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Drivers and Barriers to Digital Transformation in Universities in Tanzania Post-COVID-19 Pandemic

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ABSTRACT

The COVID-19 pandemic pushed universities around the world to quickly adopt digital learning methods, leading to a faster shift towards digital transformation in higher education. In Tanzania, as in many sub-Saharan African countries, this shift revealed both new opportunities and ongoing challenges. This study explores how universities in Tanzania have transformed digitally after the pandemic, using the Technology–Organization–Environment (TOE) framework. Data were collected from 19 universities through surveys, Learning Management System (LMS) usage reports, and review of policy documents. The findings show that while most universities have adopted LMS platforms and improved internet connectivity, the use of these systems remains basic. Universities that already had e-learning strategies and had trained their staff before the pandemic were better prepared and used digital tools more effectively. On the other hand, universities without such preparations faced difficulties, including limited use of systems and resistance from staff. National efforts, such as the Higher Education for Economic Transformation (HEET) project, the TCU e-learning guidelines, and the National Digital Education Strategy (2024–2030), have proved to be enabling factors. However, issues such as the lack of clear policies on Open Educational Resources (OER) and differences in how universities implement digital learning remain. The results offer useful lessons for policymakers and university leaders in Tanzania and similar contexts.

Keywords: *digital transformation; higher education; learning management systems; post-pandemic education; technology–organization–environment framework*

INTRODUCTION

The COVID-19 pandemic caused major disruptions in higher education globally, pushing universities to adopt digital learning approaches almost overnight. Traditional models of face-to-face instruction were no longer feasible, prompting institutions to explore online teaching tools such as Learning Management Systems (LMSs), videoconferencing, and digital assessment methods to ensure continuity of learning (UNESCO, 2020; Hodges et al., 2020). This shift marked a turning point in the digital transformation of higher education, encouraging investments in ICT infrastructure, digital pedagogy, and faculty development (Crawford et al., 2020).

In sub-Saharan Africa, including Tanzania, the transition to remote teaching exposed long-standing challenges such as limited digital infrastructure, unequal Internet access, and low levels of digital literacy (Bervell & Umar, 2017; Adarkwah, 2021). Although many universities adopted open-source platforms including Moodle to support teaching, the effectiveness of these efforts varied greatly across institutions (Ghavifekr & Rosdy, 2015; Mtebe & Gallagher, 2022). In some cases, there was minimal use of interactive LMS features such as discussion forums, assignments, or online assessments (Oye et al., 2014; Mwalumbwe & Mtebe, 2017; Sife, Lwoga, & Sanga, 2007; Bervell & Arkorful, 2020; Gakio, 2006; Unwin et al., 2010; Muganda, Samzugi, & Mallinson, 2016; Mtebe & Raisamo, 2014; Mtebe & Raphael, 2018). These limitations reflected broader structural and organisational barriers that had existed even before the pandemic.

Tanzania's experience mirrored these regional patterns. Most public universities introduced or expanded e-learning platforms, often with external support. For instance, the University of Dar es Salaam launched hundreds of online courses and trained over 300 lecturers in digital teaching tools (Mtebe, Fulgence, & Gallagher, 2021). However, evidence suggests that increased access to technology did not guarantee active use. A study at the University of Dodoma revealed that only 62 out of 841 trained lecturers were regularly using the LMS by 2019 (Mtebe, 2020), highlighting gaps in integration and adoption. Building on this, Mtebe & Gallagher (2022) examined continued usage intentions of digital technologies in a Tanzanian university post-pandemic using the Expectation-Confirmation Model. Their findings showed that although many instructors recognised the usefulness of digital tools, actual usage was still influenced by prior experience, institutional support, and perceived satisfaction. These insights underline the need to understand digital transformation as a process driven not only by technology availability but also by individual and organisational readiness.

Despite these challenges, Tanzania has made several strategic investments to support digital education. Notable efforts include the World Bank funded Higher Education for Economic Transformation (HEET) project, the Tanzania Commission for Universities (TCU) Guidelines for Online and Blended Delivery (TCU, 2022), and the National Digital Education Strategy 2024–2030 (MoEST, 2024). These initiatives demonstrate a growing national commitment to integrating digital technologies into higher education. Nevertheless, the implementation of these policies at the institutional level has been inconsistent. Some universities have integrated digital strategies into their development plans, while others continue to operate without clear policies on e-learning or Open Educational Resources (OER) (Ghasia, Machumu, & DeSmet, 2019).

