = **3.34**, SD = **1.07**). Furthermore, difficulty maintaining concentration during online or digitally enhanced classes recorded one of the highest mean scores (M = **3.35**, SD = **1.07**). These findings demonstrate that successful technology integration depends not only on infrastructure and institutional support but also on learners' confidence, motivation, self-regulation, and previous experiences with digital learning environments. Similar conclusions have been reached by van Laar et al. (2020), who emphasize that digital competence includes cognitive, behavioural, and affective dimensions that collectively influence technology adoption. UNESCO (2023) similarly argues that learner engagement and digital confidence are essential components of successful educational technology implementation.

Overall, the findings demonstrate that students experience multidimensional challenges affecting smart technology integration, encompassing infrastructural limitations, inadequate technical support, insufficient training, pedagogical inconsistencies, and psychological barriers. Although private chartered universities have made considerable progress in expanding digital learning environments, these findings indicate that sustainable technology integration requires coordinated institutional investment in infrastructure, technical support services, lecturer capacity building, learner digital literacy, and student well-being. The results are consistent with international evidence demonstrating that digital transformation is most successful when technological, organizational, pedagogical, and human factors are addressed simultaneously (Bond et al., 2024; OECD, 2023; UNESCO, 2023).

4.2 Lecturers' Perceptions of Challenges Affecting Smart Technology Integration

Lecturers were also asked to assess the challenges affecting the integration of smart technology in selected private chartered universities in Kenya. Their responses are presented in Table 2.

Table 2: Lecturers' Responses on Challenges Affecting Smart Technology Integration (N = 64)

Item	N	M	SD
My institution lacks sufficient internet connectivity to support smart technology use	64	3.55	1.01
Limited access to digital devices and equipment hinders effective implementation	64	2.98	1.08
Unreliable power supply affects the consistent use of smart technologies	64	3.05	1.10
Classrooms are not adequately equipped for technology-enhanced learning	64	1.97	1.08
Technical support for maintaining smart tools is inadequate	64	2.76	1.08
There is a lack of clear institutional policies on smart technology adoption	64	2.98	1.08
Institutional leadership has not prioritized technology integration	64	2.90	1.02
There are bureaucratic delays in approving or implementing technology-related projects	64	2.98	1.10
Smart technology initiatives are not included in strategic plans	64	3.21	0.95
Faculty are not adequately involved in decision-making on technology adoption	64	2.19	1.02
My institution lacks the financial resources to support smart technology implementation	64	3.03	1.14
Budget allocation for technology training and equipment is insufficient	64	2.98	1.07
There is limited funding for continuous technological upgrades	64	2.98	1.16
Cost of maintenance discourages full integration of smart tools	64	3.09	1.10
Lack of adequate training prevents effective use of smart technologies	64	2.91	1.13
Some lecturers resist the use of new technologies	64	3.05	1.08
I am concerned about the time and effort needed to learn new technology	64	3.07	1.04
There is fear of failure when trying to use unfamiliar smart tools	64	3.26	1.05
Negative past experiences discourage me from adopting new technologies	64	3.17	1.14
Students lack access to devices compatible with smart technology	64	3.02	1.08
Low digital literacy among students limits effective use of smart tools	64	3.03	1.08
Student resistance to new technology hinders smooth classroom integration	64	2.19	1.05
Overall Mean	**64**	**2.94**	**1.07**

The findings presented in Table 2 indicate that lecturers generally agreed that private chartered universities experience substantial challenges in integrating smart technologies into teaching and learning, as reflected by an overall mean score of **2.94** (SD = **1.07**). The overall mean falls within the agreement category of the four-point Likert scale, suggesting that lecturers perceived institutional, infrastructural, financial, technological, and human-related constraints as significant impediments to effective technology integration. The relatively high standard deviation indicates moderate variation in lecturers' experiences across universities, reflecting differences in institutional readiness, governance structures, ICT infrastructure, and financial capacity. These findings support UNESCO (2023), which argues that successful digital transformation depends on the interaction of technological, organizational, financial, and human factors rather than technological infrastructure alone. Similar observations have been reported globally by Bond et al. (2024) and OECD (2023), who emphasize that institutional barriers remain the greatest obstacle to sustainable digital transformation in higher education.

4.3 Infrastructure-Related Challenges

Infrastructure emerged as the most significant challenge affecting lecturers' use of smart technologies. Respondents strongly agreed that inadequate internet connectivity constituted the greatest barrier (M = **3.55**, SD = **1.01**), while unreliable power supply also significantly affected technology integration (M = **3.05**, SD = **1.10**). These findings indicate that although universities have adopted various digital technologies, the supporting infrastructure required for uninterrupted technology-enhanced teaching remains inadequate. Stable internet connectivity is essential for learning management systems, cloud computing, virtual classrooms, online assessments, artificial intelligence applications, and digital collaboration. Consequently, interruptions in internet services and electricity directly reduce instructional effectiveness and student participation.

