



## Enhancing Technology Integration in Ghanaian Higher Education: Strategies and Policy Directions

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### ABSTRACT

Integrating digital technologies into higher education has become a global priority. Yet, institutions in developing countries continue to confront persistent structural, human, and institutional barriers that impede meaningful adoption. This paper examines the challenges, documented best practices, and policy strategies for enhancing technology integration in Ghanaian higher education. Drawing on a systematic review of policy documents, empirical studies, and institutional reports published between 2003 and 2026, the analysis identifies critical barriers including unreliable internet connectivity, high data costs, inadequate faculty digital competencies, fragmented governance, and weak policy implementation mechanisms. Three institutional case studies the University of Ghana, Kwame Nkrumah University of Science and Technology, and the University of Education, Winneba illustrate both promising initiatives and persistent gaps. The paper argues that Ghana's technology integration challenge is not one of policy absence but of implementation capacity, institutional will, and equitable resource allocation. Key recommendations include establishing a dedicated national funding mechanism for technology integration, developing a national digital literacy framework for higher education, strengthening data protection enforcement in educational contexts, and mandating technology integration standards in accreditation. The paper concludes that without coordinated, context-sensitive, and adequately resourced interventions, Ghana's aspiration to become a digital education leader in Africa will remain unrealized.

**Keywords:** technology integration, higher education, Ghana, ICT4AD, digital transformation, e-learning, professional development, policy implementation

### 1. Introduction

The integration of technology into higher education has transitioned from an optional enhancement to an operational necessity. Technology integration refers to the purposeful and effective deployment of digital tools and resources to support teaching, learning, assessment, and institutional administration, with the ultimate aim of improving educational outcomes and preparing learners for a digitally driven world. This paradigm shift demands a fundamental reorientation of pedagogical practice, moving away from teacher-centered, rote-based instruction toward learner-centered, inquiry-driven approaches that leverage technology to foster critical thinking, creativity, and collaboration. Education policymakers across the globe have consistently argued that when technology is effectively integrated, it can transform the learning experience, expand access, and enhance the quality of education delivered to students.

Higher education systems in developing countries occupy a paradoxical position in this global transformation. On one hand, they stand to benefit enormously from technology integration, as digital tools can help overcome longstanding barriers of distance, time, and resource scarcity. On the other hand, these same systems are often constrained by insufficient infrastructure, limited funding, and inadequate human capacity, which impede their ability to harness technology effectively (Prince Ololube, 2013). Ghana exemplifies this paradox. As one of West Africa's more stable democracies with a growing economy and an expanding tertiary education sector, Ghana possesses both the ambition and the foundational policy architecture to pursue meaningful technology integration. However, persistent structural and institutional challenges have meant that integration remains partial and uneven across its higher education landscape (Mahama, Amankwah-Sarfo, & Gyedu, 2024).

Ghana's policy commitment to ICT-driven development dates back to the early 2000s, when the government formulated the National ICT for Accelerated Development (ICT4AD) policy in 2003. This comprehensive policy framework articulated a vision of transforming Ghana into an information society and knowledge-based economy, with education identified as one of the essential pillars for realizing this national ICT agenda. The subsequent ICT in Education Policy, first developed in 2006 and revised in 2015, established the operational framework for integrating ICT into teaching and learning at all levels, with three core objectives: ICT as a learning and operating tool, ICT integrated into teaching and learning, and ICT as a career option for students (Ministry of Education, 2015). More recently, the Education Strategic Plan 2018-2030 has placed further emphasis on equipping all learners with ICT skills and providing well-equipped ICT facilities to improve the quality of teaching and learning in pursuit of Sustainable Development Goal 4 (Ministry of Education, 2018).

Despite this robust policy foundation, empirical evidence suggests that the translation of policy aspirations into institutional practice has been limited. Twenty years after the inauguration of the ICT4AD policy, scholars have observed that the vision of transforming Ghana into an information and technology-driven economy through digital education remains largely unrealized (Adarkwah & Huang, 2023). A CIPP evaluation of Ghana's ICT in Education Policy (2015–2025) concluded that the reform is "policy-rich but practice-constrained," with substantial gaps persisting between policy intent and practice, particularly in infrastructure availability, teacher ICT usage, coordination across agencies, and inclusive access for rural learners, girls, and students with disabilities (Boateng, Duedu, & Opoku Ntiamoah, 2026). At the institutional level, digital transformation efforts have been predominantly top-down, initiated and spearheaded by vice-chancellors in response to external pressures such as the COVID-19 pandemic or accreditation demands, rather than being embedded into long-term governance structures and institutional culture (Loglo, 2024).

The COVID-19 pandemic served as a critical catalyst for digital transformation in Ghanaian higher education. When campuses were forced to close in March 2020, institutions scrambled to deploy online learning platforms to maintain academic continuity. The University of Education, Winneba, for instance, demonstrated notable adaptability by rapidly deploying online platforms (Ghansah, 2025). However, these efforts were largely reactive and crisis-driven. In several Ghanaian universities, despite investments in learning management systems, traditional face-to-face teaching continued to dominate after the pandemic, indicating the profound difficulty of sustaining digital reforms once the immediate crisis had passed (Mahama et al., 2024). This pattern of "symbolic compliance," where digital initiatives are adopted to satisfy external expectations but not genuinely integrated into institutional practice, has been identified as a recurring theme in Ghana's higher education technology landscape (Adarkwah & Huang, 2023).

This paper addresses a critical gap in the existing literature by systematically examining the challenges confronting technology integration in Ghanaian higher education institutions, analyzing documented best practices, and proposing evidence-informed policy recommendations. While individual studies have examined specific aspects of this problem, such as faculty digital literacy, infrastructure limitations, or the experiences of particular institutions, there is a need for a comprehensive synthesis that can inform both institutional strategy and national policy. The central research question guiding this analysis is: What are the principal barriers to effective technology integration in Ghanaian higher education, and what strategies can be employed to overcome them? This question is addressed through a systematic review and thematic analysis of relevant literature, policy documents, and institutional case studies.

