

Teacher Preparedness for ICT Integration in Tanzania's Education System: A Systematic Review of Attitudes, Competencies, and Enabling Conditions

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ABSTRACT

Information and Communication Technology (ICT) to education is a great way to improve teaching, learning, and digital literacy. In Tanzania, even though teachers have a positive view of ICT, it is still not widely used in the classroom. Most of the time, digital tools are used instead of traditional methods without changing how they are taught. This systematic review amalgamated 39 peer-reviewed studies and reports published from 2003 to 2025, concentrating on teachers' preparedness for ICT integration within Tanzania's education system, particularly investigating attitudes, competencies, and facilitating conditions. The results show that while the majority of the teachers have the basic skills to engage in ICT and have recognized the pedagogical value of technology, it is evident that many hurdles still exist. These hurdles include a lack of training, poor infrastructure, rigid policy frameworks, and a lack of good quality digital competence from school leaders. In fact, most professional development opportunities only cover basic tool usage and the pedagogy to use technology learned was not significantly advanced. Additionally, policies are primarily focused on hardware acquisition as opposed to embedding technology in meaningful, sustainable ways, while donor-driven initiatives fail to prioritize sustainability and are not long term. The success of integration in other contexts illustrates the significance of good infrastructure, funding, and ongoing professional development. In light of the findings, the review proposed a national ICT policy that recognizes teaching and learning as the main priority among ICT practices, supports mandatory development for their CPD related to ICT, builds on the infrastructure, and develops leadership-level digital competence. Further, establishing locally relevant digital resources and ultimately building a lasting partnership between the public and private sector will allow technology to play a significant role in learning. If these initiatives are not adopted, there is a risk that students learning in classrooms in Tanzania will have technology-supported learning opportunities that do not develop any tech-related skills relevant for the 21st century. Moving forward, this holistic and context-led approach is essential to addressing the disconnection between ICT awareness and transformative practice to support teachers to use technology toward improving learning.

Keywords: Digital Competence, ICT Integration, Teacher Preparedness, Tanzanian Education System

INTRODUCTION

The rapid evolution of Information and Communication Technology (ICT) has drastically transformed several sectors across the world; education is no exception. The use of ICT make the educational systems from many countries to be regarded as an important catalyst for improving teaching, learning, and digital literacy as well as training learners for a new set of work patterns in the 21st century (Oreku, 2022). In developing countries like Tanzania, educational authorities see ICT integration as the best strategy for closing educational gaps, increasing access to quality learning materials and developing new teaching and learning practices (Hare, 2007).

Tanzania has taken commendable steps to integrate ICT into its education system, indicating the potential for ICT to bring about change to traditional learning environments. The creation of national ICT policies for education as well as the launch of digital learning projects demonstrates Tanzania's intentions of utilizing technology for educational growth (United Republic of Tanzania, 2025; UNESCO, 2015). Nevertheless, the

effective implementation of ICT in Tanzanian classrooms remains a challenge. A major challenge is the preparedness of teachers to use the technology that is being integrated. Preparedness can be expressed in multiple ways, including teacher attitudes to ICT, teacher familiarity with the digital tools, and the enabling conditions in the educational context that facilitate (or inhibit) ICT integration (Minga & Ghosh, 2024; Kalinga & Ndibalema, 2023).

Available research suggests that, although Tanzanian teachers tend to have a positive disposition towards ICT and value the potential for pedagogical change, their use of ICT in teaching still tends to be relatively basic (substituting for something) and uncritical (Minga & Ghosh, 2024; Kalinga & Ndibalema, 2023). Additionally, conditions such as limited access to reliable infrastructure, lack of digital resources, few training opportunities, and several other contextual factors continue to restrict teachers' agency around using ICT dimensionally (Ndibalema & Mrosso, 2024; Mwinyi, 2024). Indeed, the evidence collectively points to a significant gap between what is intended by policy initiatives and what actually happens in the classroom, emphasizing the absence of a holistic understanding of the factors influencing teacher preparedness and the integration of ICT within Tanzanian contexts.

The purpose of this systematic review was to synthesize the available research on teachers' preparedness for ICT integration Tanzania's education system. In particular, the review focused on teachers' attitudes, competencies, and enabling conditions for teachers' preparedness. By systematically reviewing and analysing relevant studies, this study purposed to provide a comprehensive background on teacher's readiness, highlight factors related to successful ICT integration, and identify areas requiring further attention and action. The review aimed to offer policymakers, educational practitioners and researchers, diverse options on how to follow up, support, and develop teacher capacity to enable meaningful ICT integration within Tanzanian schools, and enhancing better educational systems for the future.