As universities in Tanzania move from emergency remote teaching to long-term digital learning, there is a shift in how digital tools are viewed, from temporary solutions to central components of educational planning. The focus is no longer just on access but on building inclusive, sustainable, and resilient digital ecosystems that can support high-quality teaching and learning. This transformation, however, is not without challenges. Issues such as weak ICT infrastructure, insufficient digital skills among faculty, and resistance to pedagogical change, remain critical barriers (Makoye, 2022; Sife, Lwoga, & Sanga, 2007).

While existing research on e-learning in Africa offers valuable insights, many studies have concentrated on individual factors like attitudes or usage rates. There remains a gap in understanding how broader technological, organisational, and environmental conditions interact to shape institutional adoption and transformation (Bervell & Arkorful, 2020). To address this, the current study uses the Technology–Organization–Environment (TOE) framework (Tornatzky & Fleischer, 1990) to examine post-pandemic digital transformation in 19 Tanzanian public universities.

The objectives of this study were threefold: first, to identify the key factors driving digital transformation in Tanzanian universities in the aftermath of the COVID-19 pandemic; second, to examine the main challenges that higher education institutions face in adopting and sustaining digital learning systems; and third, to propose strategic and policy recommendations that can support effective and inclusive digital transformation in the sector. To achieve these objectives, the study adopted a mixed-methods research design guided by the Technology–Organization–Environment (TOE) framework. Data were collected from 19 public universities in Tanzania through institutional surveys, analysis of Learning Management System (LMS) usage reports, and a review of relevant national and institutional policy documents. This study provides evidence to support the development of more effective digital education strategies in Tanzania and similar African contexts. It offers practical guidance to university leaders, policymakers, and development partners seeking to strengthen technology-enhanced learning in resource-limited environments.

LITERATURE REVIEW

Digital Transformation in Universities in Africa and Beyond

Over the past two decades, universities worldwide have increasingly integrated digital technologies into teaching and administration. In more developed contexts, Learning Management Systems became ubiquitous in the 2000s, providing a backbone for blended and online learning. Many African higher education institutions also adopted LMS platforms during this period, though often with donor support and varying degrees of success. By the early 2010s, roughly half of universities in sub-Saharan Africa had implemented an LMS (Unwin et al., 2010). In South Africa, for instance, all public universities had an LMS in place by 2012, with nearly half using commercial systems, such as Blackboard, and about one-third using open-source solutions including Moodle (Badaru & Adu, 2022). Despite widespread adoption, studies documented persistent under-utilisation of LMS functionalities. At Makerere University in Uganda, only a small fraction of faculty and courses actively used the LMS after initial deployment (Mayoka & Kyeyune, 2012). Similar patterns were observed at the University of Nairobi and other institutions, where only a handful of instructors regularly incorporated LMS tools into their teaching (Ssekakubo et al., 2011; Oye et al., 2014). These findings suggest that simply establishing e-learning platforms does not guarantee meaningful use.

The COVID-19 pandemic in 2020 acted as a global stress test for the digital readiness of universities. Virtually overnight, institutions had to pivot to fully online instruction, highlighting both the potential of digital learning and the gaps remaining. In African universities, the pandemic "outbreak" of online learning exposed stark inequalities in access and capacity (Adarkwah, 2021). Common challenges reported included unreliable Internet connectivity, lack of devices or affordable data for students, and limited experience among faculty in online pedagogy (Adarkwah, 2021; Ajani, 2024). Nevertheless, some positive outcomes emerged: the crisis spurred innovation and prompted academic staff to acquire new digital skills at an unprecedented pace. A systematic review of digital transformation in African higher education noted that while infrastructure deficits and resource constraints hinder implementation, there is growing momentum and recognition of e-learning's value across the continent (Ajani, 2024). Moreover, post-pandemic surveys indicate a cultural shift among educators; for example, over 75% of university lecturers in a multi-country African sample expressed intent to continue using blended or online teaching methods beyond the pandemic (OECD, 2021). This suggests that the "new normal" for African universities will likely feature a greater blend of face-to-face and digital modalities.

