



## Digital Technology Readiness for Enhanced Higher Education Teaching and Learning in Tanzania

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### Abstract

This study evaluated the preparedness of public Higher Education Institutions (HEIs) in Tanzania for the effective use of digital technologies in teaching and learning. Using a quantitative cross-sectional survey design, data was collected from 292 respondents, comprising 205 students and 87 academic staff members from 20 selected public HEIs. Binary logistic regression analysis revealed that institutions with adequate IT support staff were nearly 12 times more likely to have a functional Learning Management System (LMS) ( $\text{Exp}(B) = 11.942$ ,  $p < .001$ ). Although basic digital infrastructure, including Local Area Networks (LANs), Internet connectivity and LMS platforms, was available across the participating HEIs, the reliability of these facilities remained a significant concern. Furthermore, limited provision of regular digital literacy training for both academic staff and students constrained the effective integration and use of digital technologies. The study concludes that adequate IT human resources, continuous professional development and reliable digital infrastructure are critical for strengthening digital teaching and learning in public HEIs in Tanzania.

**Keywords:** Digital preparedness; higher education; IT support; learning management systems; Tanzania.

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### Introduction

Tertiary education undergoes a significant paradigm shift driven by the integration of digital technologies into teaching and learning (Ogar & Tangi, 2026; Bond et al., 2020). This transformation, commonly referred to as the digitalization of teaching and learning, seeks to enhance access to education, personalize learning experiences, and foster the development of 21st-century competencies among learners (UNESCO, 2023). The disruptive effects of the COVID-19 pandemic forced Higher Education Institutions (HEIs) from all over the world, including Tanzanian, to reflect on their pedagogies and

institutional readiness to embrace digitalization. Therefore, digital preparedness has emerged as a key multidimensional determinant of an institution's capacity to effectively leverage technology for enhanced teaching and learning outcomes.

Digital preparedness extends beyond mere provision of technological hardware; it encompasses a comprehensive combination of reliable digital infrastructure, strategic frameworks and policies, high-quality digital learning resources and digitally competent educators and students (Ifenthaler & Schweinbenz, 2023; Scherer et al., 2021).

In developing countries such as Tanzania, digital technologies have significant potential to bridge educational gaps and expand access to quality education for all. This potential is limited, however, due to infrastructure deficits, bandwidth limitations, insufficient financial resources and different levels of digital literacy among stakeholders (Tømte et al., 2019; Asare et al., 2022; World Bank and Knowledge Consulting Ltd, 2021). The importance of technology in education has been recognized in Tanzania's national policy framework, including the United Republic of Tanzania (2016), which promotes the integration of ICT across all sectors, including education and the Tanzania Development Vision 2050, which envisions a technology-driven, knowledge-based economy. Despite these policy aspirations, the implementation of digitally enabled teaching and learning environments in public HEIs remains uneven and warrants empirical investigation.

A review of the available literature on e-learning in HEIs in Tanzania shows that most HEIs have embraced Moodle LMS and have moved towards blended learning models (Asare et al., 2022; Mtebe & Raisamo, 2014). Nevertheless, current literature mainly examines particular aspects of digital readiness instead of applying a systemic approach. For example, while Mtebe and Raphael (2018) examined the impact of e-learning system quality on student satisfaction at the University of Dar es Salaam and Sanga et al. (2023) investigated the role of technical support in the adoption of e-learning in Tanzanian higher education institutions, limited empirical studies have examined how competence and adequacy of IT support personnel influence specific institutional outcomes, such as the functionality of learning management systems (LMSs), the availability of digital library services and the provision of digital literacy training.

Furthermore, global digital readiness frameworks, such as the NIST Cybersecurity Framework and the UNESCO ICT Competency Framework, emphasize the need for an integrated assessment of technological infrastructure, human capital and pedagogical capacity. Such a comprehensive approach remains largely absent in research on public higher HEIs in Tanzania. Although studies by Bervell and Umar (2020) and Unwin et al. (2020) highlighted the importance of infrastructure reliability and policy implementation in Sub-Saharan Africa, few have applied the Technology–Organization–Environment (TOE) framework to

examine how organizational factors, particularly the adequacy and competence of IT human capital, influence the functionality of digital systems. Consequently, this study addressed this gap by providing an evidence-based, multidimensional assessment of the digital education ecosystem in public HEIs in Tanzania, with particular emphasis on the role of organizational readiness in supporting effective digital teaching and learning.

## **Literature Review**

This section provides the theoretical and empirical literature reviewed on digital technology readiness in higher education in the global, regional and Tanzanian contexts.