METHODOLOGY

The systematic review was conducted on teacher preparedness for ICT integration within the educational system of Tanzania, with a specific interest in attitudes, competencies and enabling conditions. It followed the updated Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) to ensure methodological rigour, transparency and replicability. The analytical framework of thematic analysis was used to identify patterns and how to represent these patterns and themes in the data taken from the studies selected for the systematic review. A comprehensive and systematic search strategy was implemented to capture relevant literature within multiple electronic databases, for example, Scopus, ERIC, ProQuest, J-Gate and Google Scholar. An exclusive list of keywords and synonyms represented ICT integration, teacher preparedness, attitudes, competencies, enabling conditions and Tanzania. The keywords were: To conduct a thorough literature search, the following Boolean string was employed: ("ICT integration" OR "information and communication technologies" OR "digital technologies") AND ("teacher preparedness" OR "teacher readiness" OR "teacher training" AND "teacher professional development") AND ("attitudes" OR "perceptions" OR "acceptance") AND ("competencies" OR "skills" OR "digital literacy") AND ("enabling conditions" OR "infrastructure" OR "policy" OR "support" or "challenges") AND ("Tanzania" OR "Tanzanian education system"). The use of Boolean operators (AND, OR) allowed for effective combinations of terms to capture valuable studies. In addition, backward searching and forward searching of the included studies allowed for additional valuable literature to be located.

Eligibility Criteria

To identify studies that were relevant and of a high-quality, eligibility and ineligibility criteria were delineated in the review to ensure the appropriate studies were included. Studies published on websites, peer-reviewed journal articles and reports published from 2003-2025 were eligible studies. It was necessary for the studies to focus on teacher preparedness for ICT integration in Tanzania's education system as it pertained to their

attitudes, ICT competencies and enabling conditions. Studies also included challenges which were associated with implementing the standards-based curriculum. Eligible studies were limited to those in the English language in order to establish a uniform point of access. Non-peer reviewed literature, conference proceedings, review articles, chapters in books, books, opinion pieces, editorials, and studies that were not directly related to teacher preparedness for ICT integration in Tanzania were excluded from the review. Literature that was outside of the demonstrated time frame was also excluded in order for the findings to remain relevant to contemporary educational discourse.

Study Selection

The study selection process was systematic and occurred in three phases. The first phase involved screening the titles and abstracts of studies retrieved using database search techniques for relevance. Studies that passed the first round of inspecting were then full text reviewed to determine if it had met the purposes of the review. In the last phase of selection, only the studies that met all of the selection criteria were reviewed in-depth. To strengthen confidence in the study selection process, two research scholars and a research supervisor screened all studies independently and were resolved through discussion and consensus if there were discrepancies.

Data Extraction

A standardized data extraction form was used to collect relevant information from the studies selected for review in a systematic way. The data that was extracted included author(s), year of publication, title, and type of document. This focused on identifying recurring themes and common challenges reported in the studies.

Data Synthesis

Data segmentation was done through thematic analysis. Each study was coded line by line to identify each recurring concept. From these codes, it formed broader themes that represented aspects of the major barriers that influence teacher preparedness for ICT use in Tanzania. The themes were analysed to see their underlying meaning within the context of teacher effectiveness for ICT use in Tanzania.

Findings

The procedure for selecting studies was delineated using a flow diagram to apply PRISMA. This diagram outlined the number of records identified through database searching, those screened for eligibility, those removed and reported on to the end users, and those included in the analysis. Overall, it demonstrated the transparent process of the review from search to selection for synthesis. For a graphical representation see figure 1. A total of 350 articles were identified, with 245 duplicates removed, and 105 articles available for screening were screened using inclusion and exclusion criteria. Forty articles were subsequently excluded from the study. For the remaining 65 articles the authors screened for eligible studies, and as a result, removed 25. In total, 40 articles were aggregated for the study. The Prisma flowchart is below.

Studies were excluded if they met any of the following criteria:

1. The study did not focus on the Tanzanian education context.
2. It did not directly address teacher preparedness or ICT integration in education.
3. It was an opinion piece, editorial, conference abstract without a full paper, or a dissertation not publicly accessible.