The significance of this study extends beyond academic inquiry. Higher education is widely regarded as the bedrock for producing educated citizens and trained manpower essential for national development. In Ghana, the tertiary education sector has expanded rapidly in recent decades, with tertiary enrollment rising from 18.61% in 2020 to 24.06% in 2025 (HistorySaid, 2026). However, this expansion has placed enormous strain on physical infrastructure, faculty capacity, and financial resources. Technology integration, if effectively implemented, offers a pathway to expand access while maintaining quality, to enhance the relevance of curricula to labor market demands, and to position Ghanaian graduates competitively in the global knowledge economy. Conversely, failure to address the persistent barriers to technology integration risks perpetuating inequities, widening the digital divide between urban and rural institutions, and diminishing the international competitiveness of Ghanaian higher education.

## 2. Literature Review

### 2.1 Policy Framework for ICT in Ghanaian Education

Ghana's engagement with ICT-driven development dates to the early 2000s, when the government recognized the transformative potential of digital technologies for economic growth and poverty eradication (Ministry of Education, 2008). The National ICT for Accelerated Development (ICT4AD) policy, formulated in 2003, provided the foundational policy architecture for Ghana's information society agenda. Education constituted one of the essential pillars for realizing this national ICT vision, leading to the development of a national ICT in Education Policy. The initial stakeholder workshop for the ICT4AD policy was convened in 2001, and the process of developing a dedicated education-sector policy framework involved extensive consultations with education managers, ICT experts, and development partners over several years (Ministry of Education, 2015).

The ICT in Education Policy, finalized in its revised form in 2015, articulated three core objectives: first, ICT as a learning and operating tool that graduates should be able to use confidently and creatively; second, ICT integrated into teaching and learning processes; and third, ICT as a career option for students (Ministry of Education, 2015). These objectives were designed to ensure that graduates from Ghanaian educational institutions could develop the requisite skills and knowledge to be active participants in the global knowledge economy. The policy recognized that the successful integration of ICT into education would require not only infrastructure provision but also the development of human capacity among educators and the creation of enabling policy environments at institutional levels.

The Education Reforms of 2007 introduced ICT as a subject to be taught across all levels of the pre-tertiary education system, and subsequent reforms in 2019 further strengthened the integration of computing into basic school curricula (Ministry of Education, 2018). The Education Strategic Plan 2018–2030 emphasized the importance of providing relevant opportunities for all learners to develop ICT skills through well-equipped facilities, framing this as essential for achieving Sustainable Development Goal 4 on quality education. This policy layering from national ICT strategy to education-sector policy to specific curricular reforms demonstrates a sustained policy commitment at the national level that is notably more developed than in many peer countries in the region.

However, the existence of well-articulated policies does not automatically translate into effective implementation. Adarkwah and Huang (2023) conducted a comprehensive review of the ICT4AD policy twenty years after its inception and concluded that the policy had been unsuccessful in achieving its stated goal of transforming Ghana into an information and technology-driven high-income economy through digital education. A CIPP evaluation of the ICT

in Education Policy (2015–2025) similarly found that while the policy context was characterized by ambitious commitments to equity, access, and digital transformation, substantial gaps persisted between policy intent and practice, particularly in infrastructure availability, teacher ICT usage, coordination across agencies, and inclusive access for rural learners (Boateng et al., 2026).

The implementation gap is further illuminated by the observation that Ghana has launched numerous ICT and digitalization initiatives aimed at promoting integration in higher education, but these remain unevenly executed, hindered by financial limitations, infrastructural challenges, and managerial weaknesses (Mahama et al., 2024). Although the national policy framework outlines strategies for e-learning and digital resource provision, weak monitoring mechanisms and inconsistent institutional commitment mean that many universities continue to operate without fully functional e-learning systems or digital libraries. This pattern—ambitious national policies that fail to take root at the institutional level—is observed across Sub-Saharan Africa, suggesting that the challenge is not unique to Ghana but rather reflects broader structural dynamics in the region's higher education systems.

## **2.2 Infrastructure and Connectivity Constraints**

The state of physical and digital infrastructure constitutes one of the most fundamental barriers to technology integration in Ghanaian higher education. Technical challenges, including unreliable internet connectivity, low bandwidth allocation, and frequent power outages, not only limit connectivity but also substantially increase operational costs, as students and universities often resort to expensive private data bundles or backup systems to compensate for institutional infrastructure deficits (Mahama et al., 2024). These technical limitations are not evenly distributed across the higher education landscape; they tend to be more severe in institutions located outside the major urban centers of Accra and Kumasi, exacerbating geographic inequities in access to technology-enhanced education.

Data on internet penetration in Ghana presents a mixed picture. As of 2025, internet penetration stood at approximately 69.9%, indicating significant progress in connectivity over the past decade (DataReportal, 2025). The Internet Society's country report for Ghana notes that approximately 72% of the population used the internet at least once over three months in 2025, though the average download speed for mobile connections was 19.76 Mbps and the overall internet resilience score was 44%, indicating medium capacity to withstand unexpected faults (Internet Society, 2025). For higher education institutions, the implications of these connectivity gaps are profound. Students from rural backgrounds or those studying at institutions in less connected regions face significant disadvantages in accessing online learning resources, participating in synchronous virtual classes, and engaging with digital course materials.

The situation at the pre-tertiary level provides a sobering indication of the infrastructure deficits that feed into higher education. The CIPP evaluation of Ghana's ICT in Education Policy found that infrastructure availability, teacher ICT usage, and coordination across agencies remained substantial gaps between policy intent and practice (Boateng et al., 2026). While higher education institutions generally have better infrastructure than their pre-tertiary counterparts, the gap between institutional rhetoric and operational reality remains substantial. Many universities have invested in learning management systems and campus-wide Wi-Fi, but the quality and coverage of these services frequently fall short of what is needed for meaningful technology integration across all academic activities.