### **Theoretical Framework**

This study utilizes two interrelated theoretical frameworks. The first one is the Technology–Organization–Environment (TOE) framework, which was formulated by Tornatzky and Fleischer (1990). It is based on the idea that technological adoption at the organizational level is affected by three contexts: technological (available technologies), organizational (resources and human capital) and environmental (industry settings, regulations). In the context of this study, TOE framework guides the analysis of readiness of institutions by looking into infrastructure (technological), IT support adequacy (organizational) and national policy alignment (environmental). The second framework is the Technological Pedagogical Content Knowledge (TPACK) model suggested by Mishra and Koehler (2006). It highlights the importance of the combination of content knowledge, pedagogical knowledge and technological knowledge for successful technology integration.

### **Empirical Literature Review**

The integration of digital technologies in HEIs becomes a global imperative. According to Ghavifekr and Rosdy (2015), digital technologies play a vital role in enhancing teaching practices, expanding access to learning resources and equipping students with the competencies required for the digital economy. However, despite their increasing availability, the effective pedagogical integration of these technologies remains a significant challenge. As demonstrated by Bond et al. (2020) in their systematic evidence map of student engagement and educational technology, many institutions continue to struggle with translating access to digital technologies into meaningful improvements in teaching and learning.

Furthermore, the researchers noted that the effect of technology on deep learning is dependent on infrastructure and educator's competence. Thus, the problem of infrastructure is not enough for effective integration, as Ifenthaler and Schweinbenz (2023) suggest when they define the concept of digital readiness as multi-dimensional, including infrastructure, systems, policy and human capacity. Moreover, Kaputa et al. (2022) indicate the social nature of digital transformation in higher education; thus, it requires the change of organizational culture along with effective use of technologies. Although there is much information regarding global development, there is a need for more frameworks, which would allow to the understanding of the relationship between certain variables related to organization and digital services.

### **Digital Preparedness in Sub-Saharan Africa**

In Sub-Saharan Africa, digital preparedness in higher education is characterized by a persistent gap between policy aspirations and the actual implementation of digital transformation initiatives. As Asare et al. (2022) indicated in a systematic review of barriers and facilitators of digital transformation in developing countries, the lack of infrastructure, low digital literacy and poor institutional support are the most serious obstacles of digital transformation. Similar results were achieved by Mtebe and Raisamo (2014), according to whom slow and unstable Internet is the biggest barrier of blended learning in Tanzanian universities.

Unwin et al. (2020) observed that the persistent urban–rural digital divide and the high cost of internet bandwidth continue to impede the development of robust digital learning environments in higher education institutions in Africa. Bervell and Umar (2020) found that although Learning Management Systems (LMSs) are widely adopted in African universities, their use is often superficial. Platforms such as Moodle frequently serve as repositories for course materials rather than as interactive pedagogical tools that support meaningful teaching and learning. These findings suggest that the challenge extends beyond technology to the institutional support needed for educators to use digital systems effectively. Ghavifekr and Rosdy (2015) argued that successful ICT integration depends more on human factors than on technology, highlighting the importance of staff competence. However, quantitative evidence on the relationship between staff competence and

digital system effectiveness in Sub-Saharan African higher education remains limited.

### **Digital Preparedness in Tanzania**

In Tanzania, digital education is characterized by strong policy commitment but persistent implementation challenges at the institutional level. United Republic of Tanzania and the Tanzania Development Vision 2050 both emphasize the development of digital competencies among staff in educational institutions as a key national priority (United Republic of Tanzania, 2016). However, Mwalimu et al. (2022) found a significant gap between policy and practice, with weak translation of national digital policies into institutional strategies. As a result, digital transformation efforts are often characterized by uncoordinated planning, inadequate funding, and a lack of sustainable implementation strategies (Mohamed et al., 2022).

Sanga et al. (2023) found that perceived ease of use and usefulness of digital technologies among academic staff in Tanzanian universities were significantly influenced by the availability of technical support. However, no study in Tanzania has empirically examined the relationship between the adequacy and competence of IT personnel and the functionality of digital systems, such as learning management systems (LMSs), library management systems and digital literacy training. This study addressed this gap by examining these relationships using binary logistic regression analysis.

## **Methodology**

### **Design**

The study employed a quantitative cross-sectional survey design. This design was chosen because it is appropriate for collecting data from a large sample size at one point in time, thus making it possible to generalize results from several public HEIs (Creswell & Creswell, 2015). This study sought to measure the current digital readiness by using a structured questionnaire distributed to academic staff members and students, thus allowing for the statistical analysis of the relationship between IT support and digital infrastructure.