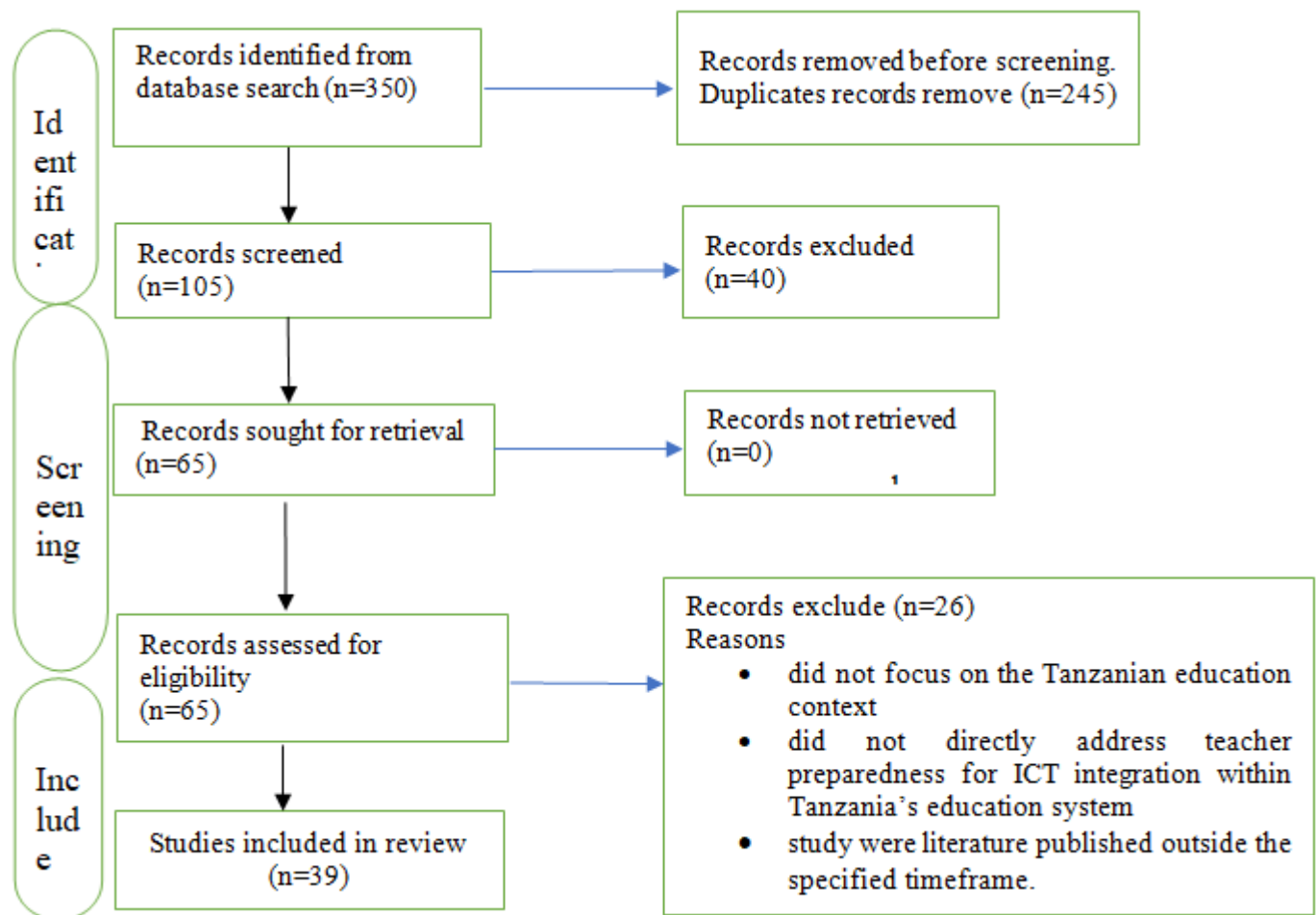


Figure 1: PRISMA flow diagram for the review.

Table 1: Study characteristics

Author(s)	Year	Title	Type of Document
Kalinga & Ndebalema.	2023	Teachers' technological competencies in enhancing teaching and learning in secondary schools in Tanzania	Journal Article
Fulgence	2020	Developing digital fluency among teacher educators: Evidence from Tanzanian Schools of Education	Journal Article
John & Ashwarya	2025	Challenges in Teachers Training for Digital Technology Integration in Secondary School Geography Subject in Tanzania: A Systematic Review	Journal Article
Mtebe & Raphael	2018	Key factors in learners' satisfaction with the e-learning system at the University of Dar es Salaam, Tanzania	Journal Article
Tandika & Ndijuye	2020	Pre-primary teachers' preparedness in integrating information and communication technology in teaching and learning in Tanzania	Journal Article
Ndebalema & Mrosso	2024	Teachers' Perceptions on the Role and Challenges of using ICT in English Language Classrooms	Journal Article
Ndebalema	2014	Teachers' Attitudes towards the Use of Information Communication Technology (ICT) as a Pedagogical Tool in Secondary Schools in Tanzania: The Case of Kondoa District	Journal Article

Minga & Ghosh	2024	Student Perceptions on ICT Use in Teaching and Learning in Public Secondary Schools in Mbeya District, Tanzania	Journal Article
Nyirenda	2025	Institute for eGovernment	Web page
UNICEF	2024	Government, Airtel, and UNICEF join hands to accelerate digital learning in Tanzania	Web page
Brookland	2025	Tanzanian schools arrive in the digital age	Report
UNESCO	2025	Information and Communication Technology Use in Education.	Web page
Hare	2007	ICT in Education in Tanzania	Report
Lubuwa, Ndibalema & Mbwambo	2022	Assessment of Tutors' Level of ICT Competencies in Teaching in Teacher Education in Tanzania.	Journal Article
Peter	2022	The use of ICT for Teaching and Learning among Secondary Schools Teachers in Mtwara, Tanzania.	Journal Article
Deogratias	2024	Investigation of Teachers ' Competency on Using ICT for Teaching and Learning Mathematics and Science Subjects in Tanzanian Secondary Schools Investigation of Teachers ' Competent.	Journal Article
Ndume, Kisanga & Selemani	2021	Integrating ICT in Tanzania secondary schools: Experience of Tanzania as it grows to second world economy.	Journal Article
Buhori & Nyaisa	2024	Exploring the Role of Social Media in Transforming Learning to Children: A Case of Selected Private Pre-Primary Schools in Tabora – Tanzania	Journal Article
Nzilano	2025	An investigation into the factors influencing ICT adoption and use in the administration of secondary schools in Dar es Salaam, Tanzania	Journal Article
Rubeba	2025	Lecturers' teaching competencies towards improving teaching and learning process in universities in Tanzania: Students' perspectives.	Journal Article
Shayo & Mnyanyi	2023	Enhancing Instructors Digital Competences in Teaching Practices: A Case of Teacher Education in Tanzania	Journal Article
Kisanjara, Michael & Noyi	2014	ICT application in teaching and learning process: A case of two selected Tanzania Teachers' Colleges.	Journal Article
Kihoza, Zlotnikova & Bada	2016	Classroom ICT integration in Tanzania: Opportunities and challenges from the perspectives of TPACK and SAMR models	Journal Article
Bitegeko, Lawrent & Cosmas	2024	Student Teachers' Perceptions of Training and Support in their Preparation for Digital Age	Journal Article
Lubuwa	2012	Implementation of the policy on ICT integration in teaching and learning: a case of a public teachers' college in Tanzania	Thesis
Kiwonde	2018	Effectiveness of ICT Teachers' Training Programmes in Enhancing Teaching and Learning of Environmental	Thesis