The cost dimension of connectivity deserves particular attention because it directly affects the equitable accessibility of technology-enhanced learning. High costs of devices, data bundles, and maintenance exclude many students, particularly those from low-income and rural backgrounds, from fully participating in digital learning (Mahama et al., 2024). A study of undergraduates in Ghana found that many students, constrained by limited access to laptops and affordable internet, depended primarily on mobile phones for their learning activities, a reliance that significantly restricted the depth of their digital engagement (Mahama et al., 2024). This finding highlights an important but often overlooked dimension of the digital divide: the difference between having some access to technology and having sufficient access to engage in meaningful learning activities.

The historical trajectory of infrastructure development in Ghanaian higher education reveals a chronic pattern of underinvestment. Budgetary constraints that result in recurring deficits make it difficult for public universities to adequately develop and maintain the technological infrastructure required for comprehensive digital integration. Even when allocations for technology infrastructure are made, competing institutional priorities often result in tech infrastructure development being placed at the bottom of the resource allocation hierarchy. Geospatial discrepancies in the location of higher education institutions further compound the problem, with institutions in the northern regions of Ghana generally facing greater infrastructure deficits than those in the southern regions.

## **2.3 Faculty Digital Competencies and Professional Development**

The effectiveness of technology integration in higher education ultimately depends on the capacity of faculty members to use digital tools pedagogically, not merely as presentation aids but as instruments for transforming teaching and learning. However, a substantial body of evidence indicates that many faculty members in Ghanaian universities lack the digital literacy and pedagogical training needed to integrate technology effectively into their teaching, learning, and research activities (Mahama et al., 2024). A study of faculty adoption of blended learning at a public university in Ghana found that while faculty with prior digital experience found the transition smoother, others faced challenges due to limited blended learning literacy, compounded by inconsistent infrastructure, insufficient institutional support, and cultural resistance to digital learning (Open Praxis, 2025).

Research on student teachers' digital literacy provides an illuminating perspective on the preparedness of the future educator workforce. A cross-sectional study of student teachers across Ghanaian public Colleges of Education assessed digital literacy across three competency levels defined by the UNESCO ICT Competency Framework for Teachers: Knowledge Acquisition, Knowledge Deepening, and Knowledge Creation. The findings revealed that

participants demonstrated relatively strong foundational skills in Knowledge Acquisition, indicating reasonable familiarity with basic digital tools and operations. However, significant gaps emerged in pedagogical integration, as measured by Knowledge Deepening, and in innovation, as measured by Knowledge Creation competency levels. Academic level predicted competency, with higher-level students outperforming beginners. These findings suggest that while foundational digital skills are being developed, the translation of these skills into pedagogical practice and curricular innovation remains a significant challenge.

A qualitative study of exemplar lecturers at a Ghanaian teacher education university offers deeper insight into the factors that facilitate and hinder faculty professional development in ICT integration. The study employed a hermeneutic phenomenology design and purposefully selected twenty exemplar lecturers using snowball sampling. Through thematic analysis of interview data, the researchers identified several intrinsic motivating factors for integration, including the desire to work smart, personal interest in technology, a drive for innovation, the motivation to help colleagues and students, and a commitment to lifelong learning. Factors fostering professional development included family support, a strong affinity for mathematics and science, the pursuit of a professional niche, and institutional elements such as support services and equipment availability.

However, the same study identified significant barriers to professional development. These included a lack of adequate funding for specialized training or conference attendance, insufficient book and research allowances to acquire necessary resources, limited and generalized professional development programs that failed to meet specific or advanced needs of lecturers across diverse subject areas, inadequate technical support characterized by a low number of ICT experts resulting in slow response times and a lack of pedagogical context in their technical instructions, and a lack of institutional competency requirements for technology integration (Ansah, Akpanglo-Nartey, & Sakyi, 2025). This final barrier, the absence of formal expectations or incentives for ICT proficiency, was particularly significant, as it led to a relaxed attitude among many lecturers who perceived no formal pressure for skill development or promotion based on ICT proficiency.

The professional development landscape is not entirely discouraging, however. Several initiatives have demonstrated the potential for meaningful capacity building when adequately resourced and strategically designed. The KNUST E-Learning Centre, for example, has trained and certified 1,600 lecturers and tutors in online pedagogy and assessment over five years, and has developed continuous professional development training programs for faculty members, teaching and graduate assistants, technicians, and even security staff (KNUST, 2025). The University of Education, Winneba, has hosted seminars to equip faculty members with advanced digital tools for education, with a particular focus on the integration of artificial intelligence in teaching and learning (UEW, 2026). These initiatives represent important steps forward, but their scale remains limited relative to the magnitude of the capacity-building challenge across Ghana's entire higher education sector.

#### ***2.4 Institutional Governance and Leadership***

The role of institutional leadership in enabling or constraining technology integration cannot be overstated. Research on digital transformation in selected Ghanaian public universities has revealed that while leadership commitment is essential, the predominant top-down model of digital transformation has significant limitations. Vice-chancellors have often initiated and spearheaded digital leadership responses in reaction to external pressures, particularly the COVID-19 pandemic, but these efforts have unfolded within a less coordinated policy climate and have not always been supported by the institutional governance structures necessary for sustainability (Loglo, 2024). The top-down approach, while expedient in crises, may not adequately engage faculty and students as active participants in the transformation process, thereby limiting the depth and durability of change.

Weak leadership commitment, fragmented governance structures, and limited monitoring mechanisms mean that national and institutional ICT policies are often only partially implemented (Mahama et al., 2024). Some digital initiatives function as what Adarkwah and Huang (2023) describe as "symbolic compliance," adopted in response to external pressures such as the COVID-19 pandemic or accreditation requirements but not embedded into long-term governance and organizational culture. This pattern of symbolic reform is not unique to Ghana; similar dynamics have been observed across Sub-Saharan Africa, where institutional theory perspectives help explain why organizations adopt structures and practices that are legitimate in their external environment without fundamentally altering their internal operations (Mahama et al., 2024).