Despite this progress, literature highlights that sustainable digital transformation requires more than emergency adoption of technology. Key success factors frequently cited include strong institutional leadership and vision, ongoing professional development for faculty, and robust technical support (Nkula & Krauss, 2014; Ajani, 2024). Comparative studies have illustrated that universities which treated e-learning as a strategic priority establishing dedicated e-learning units, investing in user training, and incentivising online teaching, fared better in integrating technology than those which approached it ad hoc (Musimenta & Rutayisire, 2021). For example, in Ghana, universities that proactively developed clear e-learning policies and technical support systems achieved higher usage rates and instructor buy-in compared to those without such organisational measures (Asamoah & Doku, 2021). Likewise, evidence from Rwanda shows that leadership commitment and early infrastructure investments were critical to scaling up digital learning (Musimenta & Rutayisire, 2021). These findings show that beyond the availability of platforms, the human and institutional context largely determined the success of digital initiatives.

Finally, the broader policy environment plays a role "beyond the campus." Governments and regulatory bodies can facilitate university digital transformation through funding, policies, and partnerships. During the pandemic, some African governments negotiated zero-rated access to

educational platforms with telecom providers, effectively removing data charges for students accessing LMS sites (Keats, 2020). Such external support can mitigate inequalities and enhance the reach of online education. However, policy support must be accompanied by implementation capacity. In some cases, well-intentioned national policies did not translate into practice due to limited follow-up and resources at the institutional level. For instance, in Malawi, ambitious e-learning policy directives had little impact because universities lacked the necessary infrastructure and expertise to implement them, resulting in fragmented efforts (Banda & Mphwiyo, 2020). Overall, the literature suggests that successful digital transformation in universities is an ecosystem effort: it requires alignment of technological tools, skilled and motivated personnel, and enabling policy frameworks both within the institution and nationally.

Theoretical Framework: Technology–Organization–Environment

This study is grounded in the Technology–Organization–Environment (TOE) framework, which provides a holistic lens for examining how institutions adopt and implement innovations. The TOE framework, originally formulated by Tornatzky & Fleischer (1990), posited that three contexts shape an organisation's technological innovations: **technological factors**, **organisational factors**, and **environmental factors**. This framework has been widely used to analyse the adoption of information systems and e-learning in institutional settings, as it captures the interplay between the capabilities of the technology, the readiness of the organisation, and the influence of external conditions (Tornatzky & Fleischer, 1990).

In the context of Tanzanian higher education, the **technological context** refers to the available ICT infrastructure and digital tools relevant to e-learning. This includes the presence of campus Internet connectivity (bandwidth, Wi-Fi coverage), hardware such as computers and servers, and software platforms like LMSs and virtual conferencing tools. Technological factors also include the quality and user-friendliness of these systems, and the extent to which emerging technologies such as mobile learning apps and open content repositories, are accessible. For instance, whether the LMS supports mobile access or integrates new features can affect adoption by students and staff. Prior studies in the region have noted that technological readiness having reliable networks, technical support, and up-to-date systems is a precondition for scaling e-learning (Mtebe, Fulgence, & Gallagher, 2021). In post-pandemic Tanzania, key technological considerations include how extensively LMS platforms are deployed and integrated, the availability of digital content, such as Open Educational Resources, and recent upgrades made possible through initiatives like the HEET project.

The **organisational context** encompasses internal institutional characteristics and processes that influence digital transformation. Relevant factors include the university's leadership support and strategic vision for e-learning, the existence of policies or units dedicated to technology-enhanced learning, the skills and attitudes of faculty and support staff, and the organisational culture towards innovation. Organisational readiness has been shown to significantly affect e-learning uptake. Universities that invest in ongoing training, provide incentives for online teaching, and cultivate a supportive culture tend to see greater adoption of digital tools (Mtebe & Raphael, 2021). For example, some universities in Tanzania established e-learning or distance education centres prior to the COVID-19 pandemic, which helped coordinate training and content development. Human resource capacity is equally crucial: the digital competencies of lecturers, IT staff, and students determine how well new systems are utilised. If instructors lack confidence in using LMS features or if there is institutional resistance to non-traditional pedagogies, e-learning may stagnate even when technology is available. Thus, analysing factors including professional development programmes, technical support availability, and faculty engagement levels is essential under the organisational dimension.

