

## Evaluating the Effectiveness of ICT Integration on Students' Learning Outcomes in Government Secondary Schools in Ilala District, Tanzania

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### Abstract

*This quasi-experimental study investigated the effectiveness of integrating Information and Communication Technology into instructional practices on students' academic performance in government secondary schools within Ilala District, Tanzania. Specifically, the study compared traditional teacher-centered instruction with two ICT-integrated strategies: simulation-based learning and online search-based learning. Four instructional groups were analyzed using pretests and post-tests to measure performance gains. Findings indicate that simulation-based learning yielded the highest performance ( $M = 62.84$ ), significantly outperforming both lecture-based instruction ( $M = 37.91$ ) and online search-based learning ( $M = 57.07$ ). Independent samples  $t$ -tests confirmed these differences were statistically significant ( $p < .001$ ), with large effect sizes. Additionally, a one-way ANOVA revealed significant performance variation across groups,  $F(3, 196) = 28.30$ ,  $p < .001$ , further validating the impact of ICT on learning outcomes. The study demonstrates that incorporating digital content fosters greater student engagement, comprehension, and test performance, even within limited instructional periods. Recommendations include expanded investment in ICT infrastructure, and curriculum reform to embed digital competencies. Strategic implementation of the National Digital Education Strategy (2024/25–2029/30) is also essential. Professional development for teachers should be prioritized to build confidence and skill in using ICT tools effectively. Post-hoc findings suggest simulation-based instruction offers the most consistent gains, making it a strong option to be used in schools across the country. The study advocates for intentional and inclusive adoption of ICT to cultivate an engaging, equitable, and future-ready educational environment.*

**Keywords:** *ICT Integration, Simulation-Based Learning, TPACK, Online Search-Based Instruction and Quasi-Experimental Design*

### Introduction

In a rapidly digitizing world, the integration of Information and Communication Technology (ICT) in education is increasingly recognized as a catalyst for enhancing student engagement, fostering critical thinking, and promoting student-centered learning. ICT encompasses a range of tools including computers, internet-based applications, and educational software that facilitate communication and information management. Globally, education systems are adopting such technologies to improve learning outcomes and equip students for a technology-driven economy (Bendera, 2024; Warrioba *et al.*, 2022). In Tanzania, the Ministry of Education and Vocational Training (MoEVT, 2007) formulated the ICT Policy for Basic Education as a roadmap for digital transformation in schools. More recently, the National Digital Education Strategy (2024/25–2029/30) reaffirmed the government's commitment to ICT integration by emphasizing

digital infrastructure development, curriculum reform, and professional development for teachers (MoE, 2024). However, the actual implementation of these policies particularly in government secondary schools within Ilala District is infrequent. Persistent barriers such as inadequate infrastructure, limited digital literacy among educators, and inconsistent policy translation continue to hinder effective adoption (Msafiri *et al.*, 2023; Bendera, 2024).

Although research highlights the transformative potential of ICT-based tools like simulations and collaborative platforms in improving learner retention and engagement, their impact in Tanzanian public secondary schools remains underexplored (Msangi & Mwila, 2024). Teaching practices continue to rely heavily on traditional lecture-based instruction, which often leads to passive learning and low academic performance (Marton & Säljö, 1976; Patrobas, *et al.*, 2023).

To bridge the gap between policy and classroom practice, this study explores the types of ICT integration that can impact student learning outcomes. Among the prominent approaches are collaborative learning, simulation-based instruction, blended learning, and the flipped classroom model. Collaborative learning utilizes digital platforms such as Google Docs and Microsoft Teams to support real-time peer interaction, content co-creation, and collective problem-solving (Levin & Frei-Landau, 2023; Warioba *et al.*, 2022). Simulation-based learning, on the other hand, engages students in interactive scenarios that mimic real-world problems, particularly in complex subjects like science and technology (Gonzalez & Kauffman, 2023). Blended learning merges conventional classroom delivery with digital learning experiences, offering students both structure and flexibility. Tools such as online discussion boards, multimedia content, and quizzes supplement face-to-face instruction, allowing for differentiated instruction and improved learner autonomy. The flipped classroom model complements these approaches by reversing the traditional instructional sequence: learners access theoretical content (e.g., via recorded videos) outside of class, while in-class time is reserved for collaborative exercises, debates, and practical application (Digest.tz, 2023; Mwaibingila *et al.*, 2025). By evaluating the relative impact of these ICT-enriched instructional models against conventional teacher-centered methods, this study aims to offer evidence-based insights into how digital learning environments can contribute to improved academic performance in Ilala District's public secondary schools.