The quality assurance dimension of technology integration is increasingly recognized as critical for institutional governance. The Ghana Tertiary Education Commission (GTEC) has been actively pursuing a digital transformation agenda that seeks to build a fully digitized tertiary education system (GTEC, 2026). GTEC has hosted summer schools focused on the theme of technology for quality assurance, with the 2026 edition examining how technology can be intentionally deployed to strengthen quality assurance rather than weaken it. The Commission has also initiated the transition from manual accreditation processes to a fully digital Accreditation Management Information System (AIMS), with training sessions conducted for deans and heads of departments across multiple institutions (GTEC, 2025). These regulatory initiatives represent an important top-down mechanism for driving institutional change, but their effectiveness will depend on the extent to which institutions develop corresponding internal quality assurance capacity.

At the institutional level, some universities have made notable progress in developing digital governance frameworks. Kwame Nkrumah University of Science and Technology (KNUST), for example, employs platforms such as Power BI, Turnitin, and Google Drive for data management, accreditation tracking, and institutional rankings (UEW, 2026). The KNUST E-Learning Centre has announced a strategy aimed at redefining its role in digital education, with focus areas including digital assessment, developing technology potentially supported by artificial intelligence to efficiently process and grade handwritten examinations, and immersive learning, involving the deployment of virtual reality (VR) and augmented reality (AR) solutions for practical training in safety-critical and hazardous environments (KNUST, 2025).

## 2.5 Theoretical Framework

Understanding the challenges of technology integration in Ghanaian higher education benefits from the application of established theoretical perspectives that illuminate different dimensions of the problem. Three complementary frameworks are particularly relevant: the Technology Acceptance Model (TAM), the Digital Divide Theory, and Institutional Theory.

The Technology Acceptance Model, originally developed by Davis (1989), posits that the adoption of technology is primarily determined by two factors: perceived usefulness and perceived ease of use. In the context of Ghanaian higher education, TAM helps explain why even when technological resources are available, faculty and students may not adopt them if they perceive the tools as difficult to use or not useful for their specific needs. Research by Boateng et al. (2016) applied an extended TAM to investigate the determinants of e-learning adoption among students at the University of Ghana. Their survey of 337 students revealed that perceived usefulness and attitude toward use had direct effects on e-learning adoption, while perceived ease of use and computer self-efficacy had indirect effects. These findings underscore the importance of designing e-learning experiences that are not only technically functional but also pedagogically compelling that is, experiences that faculty and students can readily perceive as enhancing the teaching and learning process.

The Digital Divide Theory extends the analysis beyond individual-level adoption decisions to consider systemic inequities in access to technology. This framework is particularly relevant to Ghana, where substantial disparities exist between urban and rural institutions, between well-resourced and under-resourced universities, and between students of different socioeconomic backgrounds. As Mahama et al. (2024) observe, infrastructural and economic inequities reinforce exclusion, creating a situation where students who would benefit most from technology-enhanced learning those in remote areas or from disadvantaged backgrounds are least likely to have meaningful access to it. The digital divide in Ghanaian higher education operates at multiple levels: between institutions, between students within institutions, and between Ghanaian higher education as a whole and that of more technologically advanced countries.

Institutional Theory provides a third analytical lens, focusing on how organizations respond to external pressures and how these responses may result in symbolic rather than substantive change. This perspective is particularly illuminating for understanding the gap between policy adoption and implementation effectiveness in Ghanaian higher education. As Mahama et al. (2024) explain, integration often stalls after crises because many initiatives amount to symbolic compliance adopted to meet external pressures such as COVID-19 disruptions or accreditation demands rather than being embedded into governance, leadership, and institutional culture. Once the immediate pressure recedes, weak monitoring mechanisms, fragmented leadership, and limited organizational commitment prevent digital practices from becoming sustained, systemic transformations. Institutional Theory thus helps explain why the existence of well-articulated ICT policies at both national and institutional levels has not translated into corresponding changes in teaching and learning practice.

## 3. Methodology

### 3.1 Research Design

This study employs a systematic qualitative approach combining a comprehensive literature review with in-depth case study analysis. This methodology is appropriate for the research objectives because it allows for the synthesis of existing knowledge from multiple sources while also providing detailed, contextually grounded insights into the specific experiences of Ghanaian higher education institutions. The research design is informed by the recognition that technology integration is a complex, multi-dimensional phenomenon that cannot be adequately understood through quantitative indicators alone.

### 3.2 Literature Search Strategy

The literature review was conducted through systematic searches of electronic databases including ERIC, Scopus, Web of Science, and Google Scholar. The following search terms and combinations were employed: "Ghana" AND ("technology integration" OR "ICT integration" OR "digital transformation" OR "e-learning") AND ("higher education" OR "universities" OR "tertiary education"); "ICT4AD" AND "education"; "Ghana" AND "faculty" AND ("digital literacy" OR "professional development" OR "ICT training"); and "Ghana" AND ("quality assurance" OR "data privacy" OR "policy") AND "technology." Boolean operators were used to combine search terms, and searches were limited to peer-reviewed journal articles, policy documents, and institutional reports published between 2003 and 2026. The starting date of 2003 was selected because it marks the inception of Ghana's ICT4AD policy, providing a policy-relevant temporal boundary. Including sources published through 2026 reflects the most recent available research on this rapidly evolving topic.

### 3.3 Inclusion and Exclusion Criteria

Sources were included if they met the following criteria: (a) directly addressed technology integration or ICT adoption in Ghanaian higher education or, where relevant, in Sub-Saharan African higher education with implications for Ghana; (b) were published in English; (c) provided empirical data, policy analysis, or theoretical insight relevant to the research question; and (d) were available in full text. Sources were excluded if they focused exclusively on pre-tertiary education without relevance to higher education policy or practice, or if they were opinion pieces without empirical or analytical grounding.

### 3.4 Data Analysis Approach

The data analysis followed a thematic synthesis approach. Extracted information was organized into categories corresponding to the primary themes identified in the literature: policy framework and implementation; infrastructure and connectivity; faculty capacity and professional development; institutional governance and leadership; industry-academia collaboration; emerging technologies; and ethical and legal considerations. Within each category, the analysis identified patterns, convergences, and divergences across sources. Where sources presented conflicting findings, these were noted and analyzed to understand the sources of disagreement. The analysis was iterative, with themes refined as additional sources were reviewed and synthesized.

