The Adoption and Usage of ICT in Teaching and Learning in Tanzanian Secondary Schools: A Systematic Review

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Author's contribution

The sole author designed, analyzed, interpreted and prepared the manuscript.

Systematic Review Article

ABSTRACT

This systematic review aims to enhance understanding of the level and factors affecting the adoption and use of ICT in teaching and learning in Tanzanian secondary schools over a 10-year period from 2015 to 2024. The review involved a comprehensive literature search across various online research databases and institutional library sources for studies published within this timeframe. Extracted data included year of publication, level of ICT adoption and use, geographical scope, factors influencing adoption and use, target population, and type of school ownership. A total of 544 records were identified from different databases and repositories, with 266 screened, 48 full-text articles assessed for eligibility, and 17 articles ultimately meeting the inclusion criteria for analysis. The qualitative analysis of these studies revealed that, overall, the adoption and use of ICT in Tanzanian secondary schools remained low. Key factors affecting effective integration of ICT included insufficient ICT infrastructure (94.1%), limited ICT skills and knowledge among teachers

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(47.1%), inadequate teacher training (29.4%), teacher attitudes, perceptions, and experience (23.5%), and a lack of technical support (23.5%). The review concludes that ICT adoption and usage in Tanzanian secondary schools is at a low level. It is recommended for an increased investment in ICT infrastructure to ensure that public secondary schools, in particular, have access to the necessary technological resources for teaching and learning.

1. INTRODUCTION

The adoption and use of ICT in education have become crucial for enhancing teaching and learning in secondary schools globally [1]. ICT tools like computers and educational software enable teachers to implement modern teaching methods, improving instructional quality and student engagement [2]. ICT promotes independent learning, critical thinking, and problem-solving, key skills for 21st-century education [3]. Additionally, it allows personalized learning, enabling students to progress at their own pace (Kushiator et al., 2020), while also enhancing creativity, reflection, and problem-solving abilities [3]. ICT enriches instructional practices with better content, facilitates communication, and supports a high-quality learning environment for both students and teachers (Mwenisongole & Mulengeki, 2020).

Globally, the integration of Information and Communication Technology (ICT) in education has significantly transformed traditional teaching methods, shifting from conventional teacher-centered approaches to more interactive, learner-centered models [4]. In many countries, particularly in Europe, North America, and parts of Asia, the adoption of ICT has become a key focus of educational reforms aimed at modernizing education systems and preparing students for the demands of a digital economy. In Europe, for instance, the European Commission introduced the Digital Education Action Plan in 2020, which outlines a strategy to enhance digital literacy, promote ICT use, and integrate technology into the school curricula across member states [5]. The plan emphasizes equipping students with digital skills that are essential for future job markets, encouraging innovative teaching practices, and fostering inclusive learning environments [5]. Similarly, in North America, countries like the United States and Canada have implemented policies and programs that prioritize the use of ICT in education. In Asia, countries like South Korea and Singapore have also embraced

ICT as a core component of their education strategies, with comprehensive frameworks that support technology adoption, teacher training, and student engagement with digital tools [6].

In African countries, the adoption and usage of Information and Communication Technology (ICT) in teaching and learning have gained significant momentum as governments aim to improve educational quality and modernize their systems. Countries like South Africa, Ghana, Kenya and Rwanda have introduced various initiatives to integrate ICT into secondary education. For instance, South Africa's e-Education Strategy emphasizes teacher training and equitable access to technology to support teaching and learning [7]. Isaacs, 2007). Ghana's ICT in Education Policy aims to improve educational outcomes through teacher development and student access to digital resources (Nyarko & Kituyi, 2019). In Kenya, Digital Literacy Programme focuses on providing ICT infrastructure such as laptops and tablets to enhance digital literacy (Wanzala, 2017). In Rwanda, One Laptop per Child initiative seeks to improve digital literacy and educational access (Twizeyimana & Andersson, 2019).

Regardless of these positive initiatives, many African countries face challenges in fully implementing ICT in secondary schools. Issues such as inadequate infrastructure, limited internet connectivity, high costs of ICT equipment, and insufficient teacher training hinder widespread adoption. In Tanzania, these challenges are also evident, though the government has recognized the importance of ICT in education and has introduced policies to support its integration. The National ICT Policy of 2016 emphasizes the role of technology in education and highlights the need for teacher training, digital content development, and infrastructure improvements (URT, 2016). However, like in other African countries, the implementation of these policies has been slow due to financial and infrastructural limitations.