The **environmental context** involves external forces and conditions impacting the university's digital transformation. This includes national higher education policies, regulatory requirements, funding mechanisms, and collaborations with external partners or technology providers. In Tanzania, the environmental context features guidance and pressure from bodies such as the Ministry of Education, Science and Technology (MoEST) and the Tanzania Commission for Universities (TCU) to adopt e-learning, as evidenced by official strategies and guidelines (MoEST, 2024; TCU, 2022). It also includes the financial and technical support from international development partners, for instance, the HEET project's substantial funding for ICT infrastructure and programmes, GIZ's *dSkills@EA*, which offers digital skills training (GIZ, 2023). Additionally, market and societal factors, such as increased competition among universities or the demand from a growing tech-savvy student population, form part of the environment influencing decisions. The TOE framework encourages examination of how such external drivers or constraints play a role.

METHODOLOGY

This study adopted a qualitative, multi-case study design to explore the post-pandemic digital transformation of higher education in Tanzania. Focusing on multiple institutions allowed for comparative insights across different university contexts while grounding the analysis in rich, institution-specific data. Nineteen public universities in Tanzania were selected for the study.

Data Collection

Multiple data sources were utilised to ensure a robust and triangulated understanding of each case. First, a structured questionnaire was administered to e-learning coordinators or ICT directors at the 19 universities. The questionnaire elicited information on key aspects of digital learning implementation, including LMS adoption and usage statistics, infrastructure upgrades, integration of systems, staff training initiatives, and perceived challenges. It was distributed via email and online communication channels in late 2024, capturing post-pandemic developments up to that time. In addition to the survey, institutional documents were reviewed: these included University Strategic Plans and ICT policies, internal reports on LMS or online programme usage, and any available monitoring reports from the HEET project at each university. National policy documents – notably the TCU's e-learning guidelines (2022) and the National Digital Education Strategy (2024) were also analysed to understand the external expectations placed on universities.

Data Analysis

The collected data were analysed thematically, guided by the three dimensions of the TOE framework. Initial coding of open-ended survey responses was done to categorise information into *technological factors* (e.g. LMS presence and features, connectivity levels), organisational *factors* (e.g. training provided, leadership involvement, internal policies), and *environmental factors* (e.g. references to government support, regulatory pressures, funding). Document data were similarly coded – for example, strategic plans were examined for mention of e-learning objectives (organisational context), while project reports yielded data on technology deployments (technological context). After coding, themes and patterns were identified within each dimension. The analysis looked for cross-cutting issues such as recurring challenges that span multiple universities or links between contexts (for instance, whether institutions with stronger organisational commitment better leveraged technology). The results were synthesised into a narrative that highlights key drivers and barriers in each TOE category, as well as the interactions among technology, organisation, and environment in shaping outcomes. Ethical considerations were addressed by ensuring informed consent from all survey participants and keeping institutional data confidential. The universities and respondents are referenced in aggregate or anonymously in the findings.

FINDINGS

Technological Dimension

Widespread LMS Adoption but Limited Utilization

The pandemic period saw an acceleration in LMS deployment across Tanzanian universities. By 2023, 17 out of the 19 surveyed institutions (≈89%) had operational LMS platforms, with Moodle being the predominant choice. Many universities leveraged HEET project funds to establish or upgrade these systems. Several institutions also developed mobile-friendly access to their LMS, reflecting a push to accommodate students via smartphones. Despite this broad adoption, the depth of LMS usage was modest. The platforms were used primarily to upload lecture notes and facilitate basic course communications, complementing traditional classes rather than replacing them. Only about one-third of the universities reported offering full courses or programmes online. On average, respondents estimated that fewer than 20% of instructors per university were regularly using interactive LMS features (like quizzes, forums, or assignment submissions). This aligns with the qualitative feedback:

> *"Our LMS is up and running, but usage is mostly limited to sharing materials; interactive tools are rarely used,"* (e-learning coordinator)

The limited utilisation is further highlighted by institution-specific data. For example, at one large university, although over 300 courses had been developed for online delivery, fewer than 10 departments actively engaged students through discussion forums or online assessments. In terms of other educational technologies, about half the universities integrated video-conferencing (Zoom/Teams) during remote teaching periods, but these tools were not systematically linked to the LMS in most cases.