### 3.5 Case Selection

Three Ghanaian higher education institutions were selected for focused case analysis: the University of Ghana (UG), Kwame Nkrumah University of Science and Technology (KNUST), and the University of Education, Winneba (UEW). These institutions were selected based on the availability of documented evidence regarding their technology integration initiatives, their representation of different institutional types and historical missions, and their varied geographic locations within Ghana. UG is Ghana's oldest and largest university, located in the capital, Accra; KNUST is a science and technology-focused university located in Kumasi, Ghana's second-largest city; and UEW is a specialized teacher education university located in Winneba, a smaller town in the Central Region. Together, these institutions provide a cross-section of the institutional diversity within Ghana's public higher education sector.

### 3.6 Limitations

Several limitations of this methodology should be acknowledged. First, the reliance on published literature and institutional reports means that the analysis is constrained by the availability and quality of existing documentation. Important institutional experiences that have not been documented in the academic or policy literature may be underrepresented. Second, the case study approach, while providing depth, limits the generalizability of findings to the broader population of Ghanaian higher education institutions. Third, the rapid pace of technological change means that some of the information reviewed may become outdated relatively quickly. Finally, the research is limited to publicly available sources, and some internal institutional data on technology integration, such as detailed budget allocations, usage statistics, and internal assessments, are not accessible through public sources.

## 4. Results/Findings

### 4.1 Policy Implementation Gap

The analysis reveals a persistent gap between Ghana's well-defined ICT policies and their implementation in education. Despite policies like ICT4AD, the translation into practice in higher education remains limited and superficial. Adarkwah and Huang (2023) describe the ICT4AD policy as 'unsuccessful' after twenty years, a conclusion supported by the CIPP evaluation (Boateng et al., 2026), which labels the reform 'policy-rich but practice-constrained.' The implementation gap shows 'symbolic compliance,' where structures meet external expectations without internal change (Mahama et al., 2024). While Ghana has launched ICT initiatives, efforts are uneven due to financial, infrastructural, and managerial issues, leading many universities to operate without fully functional e-learning or digital libraries.

### 4.2 Infrastructure Deficits and Connectivity Inequities

Infrastructure and connectivity deficits remain the primary barriers to technology integration in Ghana. These challenges involve not only limited physical infrastructure but also unreliable service, high costs, and unequal access. Although internet penetration reached approximately 69.9% in early 2025, with 24.3 million users, Ghana's internet resilience score was only 44%, and average mobile download speed was 19.76 Mbps (DataReportal, 2025; Internet Society, 2025). In higher education, unreliable internet, low bandwidth, power outages, and expensive data and maintenance costs particularly disadvantage students from low-income and rural backgrounds. Limited access to laptops and affordable internet also leads many students to rely mainly on mobile phones, restricting their digital learning engagement (Mahama et al., 2024).

### 4.3 Faculty Digital Competency Gaps

The analysis identifies a significant gap between faculty members' basic digital skills and their ability to integrate technology pedagogically. Although prior digital experience facilitates blended-learning adoption, many faculty face limited training, inadequate infrastructure, insufficient institutional and technical support, and socio-cultural resistance (Open Praxis, 2025). At UEW, intrinsic motivation supported professional development, but funding constraints, generalized training, limited technical assistance, and the absence of competency requirements hindered effective technology integration (Ansah et al., 2025). Similarly, student teachers demonstrated stronger basic digital skills than advanced competencies in pedagogical integration and innovation, indicating that foundational literacy is developing faster than the skills needed for technology-enhanced teaching and curricular innovation.

#### 4.4 Leadership and Governance Dynamics

Institutional leadership is a critical but ambivalent factor in technology integration. Although vice-chancellors and senior administrators have initiated digital transformation, especially during COVID-19, the predominantly top-down approach, weak monitoring, fragmented governance, and limited institutional support have constrained sustainability (Loglo, 2024). Consequently, some initiatives function as “symbolic compliance” with external pressures such as disruptions or accreditation demands rather than becoming embedded in institutional culture and practice (Mahama et al., 2024). At the regulatory level, GTEC is advancing digital transformation through technology-focused quality-assurance initiatives and the shift from manual accreditation to a digital Accreditation Management Information System (AIMS), supported by training for institutional leaders (GTEC, 2025, 2026).

#### 4.5 Institutional Case Studies

**University of Ghana:** The University of Ghana’s decade-long use of the Sakai LMS offers a key case study in sustained technology integration in Ghanaian higher education. During the COVID-19 pandemic, Sakai was critical in maintaining academic continuity when campuses closed. Vice-Chancellor Professor Nana Aba Appiah Amfo stressed that digital learning is about “resilience, adaptability, and the future of higher education,” not just convenience (Ghana News Agency, 2025). Yet the university also acknowledged ongoing “digital limitations,” highlighting both the promise of long-term LMS adoption and the challenges of deepening and broadening tech integration beyond a single platform.

**Kwame Nkrumah University of Science and Technology (KNUST):** KNUST has shown strong leadership in technology integration through its E-Learning Centre, which has developed 137 online and blended courses, supported over 50,000 students in computer-based exams, and trained 1,600 lecturers in online pedagogy. The Centre also runs continuous professional development for faculty, assistants, technicians, and security staff, while the university uses tools like Power BI, Turnitin, and Google Drive for data management and accreditation tracking. In industry-academia collaboration, KNUST benefits from partnerships such as Halliburton Ghana Operations’ ~US\$15 million commitment of advanced petroleum engineering software, training, and academic support. These efforts show that combining institutional leadership with external partnerships enables meaningful technology-enhanced learning.

**University of Education, Winneba (UEW):** As Ghana’s specialized teacher education university, UEW plays a key role in national technology integration efforts. It adapted during the COVID-19 pandemic by deploying online platforms and has outlined plans to expand ICT infrastructure, including a fiber-optic backbone and an in-house ERP system under a paperless agenda (UEW, 2026). The university also received 200 laptops through the One Million Coders Program (UEW, 2026). However, research on exemplar lecturers indicates that institutional facilities and policies remain inadequate, with persistent barriers in funding, technical support, and incentives (Ansah et al., 2025).