Despite the growing recognition of the importance of Information and Communication Technology (ICT) in transforming educational practices, there remains a significant lack of comprehensive reviews of empirical studies that evaluate both the level of ICT adoption and the factors influencing its usage in secondary schools on a national scale. Most research on this topic has been conducted at localized district, regional, or zonal levels, resulting in a gap in national coverage. Consequently, the extent to which ICT has been successfully integrated into teaching and learning processes, along with the specific barriers and enablers influencing its adoption and use within the national context, remains largely unclear. This knowledge gap impedes policymakers, educators, and stakeholders from making informed decisions about improving ICT infrastructure, training initiatives, and teaching strategies in schools. Moreover, lacking a comprehensive understanding of the current status of ICT adoption and usage, efforts to enhance educational outcomes and equip students with essential digital skills may be inadequate or misaligned with the actual needs of the education system. Therefore, this paper aims to critically examine the level and factors influencing the adoption and use of ICT in teaching and learning in Tanzanian secondary schools over an extended period of 10 years from 2015 – 2024.

This paper is important and timely as it addresses the notable gap in the literature regarding the adoption and usage of ICT in Tanzanian secondary schools. Through systematically reviewing empirical studies from 2015 to 2024, it offers a comprehensive analysis of the level and factors influencing ICT integration in secondary education at a wide geographical coverage in Tanzania. The findings of this paper are essential for informing policy and decision makers, educators, and stakeholders, enabling them to make evidence-based decisions on improving ICT use in teaching and learning in Tanzanian secondary schools. Additionally, this review support targeted interventions to enhance educational outcomes and promote equity in access to digital learning tools across different regions of Tanzania.

2. LITERATURE REVIEW

This paper was grounded in three key theories: the Unified Theory of Acceptance and Use of Technology (UTAUT), Institutional Theory, and the Resource-Based View (RBV) Theory. UTAUT [8] builds on the Technology Acceptance Model (TAM), emphasizing factors such as performance expectancy, effort expectancy, social influence, and facilitating conditions, which play crucial roles in technology adoption and usage. This theory is valuable for analyzing how social dynamics and support systems influence the adoption and use of ICT in secondary schools. Further, Institutional Theory [9] suggests that organizational and external pressures, such as government regulations and cultural norms, shape the adoption of innovations. In the context of this review, it helps explain how policies, leadership, and institutional backing affect ICT adoption and usage in the Tanzanian secondary schools. In addition, the Resource-Based View (RBV) Theory [10] highlights the importance of internal resources, such as skills, infrastructure, and human and financial resources, for the successful implementation of new technologies. This perspective is essential for understanding the impact of resource availability on ICT adoption in schools. These theories provide a comprehensive understanding of the factors influencing ICT adoption and use in secondary schools by addressing various dimensions of technology integration.

The empirical evidence indicates that the level of ICT adoption and its usage in secondary schools globally varies widely, influenced by factors such as government policies, infrastructure, teacher training, and socio-economic conditions [1]. While some regions have made significant progress in integrating ICT into the education system, others are still facing substantial challenges (Mangesi, 2010). In developed countries, the adoption and usage of ICT in secondary schools are generally high due to well-established infrastructure, government support, and teacher professional development programs [11]. Countries in Europe, North America, and parts of Asia have been pioneers in ICT integration in education [5]. For instance, by 2020, over 85% of secondary schools in EU countries reported using ICT tools regularly in classrooms [11]. In the United States, ICT adoption in secondary schools has been robust due to national policies like the National Education Technology Plan [12]. This plan emphasizes personalized learning and the use of technology to enhance student engagement and improve learning outcomes [12].

In contrast, the adoption of ICT in secondary schools in developing countries has been uneven, with many regions struggling to achieve

widespread integration [13]. In Latin America, countries such as Chile and Uruguay have made strides in incorporating ICT into their education systems; however, many rural schools still lack access to reliable internet and technological devices [14,15]. Several key barriers impede the full-scale adoption of ICT in secondary schools globally. One of the most significant challenges is infrastructure, particularly in developing countries, where schools struggle with access to reliable electricity and high-speed internet [16,17]. In many rural areas, the lack of necessary technological resources creates significant obstacles for effective ICT implementation [18]. Furthermore, inadequate technological support and maintenance contribute to the underutilization of existing ICT tools in classrooms [19,20]. Another critical barrier is the limited availability of trained teachers who are proficient in using ICT for educational purposes [11,21]. Additionally, socio-economic factors play a crucial role in ICT adoption. Students from low-income backgrounds often face challenges in accessing the technology required for effective learning, which perpetuates inequalities in education (Mwenisongole & Mulengeki, 2020; [22].