Despite national strategies promoting ICT integration in Tanzanian schools, secondary schools in Ilala District continue to face persistent challenges that undermine the effectiveness of these reforms. Infrastructural deficits such as limited access to computers, unreliable internet connectivity, and frequent power outages hinder the consistent use of digital tools. Moreover, many teachers lack the necessary professional development and pedagogical training to meaningfully incorporate ICT into their instruction.

These barriers have perpetuated a reliance on conventional, lecture-based teaching practices that often disengage learners and hinder the development of critical thinking and problem-solving skills.

Consequently, students are not benefiting fully from the instructional potential offered by ICT, which could otherwise enhance motivation, collaboration, and academic performance. While global and regional studies emphasize the benefits of digital learning environments, there is a critical gap in local empirical evidence on how different ICT-integrated instructional approaches such as simulation-based learning and online search-based activities affect academic outcomes in the Tanzanian school context. This study responds to that gap by systematically examining the impact of specific ICT-based teaching methods on student performance in Ilala District through the following objectives:

### **Objectives of the Study**

The main objective of this study is to systematically examine the impact of specific ICT-based teaching methods on student performance in Ilala District through the following specific objectives:

1. To compare the effects of teacher-centered instruction and simulation-based learning on students' academic performance in government secondary schools.
2. To assess the differences in academic performance between students taught using teacher-centered instruction and those exposed to online search-based learning.
3. To evaluate the overall impact of ICT-integrated instructional strategies (specifically simulation-based and online search-based learning) on students' academic achievement compared to traditional instructional methods.

To address these specific objectives, the study tested the following hypotheses:

1. **H<sub>1</sub>:** There is a statistically significant difference in academic performance between students taught using teacher-centered instruction and those taught using simulation-based learning.
2. **H<sub>2</sub>:** There is a statistically significant difference in academic performance between students taught using teacher-centered instruction and those using online search-based learning.
3. **H<sub>3</sub>:** ICT-integrated instructional methods specifically simulation-based and online search-based learning have a statistically significant positive impact on students' academic performance compared to teacher-centered approaches in government secondary schools in Ilala District.

### **Empirical Literature and Theoretical Framework**

This study is anchored in the Technological Pedagogical Content Knowledge (TPACK) framework by Mishra and Koehler (2006), which extends Shulman's (1986) concept of Pedagogical Content Knowledge (PCK) by incorporating the role of technology in teaching. TPACK offers a holistic approach to understanding how educators integrate technology into instructional practices through the interplay of three knowledge domains: content knowledge (CK), pedagogical knowledge (PK), and technological knowledge (TK). Rather than treating these domains separately, the model emphasizes their intersection as essential for creating effective, technology-enhanced learning environments. This framework provides a guiding lens for analysing how different instructional approaches each characterized by unique configurations of CK, PK, and TK affect student academic performance in Tanzania's public secondary schools.