#### 4.6 Industry-Academia Collaboration

Industry-academia collaboration in Ghanaian higher education is expanding but remains underdeveloped. Recent partnerships include the University of Ghana–UNDP Innovation Pod, KNUST’s NextGen Energy Innovators Challenge with Vivo Energy Ghana, and a US\$15 million Petroleum Commission–Halliburton initiative supporting KNUST’s petroleum engineering training and research (UNDP, 2025; Vivo Energy Ghana, 2026; Petroleum Commission, 2026). These initiatives help align academic training with industry needs, but stronger frameworks and sustained engagement are needed to move beyond isolated projects and integrate emerging technologies such as artificial intelligence into education (Ghana News Agency, 2026).

#### 4.7 Emerging Technologies: VR, AR, and AI

Emerging technologies such as virtual reality, augmented reality, and artificial intelligence are at an early but promising stage in Ghanaian higher education. Among 893 Ghanaian university students, perceived usefulness, ease of use, enjoyment, and personal innovativeness significantly influenced intentions to use educational metaverse platforms (Acquah et al., 2026). KNUST has identified VR and AR as priorities for practical training in hazardous environments, while the University of Ghana has advocated their responsible and inclusive use (KNUST, 2025; Ghana News Agency, 2025). Ghana’s National Artificial Intelligence Strategy 2023–2033 further supports AI education, digital inclusion, and future employment while emphasizing privacy, cybersecurity, transparency, fairness, and accountability (OECD.AI, 2026).

#### 4.8 Data Privacy and Ethical Considerations

Data privacy and security are growing concerns in Ghanaian higher education. The Data Protection Act, 2012 (Act 843) regulates the collection and use of personal data, but research indicates that educational institutions need standardized data-protection policies and stronger compliance practices (Data Protection Commission, 2012; ReVIS, 2025). As institutions increasingly collect and use sensitive student data, ethical governance must keep pace with technological change. GTEC’s emphasis on using artificial intelligence to improve teaching and learning further highlights the need to integrate privacy, security, and accountability into digital transformation efforts (GTEC, 2026).

## 5. Discussion

### 5.1 Interpreting the Policy-Implementation Gap

The persistent gap between Ghana's policy ambitions and institutional realities demands careful interpretation. The existence of comprehensive policy frameworks the ICT4AD policy, the ICT in Education Policy, and the Education Strategic Plan 2018-2030 demonstrates that Ghana's policymakers have clearly articulated a vision for technology-driven educational transformation. Yet the translation of this vision into practice at the institutional level has been profoundly limited. The CIPP evaluation of the ICT in Education Policy concluded that the reform is "policy-rich but practice-constrained," with substantial gaps persisting between policy intent and practice (Boateng et al., 2026). This disconnect is not unique to Ghana; similar patterns of ambitious policy and weak implementation have been observed across Sub-Saharan Africa (Mahama et al., 2024).

Institutional Theory provides a useful lens for understanding this gap. Organizations often adopt structures and practices that are considered legitimate in their external environment, such as ICT policies and e-learning platforms, without fundamentally altering their internal operations. This "decoupling" of formal structure from actual practice allows institutions to satisfy external stakeholders while maintaining established routines that are more comfortable and less disruptive to existing power relations. The COVID-19 pandemic temporarily disrupted this equilibrium by creating an urgent need for online learning, and many institutions responded with remarkable speed. However, as the crisis receded, so too did the urgency, and in many cases, institutions reverted to traditional face-to-face teaching models despite their continued investment in e-learning infrastructure (Mahama et al., 2024).

This pattern suggests that external pressures alone are insufficient to drive sustainable technology integration. What is needed is a combination of sustained internal commitment, adequate resource allocation, and accountability mechanisms that ensure policy aspirations are translated into measurable institutional outcomes. GTEC's efforts to digitize accreditation processes and establish quality assurance frameworks for technology use represent important steps in this direction, but their effectiveness will depend on the extent to which they create genuine incentives and requirements for institutional compliance and improvement.

### 5.2 The Digital Divide Within Ghanaian Higher Education

The analysis reveals that the digital divide in Ghanaian higher education operates at multiple levels and takes multiple forms. At the inter-institutional level, significant disparities exist between well-resourced universities in Accra and Kumasi and less well-endowed institutions in other regions. These disparities are reflected in the quality of internet connectivity, the availability of computer laboratories and e-learning facilities, and the level of technical support available to faculty and students. At the intra-institutional level, students from different socioeconomic backgrounds face vastly different levels of access to the devices, data, and connectivity required for meaningful participation in technology-enhanced learning. The finding that many students depend primarily on mobile phones for their learning activities is particularly concerning, as this reliance restricts the depth and breadth of their digital engagement (Mahama et al., 2024).

Addressing the digital divide requires not only investments in infrastructure but also targeted interventions that address the specific barriers faced by disadvantaged groups. Such interventions might include subsidized data packages for low-income students, the establishment of computer laboratories with extended opening hours in underserved institutions, and targeted digital literacy programs for students from backgrounds with limited prior exposure to technology. Importantly, addressing the digital divide requires a nuanced understanding of what constitutes meaningful access. The difference between having some access to technology and having sufficient access to engage in meaningful learning activities is crucial. Mobile phone-based learning, while valuable as a stopgap, cannot substitute for the functionality offered by full computer-based learning environments.

### 5.3 Faculty Development as a Strategic Priority

The findings on faculty digital competencies point to a clear conclusion: investments in infrastructure and platforms are necessary but insufficient without corresponding investments in human capacity. The qualitative study of exemplar lecturers at UEW identified intrinsic motivation as a key driver of professional development, but also documented significant institutional barriers including inadequate funding for specialized training, limited and generalized professional development programs, insufficient technical support, and the absence of institutional competency requirements for technology integration (Ansah et al., 2025). These findings indicate that even highly motivated faculty members face structural obstacles to developing their digital competencies.