### **Population and Sampling**

Academic staff and students from public higher education institutions (HEIs) in Tanzania constituted the target population for this study. The population comprised approximately 15,000 academic staff and more than 200,000 students across public HEIs in the country. Owing to logistical constraints and the

wide geographical distribution of institutions, a multistage sampling technique was employed.

In the first stage, purposive stratified sampling was used to select 20 public HEIs to ensure geographical representation and institutional diversity in terms of academic programs. The selected institutions were: Dar es Salaam Institute of Technology (DIT), University of Dar es Salaam (UDSM), Tanzania Institute of Accountancy (TIA), Tanzania Public Service College (TPSC), Institute of Tax Administration (ITA), Muhimbili University of Health and Allied Sciences (MUHAS), Institute of Social Work (ISW), Ardhi University (ARU), National Institute of Transport (NIT), Institute of Finance Management (IFM), Mzumbe University (MU), College of Business Education (CBE), Sokoine University of Agriculture (SUA), University of Dodoma (UDOM), Institute of Rural Development and Planning (IRDP), Water Institute (WI), Mwalimu Nyerere University of Agriculture and Technology (MNUAT), Dar es Salaam Maritime Institute (DMI), National College of Tourism (NCT), and the Open University of Tanzania (OUT).

In the second stage, convenience sampling was used to recruit accessible respondents within each institution. Academic staff were approached in their respective departments during working hours, while students were recruited from libraries, cafeterias, and lecture halls during break periods. A total of 292 respondents participated in the study, comprising 87 academic staff and 205 students.

### Research Instruments

Data was collected through a questionnaire, which comprised close-ended items designed to measure: (a) availability and dependability of digital infrastructure (Local Area Network, Internet), (b) extent of usage of the Learning Management System (LMS), (c) digital literacy skills of the staff, (d) adequacy and competency of the IT personnel, and (e) availability of complementary technologies (projector, Public Address System). The questionnaire was administered to faculty members and students from 20 selected institutions, who

were to tick appropriate options, according to their perspectives.

### Validity and Reliability

Validity of the content was ensured through careful review of the research tools by three specialists in education technology and research methodology. Based on the suggestions provided by these specialists, revisions of the items were made. Pilot testing was done among 30 subjects (excluding those in the main sample) to detect possible confusing items. Reliability of the quantitative items was calculated using Cronbach's Alpha, which gave a coefficient of 0.87 (indicating an acceptable level of reliability), as per Nunnally and Bernstein (1994).

### Data Analysis

Data was analyzed using descriptive statistics, such as frequencies and percentages as well as binary logistic regression analysis, which established the existing relationships between variables.

### Ethical Considerations

All participants gave informed consent before the study after reading and accepting the preamble on the data collection instrument. Anonymity, confidentiality and freedom to withdraw without consequences were assured. Data was kept in password-protected documents and accessed only by the research team.

### Results and Discussion

This section contains findings and discussion. It is guided by specific research question with a corresponding hypothesis.

**Research Question 1:** What is the current state of digital technology infrastructure and connectivity among public HEIs in Tanzania?

This research question sought to identify availability, variety and reliability of digital infrastructure within surveyed institutions. Results show an interesting mix of availability and reliability. As shown in Table one, 49.0% of the respondents perceived internet connectivity as reliable, 35.3% as unreliable and 15.8% were not sure.

**Table 1: Internet Reliability as Perceived by Staff and Students**

| Reliability Level | Staff (n=87) | Students (n=205) | Combined (n=292) |
|-------------------|--------------|------------------|------------------|
| Unreliable        | 28 (32.2%)   | 75 (36.6%)       | 103 (35.3%)      |
| Reliable          | 45 (51.7%)   | 98 (47.8%)       | 143 (49.0%)      |
| Not Sure          | 14 (16.1%)   | 32 (15.6%)       | 46 (15.8%)       |

Although nearly half of the respondents reported reliable internet access, more than half experienced either moderate or poor reliability, highlighting a significant challenge for digital teaching and learning, which depends on stable internet connectivity.

These findings are consistent with Mtebe and Raisamo (2014), who revealed slow and unreliable internet connectivity, which was a major barrier to effective implementation of blended learning in Tanzanian universities. The persistence of this challenge over nearly a decade suggests that

infrastructure development has not kept pace with the growing demands of digital education. From the perspective of the Technology–Organization–Environment (TOE) framework, this represents a technological constraint that limits institutional capacity to deliver effective digital teaching and learning.