		Education in Selected Primary Schools in Musoma District.	
Kisanga	2016	Determinants of teachers' attitudes towards e-learning in Tanzanian higher learning institutions	Journal Article
Mohsini, Mtani & Rashidi	2024	Student Readiness and Acceptance of eLearning Platforms: The Case of UDOM eClassroom of the University of Dodoma	Journal Article
Kafyulilo	2019	Developing TPACK in Science and Mathematics Teacher Education in Tanzania: A Proof of Concept Study	Book
Hamad, Ndibalema & Matalu	2024	Teachers' digital competency in using digital lesson content for teaching and learning in secondary schools in Zanzibar	Journal Article
Komba & Nkumbi	2008	Teacher Professional Development in Tanzania: Perceptions and Practices	Journal Article
Makunganya & Amos	2024	Attitudes of Teachers Towards Ict Integration in Teaching of Mathematics in Public Secondary Schools in Morogoro Municipal, Tanzania	Journal Article
Pima	2019	Factors that motivate teachers to use ICT in teaching: A Case of Kaliua District Secondary Schools in Tanzania	Journal Article
Mwila	2018	Assessing the attitudes of secondary school teachers towards the integration of ICT in the teaching process in Kilimanjaro , Tanzania Prosperity Mwila St Augustine University of Tanzania	Journal Article
Bakari & Ali	2023	Introduction of ICT subject in Zanzibar primary education: Challenges and opportunities	Journal Article
Tarmo	2021	Teachers' Beliefs and Their Effects on the Use of ICT in Teaching Science and Mathematics in Tanzania	Journal Article
Oreku	2022	ICT in Education: Mapping Digital Learning Initiatives in Tanzania	Journal Article
Ngao & Sang	2024	How teachers enhance ICT integration practices within professional learning communities: a qualitative study in Tanzania	Journal Article
Tilya	2007	Thematic brief ICT in education in Tanzania Lessons and experiences from IICD-supported projects	Web page

RESULTS AND FINDINGS

Teachers' ICT Competence and Confidence Levels in Tanzania

It was found that most Tanzanian school teachers demonstrate only basic ICT competencies, primarily using mobile phones, computers, and internet resources for lesson preparation, communication, and accessing educational materials. Although their knowledge acquisition levels indicate confidence in fundamental ICT skills (Lubuwa, Ndibalema & Mbwambo, 2022), studies reveal that the majority still operate at the substitution level of ICT integration, where digital tools replace traditional methods without significantly transforming instructional practices (Kalinga & Ndibalema, 2023; Fulgence, 2020).

Research indicates that most teachers possess only moderate abilities in using ICT for teaching and learning (Peter, 2022). Many remain hindered by inadequate expertise and confidence, limiting effective classroom integration (Deogratias, 2024). For instance, few secondary school teachers have developed sufficient computer and Internet skills for lesson preparation, and only 32% have received formal training in ICT pedagogy (Ndume, Kisanga & Selemani, 2021). Although awareness of the national ICT policy is growing, practical application remains weak (Peter, 2022). As a result, ICT use in schools often stagnates at basic levels such as presentation software, offering minimal pedagogical advancement compared to higher levels of integration like augmentation, modification, and redefinition, which foster innovative learner-centered approaches (Bicalho, César & Anna et al., 2022). School heads further compound the challenge, as many also lack ICT knowledge and confidence, contributing to technophobia in both teaching and administration (Nzilano, 2025).

Tanzanian university lecturers continue to exhibit limited technological competence, which constrains effective ICT integration in teaching and learning (Rubeba, 2025). Although teacher education programs emphasize technical skills and collaboration (John & Ashwarya, 2025; Mtebe & Raphael, 2018), the use of ICT in pedagogy remains weak. Studies show that while most tutors and trainees engage with ICT for teaching and professional development, their competencies are largely confined to basic applications, with limited application in innovative pedagogy (Shayo & Mnyanyi, 2023; Kisanjara, Michael & Noyi, 2014; Kihoza, Zlotnikova & Bada, 2016; Bitegeko, Lawrent & Cosmas, 2024)This highlights a persistent gap between technical proficiency and pedagogical use.

Teachers' Attitudes and Acceptance of ICT in Education

In Tanzania, teachers generally exhibit positive attitudes toward the integration of ICT in education. ICT is widely acknowledged as a valuable tool for curriculum implementation, with teachers using televisions, mobile phones, computers, and radios to support educational delivery (Tandika & Ndiujye, 2020). Similarly, studies reveal that teachers recognize ICT as an important pedagogical aid, particularly for teaching grammar, vocabulary, and pronunciation (Ndibalema & Mrosso, 2024; Ndibalema, 2014). In Zanzibar, while teachers express a positive pedagogical attitude, they face difficulties in implementing digital lesson content due to a lack of sufficient and relevant digital resources (Hamad, Ndibalema & Matalu, 2024). Despite such challenges, teachers across Tanzania report a willingness to acquire further digital skills training (Minga & Ghosh, 2024).