3. MATERIALS AND METHODS

3.1 Literature Search, Inclusion and Exclusion Criteria

A comprehensive and systematic search was conducted across multiple online research databases and institutional library sources. The online database search included platforms such as Google Scholar, PubMed, Scopus, Web of Science, Education Resources Information Center (ERIC), Journal Storage (JSTOR), Institute of Electrical and Electronics Engineers (IEEE) Xplore, ProQuest, and ScienceDirect. Additionally, institutional library searches encompassed digital libraries and repositories, journal databases, e-book collections, specialized subject databases, reference management tools, government and policy archives, and conference proceedings archives. Specific keywords were utilized during the search to ensure a focused and relevant selection of literature. These keywords included terms like "factors for adoption of ICT," "factors for usage of ICT," "adoption of ICT," "usage of ICT," "utilization of ICT," "ICT use in Tanzanian secondary schools," "ICT integration in secondary schools," "technology integration in secondary education," "barriers to ICT adoption," "educational

technology in Tanzania," and "digital literacy in secondary education." To ensure the relevance and quality of the review, inclusion and exclusion criteria were clearly defined. The inclusion criteria specified that only articles published between 2015 and 2024, focusing on factors influencing the adoption and usage of ICT in Tanzanian secondary schools, were considered. Additional inclusion criteria included studies that were peer-reviewed, presented empirical data, and involved original research. Furthermore, the review was limited to studies conducted in Tanzania Mainland, as the management of secondary education is a non-union matter between Tanzania Mainland and Zanzibar. The exclusion criteria eliminated articles older than 10 years from the year of publication and those lacking clear or complete data. Additional exclusion criteria included studies that did not focus on secondary schools, those that were not published in English, and articles that primarily discussed ICT adoption and usage in contexts outside of Tanzania. Also, theoretical papers without empirical data, opinion pieces, and articles that were duplicates were excluded. The PRISMA Flow Diagram illustrating the number of records identified, titles and abstracts screened, full-text articles assessed for eligibility, and studies included in the analysis is shown in Fig. 1.

3.2 Data Handling, Management, and Analysis

The extracted information from the studies includes year of publication, level of adoption and use of ICT, geographical scope, factors influencing adoption and usage of ICT, target population (teachers versus students), and type of school ownership. The information was entered into a Microsoft Excel sheet and thoroughly cleaned to ensure the absence of missing data and consistency before analysis. Both quantitative and qualitative analyses were performed in this review. Descriptive statistics were used to analyze the quantitative data, while thematic analysis was employed for the qualitative data.

4. RESULTS AND DISCUSSION

4.1 Literature Search Summary

A total number of 544 records were searched and identified from various databases and repositories, 266 were screened, 48 full-text articles were assessed for eligibility, where 17 articles met the inclusion criteria and included in the analysis for this review. Table 1 presents

results including the year of publication of the included studies, level of adoption and use of ICT, geographical scope, factors influencing adoption and usage of ICT, target population (teachers versus students), and type of school ownership.