The implications for institutional policy are significant. First, professional development for technology integration must be reconceptualized not as a one-time training event but as an ongoing process of professional learning embedded in the daily work of faculty members. This means integrating technology-related learning into existing structures such as faculty learning communities, peer mentoring programs, and departmental seminars, rather than treating it as a separate and disconnected activity. Second, institutions must create genuine incentives for faculty engagement with technology integration. The finding that the absence of institutional competency requirements for technology integration leads to a "relaxed attitude" among lecturers (Ansah et al., 2025) suggests that when technology proficiency is not valued in promotion and tenure decisions, faculty perceive it as optional rather than essential. Aligning institutional incentive structures with technology integration goals is therefore a critical priority.

Third, professional development must be differentiated according to faculty members' existing competencies and subject-specific needs. The critique that current programs are "limited and generalized" and fail to meet the specific needs of lecturers across diverse subject areas (Ansah et al., 2025) points to

the importance of needs-based, tailored approaches. Faculty in the humanities, social sciences, natural sciences, and professional schools face different challenges and opportunities in integrating technology into their teaching. A one-size-fits-all training approach is unlikely to be effective.

#### **5.4 The Role of Leadership and Governance**

The analysis suggests that institutional leadership plays a decisive role in determining the pace and direction of technology integration. The cases of UG, KNUST, and UEW demonstrate that when senior leadership is committed to digital transformation, meaningful progress is possible. The University of Ghana's decade-long engagement with the Sakai LMS is a testament to sustained institutional commitment. KNUST's E-Learning Centre, which has developed 137 online and blended courses, supported over 50,000 students through computer-based exams, and trained 1,600 lecturers, exemplifies how leadership can create conditions for innovation. However, the predominantly top-down nature of digital transformation in Ghanaian universities (Loglo, 2024) also highlights important limitations of this approach. When faculty and students are not meaningfully engaged in the planning and decision-making processes, technology integration may be experienced as imposed rather than owned, reducing the likelihood of deep and sustained adoption.

Effective governance of technology integration requires a balance between strategic direction from senior leadership and participatory engagement from faculty and students. Institutions need to establish governance structures such as technology integration committees with representation from academic staff, students, and technical support personnel that provide platforms for collaborative decision-making. These structures should have clear mandates, adequate resources, and genuine authority to influence institutional policy and resource allocation.

#### **5.5 The Potential and Limitations of Industry-Academia Partnerships**

The analysis identifies industry-academia collaboration as a promising but underdeveloped strategy for enhancing technology integration. Successful partnerships, such as the Petroleum Commission and Halliburton's US\$15 million deal with KNUST to provide advanced petroleum engineering software, training, and research support (Petroleum Commission, 2026), and the University of Ghana's MoU with UNDP to establish a University Innovation Pod and drive digital entrepreneurship (UNDP, 2025), demonstrate the potential for external partners to contribute resources, expertise, and practical experience to technology-enhanced learning. These partnerships can help bridge the gap between academic curricula and industry needs, providing students with opportunities to work on real-world problems and develop skills that enhance their employability.

However, the current landscape of industry-academia collaboration in Ghana is characterized by isolated, project-based initiatives rather than systematic, institutionalized partnerships. The challenge is to move from ad hoc collaborations to sustainable frameworks that provide mutual benefit to both academic institutions and industry partners. This requires the development of clear partnership models, including mechanisms for intellectual property management, resource sharing, and joint governance. It also requires institutions to develop the internal capacity to manage partnerships effectively, including dedicated staff for industry relations and clear procedures for partnership development and oversight.

#### **5.6 Ethical and Legal Dimensions**

The analysis reveals that ethical and legal considerations related to technology integration, while recognized as important, have received insufficient attention in both policy and practice. Ghana's Data Protection Act, 2012 (Act 843) provides a legal framework for the protection of personal data, establishing principles governing the processing of personal information and prescribing sanctions for non-compliance (Data Protection Commission, 2012). However, research indicates that data protection practices in educational institutions require strengthening, with a study of pre-tertiary schools in Ghana finding the need for standardized data protection policies (ReVIS, 2025). As higher education institutions collect increasing amounts of data on student learning, behaviour, and performance, the need for robust data governance frameworks becomes ever more urgent.

The ethical dimensions of technology integration extend beyond data privacy to encompass broader questions about equity, inclusion, and the purpose of education. Institutions must ensure that technology-enhanced learning environments are accessible to all students, including those with disabilities, those from low-income backgrounds, and those studying in remote areas. Ghana's National Artificial Intelligence Strategy 2023–2033 explicitly addresses ethical considerations, emphasizing data protection, privacy, cybersecurity, transparency, fairness, and accountability, and recommending the establishment of a Responsible AI Office to coordinate implementation and oversee monitoring and evaluation (OECD.AI, 2026). These policy commitments provide an important foundation, but their translation into institutional practice will require sustained attention and resources.

## **6. Conclusion and Recommendations**

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

This paper has examined the challenges, best practices, and policy strategies for enhancing technology integration in Ghanaian higher education. The analysis reveals that despite Ghana's early leadership in ICT policy development, evidenced by the ICT4AD policy, the ICT in Education Policy, and the Education Strategic Plan 2018-2030, the translation of these policies into institutional practice has been limited and uneven. The principal barriers to effective integration include inadequate infrastructure and unreliable connectivity, high costs of data and devices, limited faculty digital competencies and pedagogical training, weak institutional governance and leadership, and insufficient attention to ethical and legal considerations. Case studies of the University of Ghana, KNUST, and UEW illustrate both progress and persistent gaps. The University of Ghana's decade-long engagement with the Sakai

LMS demonstrates the potential of sustained institutional commitment, while KNUST's E-Learning Centre shows how leadership and investment can drive innovation at scale. UEW's experience, however, highlights the structural barriers that even motivated faculty members face in developing and applying their digital competencies.