Teacher Professional Development (TPD) is widely perceived as crucial, with teachers acknowledging that it enhances their professional, academic, and technical competencies (Komba & Nkumbi, 2008). Exposure to computers has been shown to shape teachers' favourable perceptions of e-learning, as evidenced in Morogoro Municipality where mathematics teachers reported feeling motivated and comfortable using ICT in their lessons (Makunganya & Amos, 2024; Kisanga, 2016). Factors such as prior experience with digital tools, access to technologies like the Internet and smartphones, and the anticipated benefits of ICT use influence teachers' willingness to adopt it. Even in remotely located schools, educators demonstrate readiness to integrate ICT when such conditions are met (Pima, 2019). Positive orientations toward ICT not only foster effective use of digital tools in teaching (Mwila, 2018), but also create opportunities for curriculum innovation. For instance, in Zanzibar, 80% of teachers recognized the importance of ICT subjects in primary schools, enabling their introduction at that level (Bakari & Ali, 2023).

However, despite these generally positive perceptions, research also highlights notable contradictions and challenges. For instance, in Kibaha District, a study of 172 science and mathematics teachers had overwhelmingly negative ICT integration beliefs that greatly restricted classroom applications (Catherine & Tarmo, 2021). Likewise, in Magu District, while the majority of teachers had positive attitudes toward ICT, integration into practices was still constrained by systemic factors. These include low ICT proficiency, poor technical support, few ICT resources, and few training opportunities. Notably, 96% of the teachers in this research reported that they had never been formally trained on the integration of ICT, and 88% reported that there was a lack of technical support as a significant hindrance (Kiwonde, 2024).

Effectiveness of ICT Tools and Teacher Training Programs

Tanzania's adoption of digital learning platforms such as Moodle, the e-Classroom at the University of Dodoma (UDOM), and televised/radio-based instruction during school closures marks the emergence of a more connected learning environment (Mohsini, Mtani & Rashidi, 2024). However, most ICT training programs remain focused on basic tool use, and their impact varies widely with each institution's capacity and infrastructure. This narrow scope of training neither fosters positive attitudes toward technology nor builds lasting teacher confidence in digital pedagogy (Shafaq, Zeng, Pathan et al., 2018). Consequently, many educators struggle to integrate advanced technologies into their lesson plans (Murithi & Yoo, 2021) and remain at the substitution level of ICT use simply replacing traditional methods with digital ones without enhancing learner engagement or transforming instructional practices (Vandeyar & Adegoke, 2024).

When thoughtfully designed, ICT can improve the quality, effectiveness, and efficiency of education by broadening access to resources, promoting innovative pedagogical practices, boosting student motivation, and strengthening teacher competencies (Peter, 2022). For these benefits to be fully realized, the Government of Tanzania must invest in continuous and contextualized training programs that extend beyond technical skills to include pedagogy, advanced devices, and ongoing coaching support.

A study in Musoma District underscores this need: although teachers considered ICT training helpful for their professional development, all participants reported insufficient time to explore resources and unclear guidance on incorporating digital tools into Environmental Education. Challenges such as poorly structured content and weak instructional strategies further undermined potential benefits (Kiwonde, 2018)

In Environmental Education specifically, ICT can enrich learning environments by facilitating access to diverse sources, fostering inquiry, and enabling collaboration. Nonetheless, inadequate resources and limited teacher expertise continue to hinder effective use in Tanzanian primary schools (Kiwonde, 2024). To move beyond shallow tool adoption toward authentic digital pedagogy, Tanzania requires training that equips teachers with both advanced technical capabilities and sound pedagogical models.

The Role of Policies, Infrastructure, and Partnerships in Enhancing Teacher ICT Readiness

Tanzania's education policies recognize the importance of technology in improving teaching and learning. The national framework emphasizes ICT as a tool to empower learners, teachers, and education leaders by expanding learning opportunities and enhancing education quality and relevance (Lubuva, 2012). It also stipulates that ICT should be taught both as a standalone subject and as a cross-curricular tool, with pedagogy training made compulsory for all student teachers. Furthermore, the ICT syllabus recommends specialization opportunities for teachers to strengthen competence in integration (Lubuva, 2012). However, despite these progressive intentions, many policies remain outdated, focusing mainly on hardware acquisition and basic operational training rather than pedagogical use. Furthermore, limited financial resources have constrained teacher professional training and ICT infrastructure in schools (Oreku, 2022; Ngao & Sang, 2024). Initiatives towards the establishment of ICT infrastructure within Tanzanian education have been based on foreign assistance in the past. The most significant achievement was in 2002 initiated 11 ICT projects under the Tanzania e-Schools program, significantly increasing awareness of computer-based learning (Hare, 2007; Nyirenda, 2025).