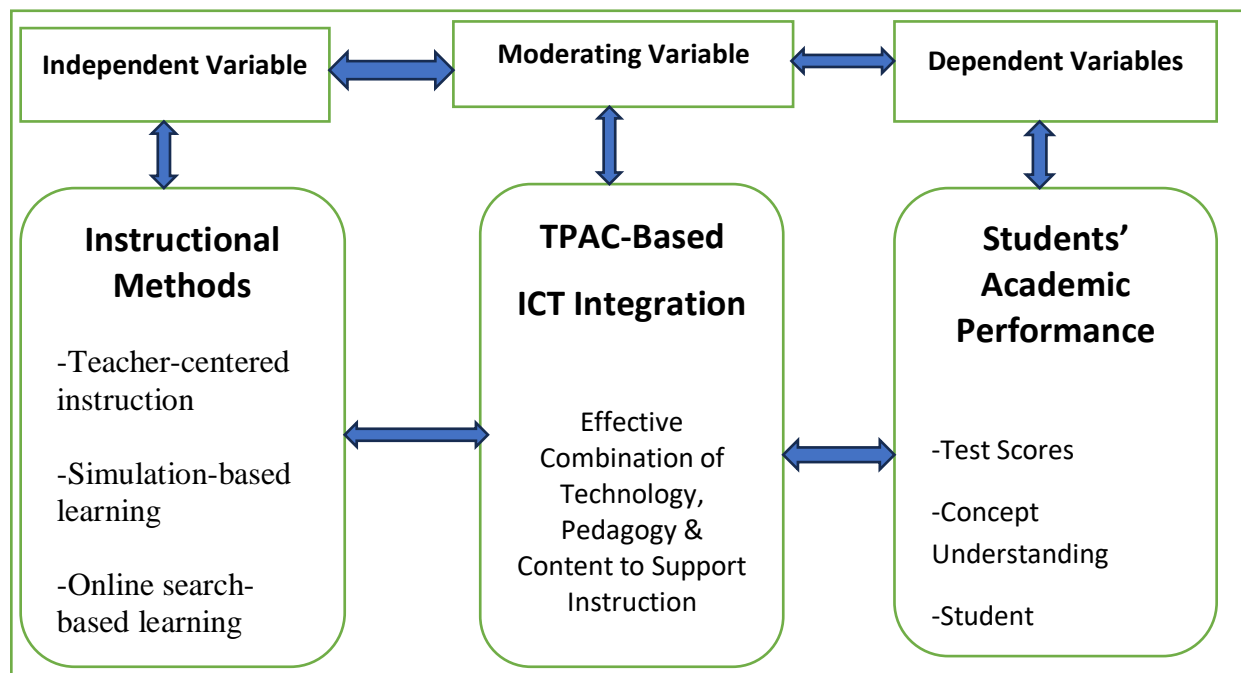
In this study, CK was kept constant across all groups, as each cohort received instruction on identical academic content. This ensured that variations in student outcomes were attributable to instructional delivery rather than subject matter differences. Three pedagogical models were employed: the teacher-centered approach relied on traditional direct instruction with minimal technology; the simulation-based model integrated multimedia tools to support exploratory learning; and the online search-based method fostered student-driven inquiry using digital resources. These varied levels of TK from minimal in traditional classrooms to high in online learning formed the basis for evaluating how technological integration influences student achievement.

TPACK was selected as the theoretical foundation due to its relevance in analysing the complex interconnection between technology, pedagogy, and subject matter particularly in environments with evolving digital landscapes. It provides a robust framework for assessing instructional quality in ICT-supported classrooms by shifting focus from technology as a standalone tool to its meaningful integration into teaching practice. This makes it ideal for examining approaches such as simulation-based and online search-based learning, which inherently demand varying degrees of technological proficiency.

Widely recognized in educational research, TPACK has proven valuable in measuring teacher preparedness, instructional design, and learner outcomes across diverse settings including resource-constrained contexts like Tanzania (Chai, Koh, & Tsai, 2013; Bingimlas, 2009). Its adaptability supports the study's aim to evaluate not only the effectiveness of instructional methods but also the depth of technology integration in enhancing pedagogy. By aligning with the goals of this research, TPACK offers a nuanced and contextually appropriate lens for understanding how digital instructional practices influence student performance in public secondary schools.

**Conceptual Framework of the Study**

Figure 1 presents the conceptual framework for this study. It highlights the relationship between instructional methods, ICT integration guided by TPACK, and student academic performance. The study investigates how teacher-centered, simulation-based, and online search-based impact student academic performance. These methods serve as the independent variable, each with varying degrees of pedagogical orientation and levels of ICT integration. Teacher-centered instruction emphasizes CK and PK with minimal technology use (Mikre, 2011). Simulation-based learning integrates moderate-to-high technological elements to foster experiential engagement (Cant & Cooper, 2009). Online search-based learning promotes autonomy and digital inquiry, requiring advanced TK and PK (Baako & Abroampa, 2023). This framework allows for a comparative analysis of traditional and ICT-integrated instructional approaches, highlighting how ICT integration mediates the effect of instructional methods on student performance.



**Figure 1:** *Conceptual Framework of the Study*

**Source:** *Researcher (2025)*

## **Review of Empirical Literature**

### **Teacher-Centered Instruction VS Simulation-Based Learning**

Globally, simulation-based learning has been shown to enhance students' understanding and engagement, particularly in complex subject areas such as science, mathematics, and healthcare education. Cant and Cooper (2009) demonstrated that learners exposed to simulated clinical scenarios displayed significantly greater confidence and conceptual clarity than those taught through lectures alone. Similarly, Gonzalez and Kauffman (2023) found that simulations promote critical thinking and problem-solving skills by enabling students to engage in realistic, low-risk environments that mirror authentic tasks.