Table 2 shows that the availability of local area network (LAN) infrastructure is relatively high, with at least 68% of respondents reporting access to both wired and wireless networks.

**Table 2: LAN Availability and Reliability**

| LAN Type                | Available (%) | Reliable (%) | Unreliable (%) |
|-------------------------|---------------|--------------|----------------|
| Wired LAN               | 68.5          | 42.3         | 57.7           |
| Wireless LAN            | 71.2          | 38.9         | 61.1           |
| Both Wired and Wireless | 45.8          | 51.4         | 48.6           |

**Table 3: Functionality of Auxiliary Teaching Technologies**

| Technology                     | Functioning (%) | Non-Functioning (%) |
|--------------------------------|-----------------|---------------------|
| Projectors                     | 62.3            | 37.7                |
| Digital Public Address Systems | 48.6            | 51.4                |
| Interactive Whiteboards        | 28.4            | 71.6                |
| Videoconferencing Facilities   | 35.2            | 64.8                |

However, the reliability of this infrastructure remains a concern. For instance, although 71.2% of respondents indicated that wireless LAN was available, 61.1% rated its performance as unreliable. This is consistent with the World Bank and Knowledge Consulting Ltd (2021), which attributed connectivity challenges in Tanzania to inadequate bandwidth capacity that has failed to keep pace with the growing number of users. The low reliability of LAN infrastructure discourages the effective use of computer laboratories by creating a poor user experience. Consequently, inadequate infrastructure not only limits access to digital resources but also contributes to barriers to technology integration (Ertmer, 1999).

Table 3 reveals considerable variation in the functionality of auxiliary digital technology. While 62.3% reported that projectors were functional, substantially lower proportions indicated that interactive whiteboards (28.4%) and video conferencing (35.2%) were functional. These

findings suggest that institutions tend to prioritize basic technologies while paying less attention to maintenance and upgrading advanced digital tools. From the perspective of the Technological Pedagogical Content Knowledge (TPACK) framework, limited functionality of interactive whiteboards and video conferencing constrains educators' ability to effectively integrate technology into pedagogical practices (Koehler & Mishra, 2009; Ertmer & Ottenbreit-Leftwich, 2010).

**Research Question 2:** To what extent are Learning Management Systems adopted, utilized and perceived as reliable by students and staff among public HEIs in Tanzania?

This research question focused on LMS adoption, usage frequency and reliability at the surveyed institutions. As shown in Table 4, LMS usage was generally low with 86.34% of respondents reporting that they rarely used the system while only 5.85% used it daily.

**Table 4: Frequency of LMS Use by Students**

| Frequency of Use | Frequency (n) | Percentage (%) |
|------------------|---------------|----------------|
| Daily            | 12            | 5.85           |
| Weekly           | 28            | 13.66          |
| Monthly          | 45            | 21.95          |
| Rarely           | 177           | 86.34          |
| Never            | 18            | 8.78           |

This limited level of engagement is concerning, given that most institutions have adopted Moodle as their primary learning management system (Mtebe & Raphael, 2018; Sanga et al., 2023). The findings support Bervell and Umar's (2020) observation that LMS platforms in many African universities function primarily as repositories for course materials rather than as interactive learning environments. Consequently, the LMS is not being utilized to its full potential to support active, student-centered teaching and learning.

Results in Table 5 show that 41.1% of all respondents perceived the LMS as unreliable while 41.1% rated it as reliable and 17.8% were not sure. The near-equilibrium between reliable and unreliable perceptions is another indication of LMS performance inconsistency. It poses a problem of 'digital trust deficit' where educators and learners are less likely to rely on the LMS for teaching and learning activities. Asare et al. (2022) found LMS reliability to be one of the major factors for effective digitalization among Sub-Saharan African HEIs.