Between 2005 and 2008, the Ministry of Education and Vocational Training (MoEVT) undertook the ICT in Teachers' Colleges Project, funded with USD 3.73 million from SIDA, supplied teacher colleges and secondary schools with ICT resources, managed under a multi-stakeholder committee comprising MoEVT, the University of Dar es Salaam, and the Tanzania Institute of Education. To support the project, the government set aside TZS 500 million every year to train ICT-capable tutors. Upon completion in 2009, the project became a program financed by the government, with suggestions to incorporate its approach into the Tanzania Beyond Tomorrow (TBT) project. This stage emphasized the reinforcement of ICT application for science and mathematics and the creation of partnerships with universities and technical institutes. Working in collaboration with the Open University of Tanzania, African Virtual University, and University of Dar es

Salaam through Moodle showed promising outcomes on developing ICT in teacher training (Andersson, Nfuka & Sumra et al., 2014).

Later initiatives included the ICT for Science, Mathematics, and English (ICT-SME), launched in 2010 with support from Global e-Schools and Communities Initiative (GESCI), equipped tutors with laptops and projectors for in-service training. Similarly, Bridge IT (2011) provided multimedia tools such as radios, videos, and TV broadcasts to support primary education in over 150 schools (Kafyulilo, 2019).

The Bright Education Trust Fund (BETF) further trained around 200 educators in basic ICT skills, though challenges remain in applying these skills pedagogically (Tilya, 2007). More recently, the Tanzania 21st Century Basic Education Program, funded by the U.S. government, deployed ICT infrastructure in 900 primary schools across Mtwara and Zanzibar. In partnership with Kicheko, this program trained teachers in digital tools and e-content aligned with the national curriculum, thereby improving instruction and student performance tracking (Brookland, 2025).

While these accomplishments are notable, there remain systemic constraints to extending ICT infrastructure such as insufficient budgets for schools and lack of capacity to maintain, and update (Ngao & Sang 2024). In promoting ICT in Tanzanian education system, public-private partnerships (PPP) and donor funding were important, including the SmartWASOMI program involving the Government of Tanzania, UNICEF, and Airtel, which increased access to modern learning resources for teachers and learners. The opportunity to develop an evidence-based strategy for digital learning against the 21st-century education approach led by UNICEF (UNICEF 2024). Similarly, the ICT for Teacher Professional Development (ICT-TPD) Framework introduced in 2009 leveraged projects like ICT-SME and Bridge IT to strengthen teacher capacity (Kafyulilo, 2019). At the international level, Tanzania has drawn lessons from other models, such as India's ICT Academy in Tamil Nadu and Intel's pilot initiatives in Nigeria, which demonstrate how private sector innovation can support teacher training and laptop deployment (Academy, 2025). These collaborations have been vital to filling gaps in financing and expertise, allowing teachers to network, exchange resources, and engage in professional development despite systemic challenges (Trucano, 2025; Ngao & Sang, 2024). However, the sustainability of these partnerships is uncertain without consistent national investment and strengthened capacity-building efforts (Ngao & Sang, 2024).

DISCUSSIONS

Digital competence is a key competence that every person needs to have in modern society (Kiryakova & Kozhuharova, 2024). Teachers' digital competencies have gained prominence in enhancing quality education in the 21st century (Demissie, Labiso & Thuo, 2022). Teachers have to possess digital competences at a high level, meaning that they are successfully able to use digital tools and technologies in their teaching practices (Kiryakova & Kozhuharova, 2024). Teaching professionals should not aim at only gaining mastery of basic computer applications, but teachers ought to manage information, create content, and use the technology to keep students connected (Demissie et al., 2022; Portillo, Garay, Tejada et al., 2020). Digital competences include digital literacy, experience using educational software and platforms, and the ability to seamlessly integrate information and communication technologies (ICT) into the organization of educational activities (Kiryakova & Kozhuharova, 2024). Consequently, effective integration of technology is achieved when students are provided an opportunity to select technological tools that help them obtain timely information, analyse and synthesize it, and present it professionally (Demissie et al., 2022; Nana Gilbertson, 2007). However, as noted by Nzilano (2025a); Bitegeko, Lawrent & Cosmas (2024); Kalinga & Ndibalema (2023); Peter (2022); Fulgence (2020); Kisanjara, Michael & Noyi (2014), teachers in Tanzania generally demonstrate only basic ICT competencies, while many school heads lack sufficient ICT knowledge and skills, compounded by inadequate familiarity with various software applications. As result, most teachers in Tanzania are not adequately prepared to fully embed advanced technologies into curriculum delivery and assessment (Buhori & Nyaisa, 2024; Deogratias, 2024; Shayo & Mnyanyi, 2023; Kihoza, Zlotnikova & Bada, 2016; Kisanjara, Michael & Noyi, 2014). This highlights a critical gap in the preparedness of Tanzanian teachers, as they tend to use technology mainly for basic tasks rather than for transforming teaching practices, reflecting low competence levels and limited effective pedagogical integration of ICT in the classroom. Consequently, this hinders administrative integration. Also, it negatively affects development of innovative teaching methods,

reduces student engagement, and limits learners' opportunities to acquire 21st-century digital skills essential for academic success and employability.