In the Tanzanian context, secondary schools remain largely dependent on teacher-centered instruction, characterized by unidirectional knowledge transmission and limited student interaction. Kiwonde (2024) found that in 18 secondary schools across Magu District, ICT integration was minimal due to inadequate teacher training and infrastructure, reinforcing the persistence of traditional methods. Daudi & Nzilano (2023), in a study conducted at Shaaban Robert Secondary School in Ilala District, revealed that while students possessed basic ICT skills, restrictive school policies and limited access hindered pedagogical innovation.

On the other hand, emerging evidence suggests that simulation-based instruction holds promise in the local context. A study by Acnsci (2024) in Dar es Salaam revealed that students who engaged in multimedia simulations scored significantly higher on assessments of scientific understanding compared to their peers taught using teacher-centered methods. These findings collectively support the argument that simulation-based approaches, when effectively integrated with pedagogical and technological knowledge, outperform traditional instruction in promoting deeper learning and improved academic performance.

### **Academic Performance in Teacher-Centered and Online Search-Based Learning**

Online search-based learning fosters autonomy, critical thinking, and digital literacy by engaging learners in guided inquiry using internet resources. Internationally, Baako and Abroampa (2023) found that Ghanaian students who were trained to navigate digital environments effectively demonstrated stronger problem-solving skills and higher academic achievement. Similarly, Ijeps (2024) reported that Nigerian students exposed to online inquiry-based instruction exhibited improved analytical thinking and content mastery across disciplines.

In Tanzania, however, the adoption of online search-based learning remains limited due to infrastructural and capacity-related challenges. Bingimlas (2009) noted that inadequate digital infrastructure and low levels of teacher ICT competence hinder meaningful technology integration in many developing countries.

Despite these barriers, promising initiatives are emerging. Digest.tz (2023) documented a study in selected urban schools in Ilala District where students engaged in supervised online research tasks. These students outperformed their peers in comprehension-based assessments and demonstrated enhanced synthesis skills, suggesting that even in resource-constrained settings, online search-based learning can yield positive academic outcomes when supported by appropriate scaffolding and teacher facilitation. These findings suggest that online search-based learning, when adequately supported by infrastructure and teacher facilitation, has the potential to surpass the outcomes of traditional instruction in fostering independent and analytical thinking.

### **Impact of ICT-Integrated Instructional Strategies and Traditional Methods**

A growing body of global evidence supports the positive relationship between ICT integration and student achievement. Means *et al.* (2009), in a comprehensive meta-analysis, concluded that students in technology-supported learning environments consistently outperformed those in traditional classrooms across multiple academic indicators. The benefits were particularly evident in blended and simulation-rich instructional settings. Kirkwood and Price (2014) further emphasized that the effectiveness of ICT-enhanced pedagogy depends not merely on the presence of technology, but on its alignment with learner-centered instructional design.

In Tanzania, national policy frameworks such as the National Digital Education Strategy (2024/25–2029/30) advocate for the integration of ICT in education. However, implementation remains uneven. Msafiri *et al.* (2023) and AWS (2024) reported that while some government secondary schools have begun embedding ICT into teaching and learning, disparities persist due to infrastructural gaps and inconsistent teacher training. Nevertheless, where ICT is meaningfully integrated through professional development, curriculum alignment, and active learner engagement student performance has shown measurable improvement. UNESCO (2022) also highlighted that ICT integration aligned with pedagogical goals, particularly through simulation-based and inquiry-driven models, enhances inclusivity, engagement, and academic excellence. These findings affirm that ICT-integrated instructional strategies, especially those grounded in the TPACK framework, offer substantial advantages over passive, lecture-based approaches in improving student learning outcomes

### **Methodology**

The study adopted a quantitative experimental design to evaluate the impact of various ICT-based instructional methods on student academic performance. Conducted in a government secondary school in