## **6.2 Implications for Policy and Practice**

The findings of this study have several important implications for policymakers, institutional leaders, and other stakeholders in Ghanaian higher education. First, the persistent gap between policy aspiration and implementation reality suggests that current approaches to policy design and implementation are inadequate. Future policy development should incorporate more robust implementation mechanisms, including clear timelines, measurable targets, designated responsibility centers, and regular monitoring and reporting requirements. Policy documents should not be treated as terminal achievements but as living frameworks subject to periodic review and adaptation based on implementation experience and evolving technological and educational contexts. Second, the analysis underscores the critical importance of addressing the digital divide within Ghanaian higher education. Infrastructure investments and connectivity improvements are necessary but must be accompanied by targeted interventions that address the specific barriers faced by disadvantaged institutions, regions, and student populations. The design of such interventions should be informed by a nuanced understanding of what constitutes meaningful access, recognizing that mobile phone-based learning, while valuable, cannot substitute for the functionality required for deep engagement with technology-enhanced learning. Third, the findings highlight the need for a fundamental reconceptualization of faculty professional development for technology integration. Current approaches, characterized by occasional workshops and general training sessions, are insufficient to develop the sophisticated pedagogical competencies required for meaningful integration. What is needed is a systematic, ongoing approach to professional learning that is embedded in faculty work, differentiated by subject and competency level, supported by adequate technical and pedagogical support, and aligned with institutional reward structures.

## **6.3 Policy Recommendations**

Based on the analysis, the following policy recommendations are offered to the Government of Ghana, the Ghana Tertiary Education Commission, and institutional leaders:

### **1. Develop a comprehensive National Digital Higher Education Strategy**

Building on the existing policy framework, Ghana should develop a dedicated national strategy for digital transformation in higher education that establishes clear targets, timelines, and accountability mechanisms. This strategy should be developed through a participatory process involving universities, regulatory bodies, industry, and student representatives, and should include specific provisions for monitoring and evaluation.

### **2. Establish a dedicated funding mechanism for technology integration**

The government should establish a competitive funding mechanism analogous to research grant schemes specifically for institutional technology integration projects. This mechanism should prioritize projects that demonstrate potential for systemic impact, sustainable implementation, and equitable access. Funding allocations should consider institutional size and resource base, with mechanisms to ensure that less well-endowed institutions are not disadvantaged in accessing funds.

### **3. Create a national digital literacy and AI literacy framework for higher education**

Building on the UNESCO ICT Competency Framework for Teachers and Ghana's National Artificial Intelligence Strategy 2023–2033, Ghana should develop a national framework that specifies the digital competencies expected of higher education faculty and students. This framework should be integrated into teacher education curricula, faculty professional development programs, and institutional quality assurance mechanisms.

### **4. Strengthen data protection enforcement in educational contexts**

The Data Protection Commission should develop sector-specific guidelines for the handling of student data in higher education institutions, including requirements for privacy impact assessments, data sharing agreements with third-party vendors, and transparency mechanisms that inform students about how their data is collected and used.

### **5. Establish a national network of higher education innovation hubs**

The government and GTEC should support the creation of a network of innovation hubs across public universities, modelled on successful examples such as the University of Ghana's Innovation Pod with UNDP. These hubs should serve as focal points for industry collaboration, technology experimentation, and faculty professional development, with a mandate to share best practices and resources across the network.

### **6. Mandate technology integration standards in accreditation**

GTEC should incorporate technology integration standards into its accreditation framework, requiring institutions to demonstrate not only the existence of e-learning platforms and digital resources but also evidence of their effective use in teaching and learning, faculty competency in technology integration, and institutional planning for sustained digital transformation.

#### 6.4 Directions for Future Research

This study has identified several areas requiring further research. First, there is a need for rigorous impact evaluations of specific technology integration initiatives in Ghanaian higher education. While descriptive case studies provide valuable insights, they do not establish causal relationships between technology interventions and educational outcomes. Experimental and quasi-experimental studies are needed to determine which approaches are most effective in improving student learning and engagement. Second, more research is needed on the specific experiences of students with technology-enhanced learning in Ghanaian higher education. Much of the existing literature focuses on institutional and faculty perspectives, and student experiences, particularly those of students from disadvantaged backgrounds, are less well documented. Qualitative research on how students from different socioeconomic and geographic backgrounds navigate technology-enhanced learning environments would provide valuable insights for designing more equitable and effective learning experiences. Third, there is a need for research on the economics of technology integration in Ghanaian higher education. What are the costs of implementing and sustaining different technology solutions? How do these costs compare to the educational benefits achieved? What funding models have proven most effective in other contexts, and what are the implications for Ghana? Addressing these questions would provide evidence to inform resource allocation decisions at both institutional and national levels. Fourth, as artificial intelligence becomes increasingly integrated into educational technologies, research is needed on the ethical, pedagogical, and equity implications of AI adoption in Ghanaian higher education. How do AI-driven tools affect student learning and faculty workloads? What are the risks of algorithmic bias and exclusion? How can institutions ensure that AI adoption benefits all students, not just those with access to the latest technologies?

#### 6.5 Conclusion

The integration of technology into Ghanaian higher education is not merely a technical challenge but a systemic transformation that requires sustained commitment from all stakeholders. Ghana possesses important assets, particularly a robust policy framework, a growing base of digital infrastructure, committed institutional leaders, and a motivated faculty that can be leveraged to accelerate progress. However, these assets must be matched with the resources, incentives, and accountability mechanisms necessary to translate aspiration into achievement. The digital divide within Ghanaian higher education, both between institutions and between students, must be addressed through targeted interventions that ensure the benefits of technology-enhanced learning are equitably distributed.

The experience of the COVID-19 pandemic demonstrated that Ghanaian higher education institutions are capable of rapid adaptation when the need is urgent, and the commitment is real. The challenge now is to sustain and deepen that commitment beyond the crisis, to move from emergency responses to strategic, systemic transformation. This requires not only technical solutions but also political will, institutional leadership, and a collective commitment to the principle that quality higher education should be accessible to all Ghanaians, regardless of their geographic location, socioeconomic status, or field of study. The strategies outlined in this paper provide a roadmap for moving forward, but their implementation will require sustained effort, adequate resources, and genuine collaboration among all stakeholders. Only through such collective endeavor can Ghana realize the promise of technology to enhance the quality, relevance, and accessibility of its higher education system.

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