**Table 5: Perceived Reliability of LMS Platforms**

| Reliability Level | Staff (n=87) | Students (n=205) | Combined (n=292) |
|-------------------|--------------|------------------|------------------|
| Unreliable        | 32 (36.8%)   | 88 (42.9%)       | 120 (41.1%)      |
| Reliable          | 38 (43.7%)   | 82 (40.0%)       | 120 (41.1%)      |
| Not Sure          | 17 (19.5%)   | 35 (17.1%)       | 52 (17.8%)       |

**Table 6: Frequency of Digital Literacy Training**

| Training Frequency | Staff (n=87) | Students (n=205) | Combined (n=292) |
|--------------------|--------------|------------------|------------------|
| Frequently         | 8 (9.2%)     | 12 (5.9%)        | 20 (6.8%)        |
| Occasionally       | 22 (25.3%)   | 35 (17.1%)       | 57 (19.5%)       |
| Rarely             | 42 (48.3%)   | 118 (57.6%)      | 160 (54.8%)      |
| Never              | 15 (17.2%)   | 40 (19.5%)       | 55 (18.8%)       |

As shown in Table six, 73.6% of respondents (54.8% rarely and 18.8% never) reported receiving limited digital literacy training. The training gap was particularly pronounced by students with 77.1% indicating that they rarely or never received such training. Therefore, many students received little or no instruction on effective use of the learning management system and other institutional digital technologies. Consistent with Mtebe and Raphael (2018), the findings suggest that inadequate training negatively affects students' satisfaction with the e-learning experience. It is important to note that the lack of continuous professional development hinders the development of Technological Pedagogical Content Knowledge (TPACK), limiting educators' ability to integrate technology effectively into subject-specific teaching. As UNESCO (2018) emphasizes, teacher professional development

should be continuous, pedagogically focused, and institutionalized.

**Research Question 3:** How does adequacy and competence of IT support staff predict the availability and functionality of key digital infrastructure among public HEIs in Tanzania?

This research question was aimed at establishing the relationship between IT support staff variables and institutional digital infrastructure outcomes. As the relationship between the two concepts is rather exploratory, the following hypothesis was tested in Table 7: **H<sub>0</sub>:** There is no significant relationship between adequacy and competence of IT support staff and availability of a functional Learning Management System among public HEIs in Tanzania.

**Table 7: Binary Logistic Regression Predicting Key Digital Infrastructure Outcomes**

| Statistic                  | Value  | df | p-value | Interpretation                     |
|----------------------------|--------|----|---------|------------------------------------|
| Omnibus Test ( $\chi^2$ )  | 48.72  | 3  | < .001  | Model is statistically significant |
| Nagelkerke R <sup>2</sup>  | .42    | —  | —       | Predictors explain 42% of variance |
| Hosmer-Lemeshow            | 7.84   | 8  | .312    | Good model fit (p > .05)           |
| -2 Log Likelihood          | 284.56 | —  | —       | Model deviance                     |
| Cox & Snell R <sup>2</sup> | .31    | —  | —       | Alternative effect size measure    |

In Table 7, a binary logistic regression analysis was used to test the hypothesis, employing three predictor variables (adequacy of IT support staff, competence of IT support staff and commitment of IT support staff) and five dependent variables (LMIS availability, access to online library catalogues, subscription to digital resources, digital literacy training provided and availability of functioning LMS). The model is statistically significant,  $\chi^2(3) = 48.72$ ,  $p < .001$ , and the value of the Nagelkerke  $R^2$  equals .42, which means that the independent variables explain 42% of the variance in the digital infrastructure outcomes.

Table 8 summarizes the results of the binary logistic regression analysis. The most interesting finding is that adequacy of IT support staff is the strongest predictor of digital technology readiness of universities and colleges under investigation. To be more specific, institutions with adequate number of IT staff were 11 times more likely to have a functioning LMS ( $\text{Exp}(B) = 11.942$ ,  $p < .001$ ), 8 times more likely to have an online library catalogue ( $\text{Exp}(B) = 8.059$ ,  $p = .015$ ) and almost 8 times more likely to offer digital literacy training ( $\text{Exp}(B) = 7.822$ ,  $p = .014$ ). Such results allow claiming that human resources in the field of IT are the most important part of digital infrastructure effectiveness.