Dar es Salaam, the setting allowed for control over curriculum and learning environment variables, enhancing internal validity. Three instructional methods were operationalized to represent varying levels of technology integration in line with the TPACK framework. Teacher-centered instruction involved direct, teacher-led delivery of content with minimal technology use, emphasizing CK and PK (Mikre, 2011). Simulation-based learning employed interactive digital simulations to foster experiential learning, integrating moderate-to-high levels of TK, CK, and PK so as to enhance engagement and application of knowledge (Cant & Cooper, 2010). Online search learning required students to engage with online resources, conduct searches, and complete digital exercises, promoting TK alongside PK and encouraging learner autonomy (Baako & Abroampa, 2023). The instructional method served as the independent variable, academic performance was the dependent variable, and degree of ICT integration was the moderating variable. A stratified random sampling technique was used to select 200 students consisting of 96 males (48%) and 104 females (52%), ensuring each participant underwent a 40-minute pretest, followed by a 40-minute instructional session using one of the four methods, and concluded with a 40-minute post-test. The choice of a 40-minute duration was based on several grounds: national standard lesson length in Tanzanian secondary schools (TIE, 2010); from a psychological perspective, research demonstrates that adolescents' attention span for instructional activities typically ranges between 30 and 45 minutes making 40 minutes suitable for balancing content coverage with sustained engagement (Blakemore, 2018; Sousa, 2016); pedagogically, the 40-minute session allows sufficient time for teachers to introduce new material, engage students in active learning, and conduct formative assessments without reducing lesson variety or breadth of curriculum coverage (Ornstein & Lasley, 2000). Assessment instruments included multiple-choice and matching items aligned with instructional content to measure comprehension, recall, and application. Descriptive statistics were used to summarize performance outcomes, while inferential techniques including one-way ANOVA and independent samples t-tests assessed differences across instructional groups. The methodology ensured robust evaluation of how pedagogical strategies integrated with technology influence learning outcomes, offering insights into effective ICT-supported instruction in Tanzanian secondary education. Table 1 presents the distribution of the 200 students across instructional groups by gender.

**Table 1: Gender Distribution by Instructional Group (N = 200)**

<b>Instructional Group</b>	<b>Male</b>	<b>% Male</b>	<b>Female</b>	<b>% Female</b>	<b>Total</b>	<b>% Total</b>
Lecture / Audio	24	48.00	26	52.00	50	25.00
Handouts	25	50.00	25	50.00	50	25.00
Online Resources	23	46.00	27	54.00	50	25.00
Simulation	24	48.00	26	52.00	50	25.00
<b>Total</b>	<b>96</b>	<b>48.00</b>	<b>104</b>	<b>52.00%</b>	<b>200</b>	<b>100.00</b>

*Source: Researcher (2025)*

## Findings of the Study and Discussion

### Effects of Teacher-Centered Instruction and Simulation-Based Learning on Students' Performance

The comparative analysis between teacher-centered instruction and simulation-based learning revealed that students taught using simulation-based ICT tools achieved significantly higher academic performance. The mean score difference was 24.93 points ( $M = 62.84$  vs.  $M = 37.91$ ), with a large practical effect size (Cohen's  $d \approx 1.58$ ). These findings validate Hypothesis  $H_1$  and indicate that simulation-based environments promote deeper understanding, improved engagement, and enhanced conceptual clarity compared to traditional lecture formats. Globally, interactive simulations are recognized for fostering critical thinking and real-world problem-solving (Cant & Cooper, 2009; Gonzalez & Kauffman, 2023). Locally, while multimedia simulations improve outcomes in Tanzanian secondary schools, the adoption of such methods is often limited by rural school infrastructure gaps, unreliable electricity, and insufficient teacher ICT training (Msambwa, Kangwa, & Cai, 2024; ICT Commission, 2024).

These results suggest that urban schools with access to computers and reliable electricity can implement simulation-based instruction effectively, whereas rural schools may require investments in ICT infrastructure, teacher professional development, and appropriate digital tools. For policymakers, this emphasizes the importance of equitable ICT resource allocation and training programs to ensure that all students, regardless of location, can benefit from ICT-integrated pedagogy.

### Comparing the Effects of Teacher-Centered Instruction and Online Search-Based Learning on Students' Performance

The comparative analysis between teacher-centered instruction and online search-based learning showed that students in the online learning group performed significantly better ( $M = 57.07$ ) than those in the lecture group ( $M = 37.91$ ). A 19.16-point difference, confirmed through an independent samples t-test ( $t(98) = -6.78, p < .001$ ), highlighted the academic benefits of digital inquiry-based methods. The findings support Hypothesis H<sub>2</sub> and suggest that ICT-supported learning environments encourage critical thinking, autonomy, and deeper content engagement.

These results align with prior global and local studies confirming the value of internet-based instruction. While infrastructure and teacher ICT competence remain challenges in Tanzania promising initiatives like supervised online research in Ilala District show strong outcomes and supports the conclusion that digital inquiry boosts problem-solving and comprehension skills (Baako & Abroampa, 2023; Bingimlas, 2009). Overall, the evidence underscores the effectiveness of online search-based learning in enhancing academic performance, particularly when guided by ICT-trained educators and structured content.