Interestingly, lecturers disagreed that classrooms were inadequately equipped with digital technologies (M = **1.97**, SD = **1.08**), suggesting that most institutions possess basic technological equipment but experience greater challenges related to infrastructure reliability than equipment availability. This distinction implies that investment in hardware alone is insufficient unless accompanied by reliable supporting services. Similar findings have been reported by Ifenthaler and Yau (2020), who argue that dependable ICT infrastructure is fundamental for effective educational technology implementation. Comparable evidence from South African universities demonstrates that unstable internet connectivity and electricity outages remain major barriers to digital teaching despite significant institutional investment in ICT infrastructure (Czerniewicz et al., 2020). In Kenya, the Commission for University Education (2022) similarly identifies infrastructure reliability as a critical determinant of quality technology-enhanced learning.

4.4 Institutional Governance and Leadership Challenges

Institutional governance challenges also featured prominently in the findings. Lecturers agreed that smart technology initiatives were insufficiently integrated into institutional strategic plans (M = **3.21**, SD = **0.95**), while bureaucratic delays (M = **2.98**, SD = **1.10**) and lack of clear institutional policies (M = **2.98**, SD = **1.08**) hindered effective technology implementation. Respondents further perceived that institutional leadership had not consistently prioritized digital transformation (M = **2.90**, SD = **1.02**). These findings suggest that effective technology integration depends not only on technological resources but also on strategic leadership, policy coherence, and institutional governance.

Conversely, lecturers generally disagreed that faculty members were adequately involved in institutional decision-making regarding technology adoption (M = **2.19**, SD = **1.02**). This finding indicates limited participatory governance and suggests that technology-related decisions are frequently centralized within senior management and ICT departments. Similar conclusions have been reached by Selwyn (2022), who argues that participatory governance enhances institutional ownership and sustainability of digital transformation initiatives. UNESCO (2023) likewise recommends inclusive governance structures that actively engage academic staff in institutional technology planning and implementation. Within Kenya, the Commission for University Education (2022) advocates collaborative governance frameworks that integrate ICT planning into broader institutional quality assurance and strategic management systems.

4.5 Financial Constraints

Financial limitations emerged as another major challenge. Lecturers agreed that inadequate institutional financial resources (M = **3.03**, SD = **1.14**), insufficient budgets for technology training and equipment (M = **2.98**, SD = **1.07**), limited funding for continuous technological upgrades (M = **2.98**, SD = **1.16**), and high maintenance costs (M = **3.09**, SD = **1.10**) constrained smart technology integration. These findings demonstrate that sustainable digital transformation requires continuous investment rather than one-time procurement of technological infrastructure.

Universities must continually finance software licensing, cybersecurity, internet subscriptions, equipment replacement, system maintenance, and professional development to sustain digital ecosystems. Financial limitations therefore reduce institutions' capacity to maintain technological relevance and respond to rapidly changing digital innovations. Similar findings have been reported by OECD (2023), which emphasizes that long-term financing remains one of the greatest determinants of successful institutional digital transformation. African studies similarly demonstrate that inadequate funding significantly limits ICT expansion and maintenance within universities (Mtebe & Raphael, 2021). In Kenya, recent reports by the Ministry of Education (2023) and the Commission for University Education (2022) indicate that financial sustainability remains a significant challenge affecting higher education digital transformation.

4.7 Professional Development and Human Capacity Challenges

Professional development challenges were also evident. Lecturers agreed that inadequate training opportunities (M = **2.91**, SD = **1.13**) limited their ability to integrate smart technologies effectively into teaching. Interview evidence further suggested that institutional training programmes were often irregular, generalized, and insufficiently aligned with discipline-specific instructional needs. These findings indicate that although universities recognize the importance of digital capacity building, institutional investment in continuous professional development remains inadequate.

Attitudinal and psychological barriers equally influenced technology integration. Lecturers reported resistance to technological change (M = **3.05**, SD = **1.08**), concern regarding the time required to learn new technologies (M = **3.07**, SD = **1.04**), fear of failure when using unfamiliar digital tools (M = **3.26**, SD = **1.05**), and discouragement arising from previous negative experiences (M = **3.17**, SD = **1.14**). These findings demonstrate that technology integration is influenced not only by institutional resources but also by lecturers' confidence, technological self-efficacy, and willingness to adopt innovative instructional practices. Similar observations have been made by Ertmer and Ottenbreit-Leftwich (2010) and Tondeur et al. (2021), who identify teacher beliefs and self-confidence as strong predictors of educational technology adoption. Comparable findings have also been reported in African universities where limited confidence and inadequate professional support continue to slow digital transformation (Czerniewicz et al., 2020; Mtebe & Raphael, 2021).

4.8 Student-Related Challenges

Lecturers also perceived student-related factors as influencing technology integration. Respondents agreed that many students lacked compatible digital devices (M = **3.02**, SD = **1.08**) and possessed insufficient digital literacy skills (M = **3.03**, SD = **1.08**). These findings indicate that learner preparedness remains an important determinant of successful technology-enhanced learning. Limited access to personal devices restricts students' participation in online learning, digital assessment, collaborative activities, and independent research.