**Table 8: Regression Coefficients**

| Outcome Variable                 | Predictor Variable | B      | S.E.  | Sig.    | Exp(B) |
|----------------------------------|--------------------|--------|-------|---------|--------|
| Availability of LMIS             | Adequate IT Staff  | 1.637  | 0.724 | 0.025*  | 5.141  |
|                                  | Competent IT Staff | 1.149  | 0.548 | 0.035*  | 3.156  |
|                                  | Committed IT Staff | -0.229 | 0.412 | 0.576   | 0.795  |
| Online Library Catalogue         | Adequate IT Staff  | 2.087  | 0.861 | 0.015*  | 8.059  |
|                                  | Competent IT Staff | 0.923  | 0.594 | 0.120   | 2.518  |
|                                  | Committed IT Staff | -1.048 | 0.423 | 0.013*  | 0.351  |
| Digital Resource Subscription to | Adequate IT Staff  | 1.325  | 0.856 | 0.126   | 3.763  |
|                                  | Competent IT Staff | 1.949  | 0.721 | 0.007** | 7.021  |
|                                  | Committed IT Staff | -0.604 | 0.426 | 0.154   | 0.547  |
| Digital Literacy Training        | Adequate IT Staff  | 2.057  | 0.836 | 0.014*  | 7.822  |
|                                  | Competent IT Staff | 1.970  | 0.612 | 0.001** | 7.174  |
|                                  | Committed IT Staff | 0.227  | 0.437 | 0.599   | 1.255  |
| Functional LMS Available         | Adequate IT Staff  | 2.480  | 0.698 | 0.000** | 11.942 |
|                                  | Competent IT Staff | 0.225  | 0.528 | 0.669   | 1.253  |
|                                  | Committed IT Staff | -0.170 | 0.431 | 0.693   | 0.844  |

**Note:** \*  $p < .05$ , \*\*  $p < .01$ . S.E. = Standard Error.  $\text{Exp}(B)$  = Odds Ratio. The model fit statistics ( $\chi^2 = 48.72$ ,  $df = 3$ ,  $p < .001$ ; Nagelkerke  $R^2 = .42$ ; Hosmer-Lemeshow  $p = .312$ ) are provided in the Model Fit Statistics table above, demonstrating that the model is statistically significant and has good fit.

The competence of IT support staff was a significant predictor for LMIS availability ( $\text{Exp}(B) = 3.156$ ,  $p = .035$ ), subscription of libraries to online digital resources ( $\text{Exp}(B) = 7.021$ ,  $p = .007$ ) and provision of digital literacy training ( $\text{Exp}(B) = 7.174$ ,  $p = .001$ ). Although adequacy of IT support staff plays a crucial role in establishing the foundations of digital system functionality, competence is vital for provision of specialized and expensive services. Management of the subscriptions to e-journals and e-books, provision of authentication and creation of digital literacy training program is impossible without highly skilled employees. As ISTE Standards for Education Leaders (ISTE, 2023) state, it is vital to build a team of specialists who would be able to create and leverage digital resources.

It is worth mentioning that commitment of IT support staff was rarely a significant predictor and was even negatively correlated with some

outcomes, like access to online library catalogues ( $\text{Exp}(B) = 0.351$ ,  $p = .013$ ).

According to the COBIT framework, organizations require an adequate number of skilled personnel to deliver value from their IT investments (ISACA, 2018). These findings suggest that commitment alone cannot compensate for inadequate human resource capacity. Therefore, higher education institutions (HEIs) should prioritize the recruitment, development, and retention of qualified IT support staff to maximize the effectiveness and sustainability of their digital technology investments.

## Conclusions and Recommendations

Based on the findings, the study concludes that most public higher education institutions (HEIs) in Tanzania possess the basic digital infrastructure required to support teaching and learning,

particularly local area networks (LANs) and Internet connectivity. However, the reliability of these facilities remains a major challenge, limiting their effective utilization for digital teaching and learning. The study therefore recommends a shift from a procurement-oriented approach to infrastructure management towards a reliability-oriented strategy. This should include establishing service-level agreements with Internet service providers, implementing redundant Internet connectivity options to minimize service disruptions and allocating dedicated budgets for regular network maintenance, upgrades and capacity enhancement.

Secondly, the study concludes that although learning management systems (LMSs) have been widely adopted across public HEIs in Tanzania, their utilization by students remains suboptimal. This indicates that the availability of digital platforms alone does not guarantee their effective use for teaching and learning. The study therefore recommends that HEIs institutionalize comprehensive digital literacy training programs for both students and academic staff. These programs should be aligned with the UNESCO ICT Competency Framework for Teachers, tailored to users' needs, pedagogically oriented and designed to strengthen Technological Pedagogical Content Knowledge (TPACK) to promote meaningful integration of digital technologies into teaching and learning.

Finally, the study concludes that the adequacy and competence of IT support staff are critical determinants of the functionality and sustainability of digital infrastructure in public higher education institutions. Institutions with sufficient and well-qualified IT personnel are more likely to maintain functional learning management systems, digital libraries and effective digital literacy training programs. The study therefore recommends the development of national IT staffing standards for public HEIs, specifying minimum staff-to-user ratios and the core competencies required of IT personnel to ensure reliable technical support and the effective delivery of digital teaching and learning services.

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