In Indonesia, ICT is positively embraced in teaching-learning situations, where it enhances student engagement and learning outcomes (Silviyanti & Yusuf, 2015). In India, teachers show high adaptability and utilize ICT tools, especially for teaching regional languages (Thannimalai, Ponniah & Nawastheen, 2022). Mauritian teachers are frequent computer users who recognize the pedagogical value of technology in enhancing teaching-learning situations (Perienen, 2020). Supporting this positive outlook, most pre-service teachers also view technology as essential, with nine out of ten highlighting its role in visualizing complex concepts and many expressing interest in web-based teaching resources (Lin, 2008). Despite global progress, significant challenges remain. Many South African teachers struggle to employ ICT as a transformative tool, largely because Continuous Professional Development (CPD) programmes do not adequately address their TPACK needs or the barriers they face (de Freitas & Spangenberg, 2019). In Tanzania's Kibaha District, 172 teachers reported to exhibit negative attitudes about ICT integration in teaching-learning situations, which significantly hindered classroom use (Catherine & Tarmo, 2021). Teachers can quickly adapt and integrate ICT in their classroom instruction if they have a positive attitude towards the technology, and also the negative attitude impedes the successful implementation of ICT in institutions (Bariu & Chun, 2022). Tanzanian teachers' reluctance may hinder efforts to modernize teaching practices and improve student outcomes. Consequently, if the current trend of predominantly negative teacher beliefs towards ICT persists in Tanzania, the integration of technology in teaching and learning will likely remain limited, and classrooms may continue to experience low levels of digital adoption.

Teachers' attitudes and perceptions toward integrating technology into teaching and learning are crucial for fostering effective educational practices. Research from various countries consistently highlights a growing positive attitude among educators toward adopting ICT in education. In Malaysia, teachers actively integrate ICT into classroom practice, demonstrating favourable perceptions and strong knowledge of digital tools (Termit & Samli, 2014; Ramadass & Shah, 2022). As noted by Hamad, Ndibalema & Matalu, (2024); Bakari & Ali, (2023); Mwila (2018); Kisanga (2016), teachers in Tanzania generally demonstrate positive attitudes, which are essential for fostering the effective use of ICT in teaching and learning. However, most teachers in the Magu District find difficulties to integrate into actual teaching due to systemic barriers. These included low ICT competence, inadequate technical support, limited ICT resources, and insufficient training opportunities. Alarming, 96% of teachers in this study indicated they had never received formal training in ICT integration, and 88% cited the lack of technical support as a major barrier (Kiwonde, 2024). This undermines teachers' ability to translate these attitudes into effective classroom practices. Consequently, students may continue to face unequal access to quality digital learning opportunities, and the nation risks falling behind in achieving sustainable ICT integration in education.

Teachers' attitude on the benefits of ICT towards teaching ICT can help make difficult topics easy, makes lessons clear and easy to understand and effective implementation (Bariu & Chun 2022). Positive attitude towards ICT demonstrate ability of teachers' ICT integration (Xu, Zhao, Zheng et al., 2025). Consistent with these findings, Makunganya & Amos (2024); Das & Chetia (2023) found that teachers in Tanzania demonstrated positive attitudes, with many reporting that they were ready, motivated, and comfortable integrating ICT into mathematics instruction. Similarly, both rural and urban teachers in Kamrup District expressed favourable perceptions of ICT use in secondary schools. However, many Tanzanian teachers lacked necessary competence, while limited awareness and inadequate training left them unprepared for effective ICT integration in schools (Kweka, 2017; Kayombo & Mlyakado, 2015). Tanzania must focus on strengthening teachers' competence through targeted professional development programs that go beyond basic ICT skills to include pedagogical integration strategies.

Policies such as Ghana's 2015 ICT in Education Policy, highlight the importance of teacher preparation with a strong emphasis on pedagogy to foster meaningful student learning outcomes through technology in classrooms (Abedi, 2023; Sarpong, 2023). As noted by Ngao & Sang (2024) and Oreku, (2022), Tanzanian's ICT in Education Policy was adopted in 2003 remain outdated, emphasizing hardware acquisition and basic operational training rather than the pedagogical integration of ICT to enhance learning outcomes. This gap not only undermines classroom innovation and interactive pedagogy but also places Tanzanian students at risk of

missing out on the full benefits of technology for improving learning outcomes and acquiring essential 21st-century skills. Moreover, it widens the digital divide between Tanzania and other countries like Ghana, which have adopted advanced ICT frameworks that prioritize teacher preparedness. Consequently, Tanzanian students may struggle to achieve improved academic performance, critical thinking, and problem-solving skills, leaving them less equipped with the digital literacy and 21st-century competencies required for higher education, employment, and participation in a technology-driven global economy.

In the United States, local initiatives such as the Warren County School District in Kentucky demonstrated how strong partnerships and well-targeted funding can enhance ICT integration. Priorities included equipping classrooms, subsidizing student access to devices, and providing both technical and pedagogical support (Jhurree, 2005). Similarly, Michigan's holistic model brought together government, private sector, and educational institutions to fund statewide digital networks and develop inclusive ICT standards (Jhurree, 2005). These cases highlight that financial investments are most effective when combined with collaborative partnerships that pool resources and expertise. In Tanzania implementation of ICT in education is further constrained by limited financial resources, which restrict both professional training opportunities and the provision of adequate ICT infrastructure in schools. For instance, while the Bright Education Trust Fund (BETF) has trained about 200 educators in basic ICT skills, inadequate budgets and poor infrastructure maintenance continue to hinder effective pedagogical use (Trucano, 2025; Ngao & Sang, 2024 & Tilya, 2007). This is a persistent barrier to ICT integration in schools. With insufficient funding for professional development, many teachers remain underprepared to use ICT as a pedagogical tool, and students have limited access to digital learning resource. Consequently, classrooms will remain largely traditional, innovation is stifled, and Tanzanian learners risk falling behind their peers in other countries where strong funding and collaborative partnerships have enabled widespread ICT adoption, this not only reduces immediate learning outcomes but also limits students' preparedness for higher education and the digital workforce.