Connectivity and Infrastructure

All universities reported improvements in campus Internet connectivity between 2020 and 2023, thanks in part to HEET investments and collaboration with the Tanzania Education and Research Network (TERNET). Major universities in urban centres upgraded their bandwidth to 1 Gbps or higher. For instance, the University of Dar es Salaam reached approximately 1.8 Gbps, and several others, such as the Open University of Tanzania and Sokoine University, attained around 1 Gbps capacity. However, smaller and more remote campuses continued to face constraints; some had bandwidth under 100 Mbps and intermittent service quality. Wi-Fi coverage was generally strong in academic buildings and libraries (over 90% of institutions had wireless access in lecture halls), but coverage in student residential areas lagged. Only ~30% of the universities had extended campus Wi-Fi to dormitories or off-campus student hostels, limiting student access after hours. Additionally, the availability of modern e-learning facilities varied. Four universities established new multimedia studios for recording digital learning content (with one institution building two studios), yet the majority (15 out of 19) either lacked a functional media studio or had projects still in procurement. A number of respondents acknowledged this shortfall: content production capacity was insufficient, and reliance on external sources or simple recorded lectures was common. On a positive note, about one-third of the universities invested in emerging technologies such as virtual computer labs or lecture capture systems as part of their digital transformation, though these were in pilot stages. Overall, the technological foundation for e-learning improved significantly sector-wide (nearly all institutions now have an LMS and better Internet access), but uneven infrastructure quality and low platform engagement remain challenges.

Organisational Dimension

Institutional Readiness and Integration

The findings indicate that universities which had made pre-pandemic investments in e-learning were better positioned to integrate technology during and after the COVID-19 pandemic. Roughly half (10 out of 19) of the surveyed universities had established dedicated e-learning or ICT-in-education units before 2020; these institutions reported a smoother transition to online modalities. For example, the Open University of Tanzania and one major campus in Dar es Salaam leveraged their existing e-learning strategies to quickly scale up online coursework. As part of digital transformation efforts, about 12 universities (≈63%) adopted new or upgraded Student Information Systems (SIS) during the HEET project period, and several of these integrated their SIS with the LMS for automated enrolment and grade syncing. Nonetheless, full systems integration was limited. Only six universities managed to connect their LMS with other key systems (such as registration databases or library systems) in a seamless way. A few respondents described integration projects as "ongoing but technically complex." Most institutions still operate various platforms such as LMS, admissions and finance, in silos, requiring manual data transfers and creating inefficiencies. Administrative digitalisation also expanded: nearly half the universities implemented "e-office" platforms for electronic document handling and workflows (e.g. paperless meetings, digital approvals), and about 40% introduced new systems for library services, research management, or human resources. However, the adoption of these systems was uneven across departments, and some older staff remained accustomed to paper-based processes despite the new tools.

Human Capacity and Culture

A prominent theme in the findings is the pivotal role of human capacity building. At the onset of the pandemic, most universities had only a minority of faculty experienced in online teaching. In response, universities conducted extensive training programmes. Cumulatively, the 19 universities trained thousands of their academic staff between 2020 and 2022 on various aspects of e-learning (ranging from basic LMS usage to online pedagogy and content creation). Many training sessions were supported by international initiatives; for instance, the GIZ-dSkills@EA programme was cited by multiple respondents as providing valuable instructional design workshops. As a result of these efforts, respondents noted an overall improvement in lecturers' digital skills and confidence. One faculty member commented,

> *"Initially I was very skeptical of teaching online, but after several workshops I feel more capable and even excited to use the LMS now."*

Despite this progress, challenges in organisational culture persist. Several institutions reported that a segment of senior faculty members remained reluctant to embrace e-learning, preferring traditional face-to-face methods. As one coordinator put it,

> *"There is still resistance among some veteran professors, they view online teaching as inferior or not part of their job description."*

To encourage uptake, a few universities have started to include e-learning engagement in performance appraisal or recognition systems. For example, at two universities (including an institute of finance and a university college of education), the administration introduced incentives by acknowledging active e-learning use during annual staff evaluations or awards. These policy nudges have had some positive effect on motivation. Nonetheless, maintaining momentum in digital practices as in-person classes resumed emerged as a concern: without continued emphasis from leadership, there is a tendency in some institutions to "revert to old habits." This underscores that

building a sustainable digital culture requires ongoing change management and support beyond the emergency phase.