### **Evaluating the Impact of ICT-Integrated Instructional Strategies on Students' Performance**

Students exposed to ICT-integrated methods like simulation-based and multimedia-enhanced instruction achieved significantly higher scores ( $M \approx 59.96$ ) than those taught via traditional methods ( $M \approx 36.46$ ). Statistical analysis confirmed a highly significant performance gap, supporting Hypothesis H<sub>3</sub> and highlighting the positive impact of digital tools on understanding, retention, and motivation.

These results reflect both global and local research affirming the value of technology-aligned pedagogy. In Tanzanian secondary schools, ICT-enriched teaching fosters deeper learning when supported by adequate infrastructure and teacher professional development, though rural schools with limited electricity and devices may face challenges. Integrating tools such as animations, videos, and interactive presentations can substantially improve academic outcomes, but equitable access and teacher support are critical for nationwide effectiveness. Despite infrastructure limitations in Tanzania, these findings suggest that even resource-limited schools could benefit from low-cost ICT interventions such as multimedia presentations, offline simulations, or tablet-based learning, provided teachers are trained to integrate technology effectively (Kiwonde, 2024; Ngowi, 2023).

### **Comparing Students' Academic Performance Across Learning Styles**

To evaluate differences in academic performance across all four instructional methods Lecture/Audio, Handouts, Online Search-Based, and ICT-Enriched Simulation, a one-way ANOVA was conducted using students' post-test scores. Descriptive statistics indicated varying levels of performance

**Table 2: One-Way ANOVA Descriptive Statistics**

Group	N	Mean Score	Std. Deviation
Lecture/Audio	50	37.91	14.3
Handouts	50	41.2	15.87
Online Search-Based	50	57.07	14.79
ICT-Enriched Simulation	50	62.84	18.9

**Source: Researcher (2025)**

Table 2 reveals that the overall mean score across all 200 students is 49.76, indicating that traditional methods (Lecture/Audio and Handouts) fall below this average, while ICT-based methods (Online Search and Simulation) exceed it.

**Table 3: One-Way ANOVA Summary**

Source	Sum of Squares	df	Mean Square	F	Sig.
<b>Between Groups</b>	21,914.00	3	7,304.67	28.30	.000**
<b>Within Groups</b>	50,585.72	196	258.08		
<b>Total</b>	<b>72,499.72</b>	<b>199</b>			

**Source: Researcher (2025)**

Table 3 reveals that, there was a statistically significant difference in scores between the groups:  $F(3, 196) = 28.30, p < .001$ . The F-value (28.30) shows that the differences in group means are large relative to variation within each group. The p-value (.000) is highly significant ( $p < .001$ ), indicating that at least one instructional method significantly impacts student academic performance. This confirms the earlier hypothesis and aligns with t-test results showing simulation and online search methods outperform traditional lecture and handouts.

## Conclusions

This study confirms that ICT has the power to revolutionize education, especially when integrated thoughtfully into classroom instruction. Simulation-based learning, as evidenced by Kihzoza *et al.* (2016), emerged as the most effective strategy, with students showing greater engagement, retention, and academic performance. The use of visually stimulating, interactive media such as motion graphics, audio cues, and digital books enhanced learners' understanding far beyond traditional lecture or handout methods. As

learners become increasingly fluent in operating digital devices, these tools align naturally with their preferences and cognitive styles.

However, the journey toward successful ICT integration in Tanzanian secondary schools is complex. Empirical studies such as Mng'ong'ose *et al.* (2020) highlight environmental, cultural, and infrastructural barriers that continue to challenge both educators and policymakers. Bridging the digital divide requires strong leadership from the Ministry of Education, which must prioritize access to technology, expand digital infrastructure, and provide ongoing teacher training in ICT and digital literacy. Implementation of the National Digital Education Strategy (2024/25–2029/30), as outlined by MoEST (2024), will be critical in mainstreaming digital resources, supporting curriculum reform, and guiding research-driven innovation.

The curriculum must advance to incorporate digital competencies including the use of AI-enhanced learning tools and adaptive platforms, as explored in global meta-analyses like Zawacki-Richter *et al.* (2019). Teachers should be empowered through continuous professional development to confidently embed these strategies into their pedagogy. Moreover, schools must adopt inclusive and learner-centered approaches that accommodate diverse learning styles: visual, auditory, reading/writing, and kinaesthetic. Addressing challenges such as high costs, uneven access, and regional disparities will be key to making ICT-enhanced education a reality for all learners.

Thus, this study highlights that ICT-enriched strategies are not merely supplementary but essential. When supported by policy, infrastructure, and training, they hold the key to unlocking equitable, effective, and future-ready education in Tanzania and beyond.

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