Sustainable ICT integration also depends on robust and equitable infrastructure. In Mauritius, the gradual installation of computer labs ensured manageable growth while fostering teacher training and student access. In Michigan, consistent internet connectivity, equitable digital infrastructure, and ongoing professional development were made possible through multi-stakeholder efforts. Such infrastructure-driven approaches ensure that ICT benefits extend to both teaching and learning processes (Jhurree, 2005). As noted by Ngeze (2017) many schools in Tanzania lacked proper ICT infrastructure for teaching and learning. This lack of infrastructure not only hinders effective classroom integration but also reduces Tanzania's competitiveness compared to other countries and states like Mauritius and Michigan, where strategic investments in ICT have strengthened teacher preparedness and improved learning outcomes. Consequently, teachers face difficulties in adopting digital pedagogies, students experience limited access to e-learning resources, and the overall quality of education is compromised, widening the digital divide between Tanzania and countries that have invested in stronger ICT systems.

Digital technology has fundamentally transformed the way education is delivered and has become an essential component of modern learning systems. As Rajesh (2019) notes, digital technology plays a vital role in enhancing education by enabling personalized, collaborative, and efficient learning experiences. It offers students instant access to vast information for independent exploration, supports tailored instruction, and enriches learning through multimedia tools like videos and simulations. It fosters collaboration through real-time communication and resource sharing, developing essential teamwork and digital skills. Additionally, technology streamlines assessment, feedback, and administrative tasks, allowing teachers to monitor progress effectively and focus more on student engagement and support. Global regions employ a mix of high-tech and low-tech platforms, like Kolibri, Zoom, and Duolingo, to personalize and broaden access to learning (Charles, George, Moses et al., 2023; Rajesh, 2019; Rubagiza, Were & Sutherland, 2011). To optimize effectiveness in Tanzania, there's a need for context-sensitive, scalable, and interactive ICT tools, coupled with ongoing, skill-specific training tailored to local teaching needs and curriculum goals. According to Vandeyar & Adegoke (2024); Murithi & Yoo (2021); Kiwonde (2018) many Tanzanian primary school teachers struggle to integrate advanced technologies into Environmental Education lessons, often remaining at the substitution level due to inadequate practical training, limited guidance, insufficient ICT skills, and scarce technological resources, which collectively hinder meaningful learner engagement and transformative instructional practices. This gap highlights the need for context-sensitive, skill-specific interventions and scalable ICT tools tailored to local

curriculum goals to move beyond substitution toward transformative instructional practices. Consequently, ICT integration in Environmental Education lessons remains superficial, widening the digital divide and limiting students' opportunities to develop essential 21st-century skills, and its impact remains limited because teachers often cannot move beyond basic substitution-level use.

RECOMMENDATIONS

Based on this study, the following measures are proposed for teachers, administrators, government, and non-governmental organizations.

1. Get advanced, hands-on training on incorporating ICT into subject-specific pedagogy to go beyond fundamental technical skills. Learner-centred strategies, assessment integration, and innovative use of digital tools should be prioritised in programs.
2. Update the 2003 ICT in Education Policy to place more emphasis on ongoing teacher professional development, emerging technologies, and pedagogical applications than on hardware acquisition alone.
3. Make investments in dependable internet access, maintenance systems, and electricity, particularly in underserved and rural schools. Sustainable infrastructure can be ensured by utilising public-private partnerships.
4. Make ICT-focused CPD required, offering pre-service and in-service teachers mentorship programs, peer-learning communities, and frequent refresher courses.
5. Provide school leaders with targeted ICT training to reduce technophobia, improve administrative integration, and create a technology-friendly school culture.
6. Develop and promote context-sensitive digital resources aligned with the Tanzanian curriculum and available in local languages to increase relevance and adoption.
7. Secure long-term financial commitments for ICT projects through multi-stakeholder collaboration, ensuring that donor-supported initiatives are scalable and sustainable.

CONCLUSION

This systematic review reveals a notable disconnect between Tanzanian teachers' generally optimistic attitude towards the use of ICT, and their skills in effectively using ICT as part of their pedagogy. The majority of teachers still operate at the substitution level of ICT use, and barriers to integration - limited infrastructure, inadequate training, outdated policy, and weak leadership competencies - restrict further integration. There are many government and donor-initiated programs which increased awareness of the issue and provided access, and there is lack of sustainability and depth in pedagogy. In order to address the gap, Tanzania needs to take a systemic approach by addressing policy, developing infrastructure, embedding pedagogical ICT skills into teacher training, and developing leadership competencies; combining local capacity building with sustainable partnerships can enable local growth from a basic substitute ICT Usage to transformative teaching practices in order for students to meet 21st century demands.

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