However, lecturers generally disagreed that students resisted technology adoption (M = **2.19**, SD = **1.05**). This finding suggests that students are generally willing to engage with digital learning but are constrained by access, affordability, and competence rather than negative attitudes. Similar conclusions have been reported by Daniel (2015) and van Laar et al. (2020), who emphasize that learner readiness depends largely on digital competence and equitable access rather than willingness alone.

4.9 Interview Findings

The qualitative findings strongly corroborated the quantitative results by revealing that university administrators viewed smart technology integration as a strategic institutional priority but acknowledged that implementation remained constrained by multiple interconnected challenges.

Deputy Vice Chancellors (Academic Affairs) consistently observed that financial limitations significantly affected the acquisition, maintenance, and upgrading of digital infrastructure. One administrator remarked:

"Technology is no longer optional in higher education, but maintaining modern digital infrastructure requires continuous investment, which is becoming increasingly difficult because universities are operating under significant financial pressure."

Heads of ICT emphasized that shortages of qualified technical personnel limited institutions' ability to provide timely technical support. One ICT Director explained:

"We have the infrastructure in place, but the number of technical staff is inadequate to support the growing demand from both lecturers and students. As technology use increases, technical support requirements also increase."

Directors of Quality Assurance highlighted the importance of institutional policies and monitoring systems in sustaining technology integration. Although

universities had developed ICT policies, implementation varied considerably across faculties and departments because of differences in leadership commitment, resource availability, and staff preparedness.

Classroom observations similarly revealed considerable institutional variation. Lecturers who had received continuous professional development demonstrated greater confidence in integrating learning management systems, online assessments, multimedia resources, and collaborative digital platforms. Conversely, lecturers with limited training relied predominantly on traditional lecture methods despite the availability of digital technologies.

4.10 Comparative Analysis

Comparison of students' and lecturers' perceptions reveals both convergence and divergence regarding the challenges affecting smart technology integration.

Both groups consistently identified inadequate infrastructure, limited financial resources, insufficient technical support, and inadequate training as major barriers to successful technology integration. This convergence suggests that digital transformation challenges are institutional rather than stakeholder-specific and require comprehensive organizational interventions.

However, important differences also emerged. Students expressed greater concern regarding access to digital devices, classroom infrastructure, technical support, online learning engagement, and digital anxiety. Their responses reflected the practical challenges experienced while participating in technology-enhanced learning environments.

In contrast, lecturers were more concerned about institutional governance, strategic planning, financial sustainability, professional development, organizational leadership, and the time required to adapt to emerging technologies. These concerns reflect their broader instructional and institutional responsibilities in implementing digital transformation.

The comparison therefore demonstrates that while students primarily experience technology integration challenges at the operational level, lecturers experience additional institutional and organizational barriers that influence instructional innovation. These findings suggest that universities should develop differentiated intervention strategies that address the distinct needs of both stakeholder groups while strengthening institutional systems that support digital transformation.

5. Conclusion and Recommendations

5.1 Conclusion

This study concludes that the integration of smart technology in teaching and learning in private chartered universities in Kenya is a complex institutional process that extends beyond the acquisition of digital devices, platforms, and connectivity. Although the universities have made progress towards digital transformation, effective and sustainable integration remains dependent on the interaction of institutional preparedness, reliable infrastructure, adequate financing, pedagogical capacity, technical support, and the digital readiness of both lecturers and students. The study therefore establishes that technology provision alone cannot guarantee meaningful integration; rather, universities need to develop an enabling institutional environment in which leadership, policies, resources, professional development, technical support, and user capacity operate in a coordinated manner. The interconnected nature of these factors further implies that weaknesses in one area can limit progress in others, making fragmented interventions less effective. Consequently, sustainable smart technology integration requires private chartered universities to move beyond technology acquisition towards purposeful, supported, and pedagogically meaningful utilization, with institutional strategies aligned to the continuous improvement of teaching and learning. The success of digital transformation should ultimately be assessed not by the volume of technologies adopted, but by their capacity to improve the quality, accessibility, efficiency, and effectiveness of teaching and learning.

5.2 Recommendations

Based on the findings of this study, the following recommendations are proposed.

1. Private chartered universities should strengthen digital infrastructure by investing in reliable high-speed internet connectivity, uninterrupted power supply, smart classrooms, modern computer laboratories, and institution-wide wireless networks to enhance equitable access to smart technologies.
2. University councils and management should increase financial investment in digital transformation by providing sustainable budgets for ICT infrastructure acquisition, equipment replacement, software licensing, maintenance, cybersecurity, and continuous technological upgrades.
3. Universities should develop and implement comprehensive institutional digital transformation strategies that clearly integrate smart technology initiatives into strategic plans,

quality assurance frameworks, and institutional governance structures.

4. Institutional leaders should establish continuous professional development programmes that provide lecturers with regular, discipline-specific, practical, and hands-on training in emerging educational technologies, digital pedagogies, artificial intelligence applications, online assessment, and technology-supported teaching strategies.
5. Universities should strengthen ICT support services by recruiting additional qualified technical personnel and establishing responsive help desks capable of providing timely assistance to lecturers and students experiencing technical difficulties.

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