Environmental Dimension

Policy Frameworks and Funding

The external environment in Tanzania during this period was generally enabling digital transformation in higher education. The Ministry of Education, Science and Technology (MoEST) launched the **National Digital Education Strategy 2024–2030**, which outlines a comprehensive agenda for expanding e-learning infrastructure, developing local digital content, and training educators nationwide (MoEST, 2024). Likewise, the Tanzania Commission for Universities issued official guidelines to standardise and promote quality in online and blended learning across universities (TCU, 2022). University leaders reported that these policy signals provided important top-down encouragement and targets. More tangibly, the World Bank-funded **HEET** project (2021–2026) was a game-changer in terms of funding: a total of approximately USD 425 million was allocated to overhaul higher education, with a significant portion earmarked for ICT and digital learning initiatives. All 19 surveyed universities benefited from HEET grants, using them to purchase ICT equipment (servers, campus network hardware, computers for labs), expand Internet bandwidth, develop LMS platforms, and create digital content. According to the data, about 70% of each institution's HEET budget for digitisation on average was invested in technology infrastructure and e-learning support. Respondents acknowledged the impact of this funding; many transformative activities (like installing fibre networks or procuring e-learning studios and assistive technologies) would have been impossible otherwise. Alongside HEET, technical assistance from development partners played a role: for instance, GIZ (2023) provided expertise for digital skills training and open educational resources through regional projects.

DISCUSSION

The findings of this study show the complex interplay of technology, organisational dynamics, and policy environment in shaping digital transformation, consistent with the TOE framework. In many respects, Tanzania's experience during the post-pandemic period mirrors global trends in higher education; universities were compelled to adopt online learning out of necessity, but the outcomes were heavily moderated by local readiness and context (UNESCO, 2020; Hodges et al., 2020). Simply having an LMS or access to high-speed Internet did not guarantee effective digital education; rather, the depth of integration and pedagogical use of these tools varied widely between institutions. This reinforces observations from prior studies in SSA that structural challenges often impede the realisation of e-learning's full potential (Bervell & Umar, 2017; Ghasia et al., 2021). For instance, even though most universities in Tanzania now possess similar technologies, those with stronger organisational commitment (leadership support, training, incentives) achieved more meaningful adoption than those without; a pattern also reported in other African contexts such as Rwanda and Ghana. Musimenta & Rutayisire (2021) noted that in Rwandan institutions, proactive leadership and staff development were more critical to successful online learning uptake than technology availability alone. Similarly, Asamoah & Doku (2021) found that Ghanaian universities with clear e-learning strategic plans outperformed peers during the COVID-19 transition. These comparisons highlight that the organisational **dimension** (in TOE) often differentiates institutions that merely install technology from those that actually transform educational practice.

From a technological standpoint, the study's results confirm both progress and enduring gaps. The widespread LMS adoption in Tanzania by 2023 represents a significant leap forward compared to a decade ago when e-learning systems were relatively novel in the region. This aligns with the continental push observed since the 2010s; by around 2015, many African universities had at least one LMS in place (Unwin et al., 2010; Ssekakubo et al., 2011). However, our findings on low

utilisation of advanced LMS features are not unique. Underuse of LMS functionalities has been a recurring theme in the literature; for example, Bervell & Umar (2018) documented that fewer than 15% of students engaged with discussion forums in a Ghanaian university's LMS, and our data similarly show forums and quizzes were rarely employed in Tanzanian cases. Even at institutions where connectivity issues were largely solved, the expected uptick in rich online learning activities did not fully materialise. This implies that barriers beyond access such as pedagogical habits, content availability, or user confidence are at play. It echoes the Czerniewicz et al. (2020) argument that deep-seated academic cultures and attitudes can inhibit the uptake of digital methods despite the presence of technology. In South Africa, for instance, faculty hesitance rooted in traditional views of teaching, limited LMS usage even when robust systems existed (Czerniewicz et al., 2020). Our study found similar resistance among some senior academics in Tanzania, underlining that **cultural change** is a critical component of digital transformation.

The role of the environment, that is, policies and external support in Tanzania's digital transformation, comes through strongly and offers lessons. The coordinated national effort (strategies, guidelines, funding) accelerated progress. Comparatively, not all SSA countries had such large-scale initiatives; Tanzania's HEET project is among the more generous education ICT investments in the region in recent years. The injection of resources led to tangible infrastructure gains (e.g. several universities now have fibre networks and modern computer labs). Yet, the Tanzanian case also demonstrates that external drivers have to be matched by internal absorptive capacity. The relatively low adoption of OER policies despite national advocacy mirrors experiences elsewhere. In Malawi, Banda & Mphwiyo (2020) noted that while the government promoted OER and e-learning, universities on the ground often lacked the know-how or incentives to implement these ideas, resulting in limited actual change, a situation comparable to what we observed. On a positive note, the environmental context in East Africa also fostered innovation to bridge access gaps; for example, the Kenyan and Rwandan governments partnering with telecom companies to zero-rate educational sites (Keats, 2020) represents a creative policy response. Such practices could be emulated or scaled in Tanzania to address the enduring issue of student data costs, which a number of our respondents flagged as a barrier to equitable online participation. In short, the **environmental dimension** in TOE can significantly empower universities (through funding, regulations, partnerships), but its impact is ultimately mediated by how institutions act on those opportunities.

Another key insight from this study is the necessity of aligning all three TOE elements: technology, organisation, and environment, for a truly sustainable digital transformation. Instances where one or two dimensions were strong but another was weak resulted in suboptimal outcomes. For example, we saw cases of universities with solid ICT infrastructure and ample government support (environment) but weak internal training programmes (organisation) leading to underutilisation of systems. Conversely, a few universities had motivated faculty and good internal management (organisation) but were constrained by insufficient bandwidth or outdated equipment (technology), limiting what they could achieve online. The TOE framework thus proved effective in diagnosing these misalignments. It confirms Tornatzky & Fleischer's (1990) premise in a contemporary African higher education setting: successful innovation adoption is a systemic endeavour. Notably, the universities in our study that exhibited the most progress were the ones that scored relatively well in all three areas; they had invested in modern e-learning technology, established supportive institutional structures, and leveraged external initiatives fully.

CONCLUSION

This study explored the key drivers, institutional challenges, and policy implications of digital transformation in Tanzanian universities following the COVID-19 pandemic, using the Technology–Organization–Environment (TOE) framework. While most universities have achieved substantial technological progress such as implementing LMS platforms and improving Internet connectivity,

the depth of integration into teaching and learning remains inconsistent. The findings indicate that organisational factors such as leadership support, prior investment in e-learning, and human resource capacity are central to meaningful transformation. Institutions that had invested early in digital education infrastructure and training were better positioned to scale up and integrate digital tools during the pandemic. Conversely, universities without such foundational investments struggled to move beyond basic adoption, reaffirming the principle that sustainable digital transformation is not solely dependent on technology, but on aligning systems with people and institutional processes.

The broader policy environment in Tanzania also played a vital role in enabling change. Strategic initiatives such as the National Digital Education Strategy and the HEET project provided much-needed funding, clear directives, and shared goals across the sector. These efforts led to significant advancements, including expanded digital infrastructure and heightened awareness of e-learning's value. However, the persistence of issues such as low LMS engagement and the absence of OER policies suggests that implementation challenges remain. The study affirms that successful digital transformation is achieved through the alignment of technological tools, institutional readiness, and enabling policies. Tanzania's evolving experience offers valuable lessons for other Sub-Saharan African countries, highlighting both the potential for scalable innovation and the importance of sustained commitment, capacity building, and cross-sector collaboration in realising inclusive and resilient higher education systems.

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