4.2 Studies by Year of Publication

This systematic review included studies published between 2015 and 2024, offering a comprehensive analysis of the level and factors influencing ICT integration in secondary education across various geographical regions in Tanzania. According to the distribution of studies by year of publication, the majority of studies included in this review were published in 2016, accounting for 23.5% of the included studies. This was followed by 2019, which contributed 17.6% of the publications. Other notable years included 2015, 2018 and 2021, each representing 11.8% of the total studies included in this review. The overall distribution of studies, based on the year of publication is presented in Fig. 2.
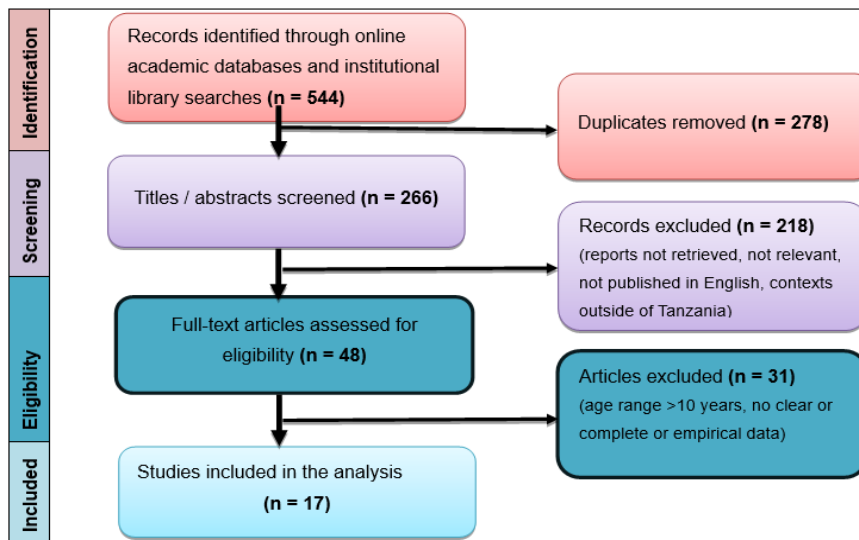

Fig. 1. PRISMA Flow Diagram: identification, review and selection of articles included in the systematic review
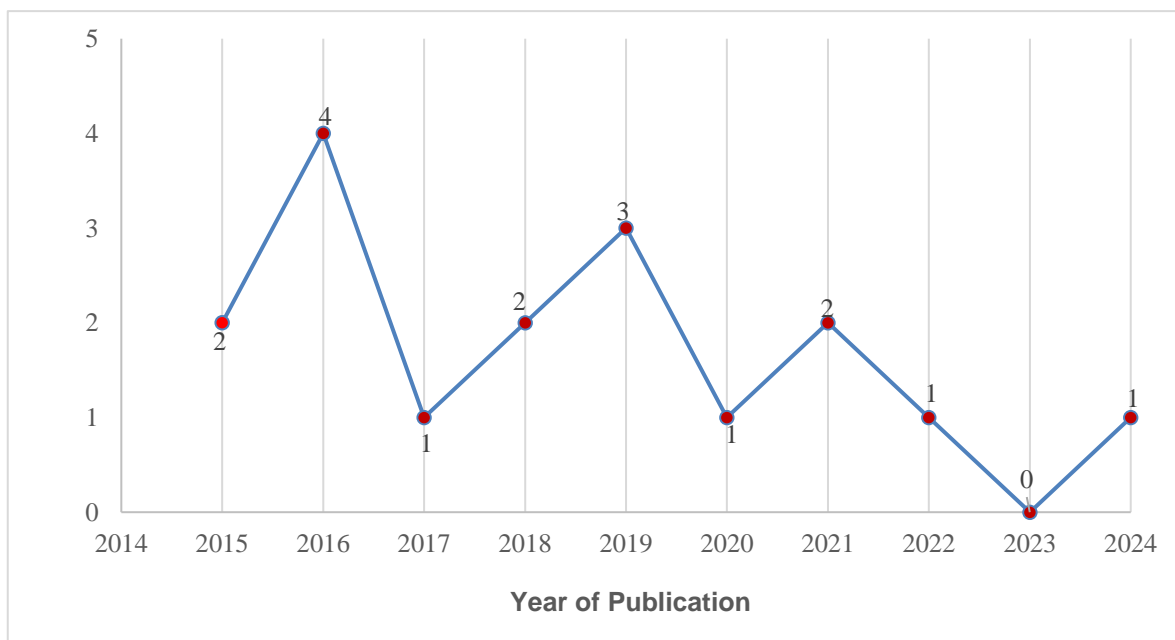*Sources: Page et al. [23]*

Fig. 2. The study sample by year of publication

Table 1. The adoption and usage of ICT in secondary schools in Tanzania

S/N	Level of Use of ICT	Geographical scope	Factors influencing adoption and usage of ICT	Target population	Type of school ownership	Sources
1.	-	Dodoma Municipal	Limited ICT infrastructures and limited ICT skills among teachers	Teachers	Public & Private	Malero et al. [24]
2.	-	Dodoma Municipal	Readiness to adopt new methods of teaching and learning ICT, and use of ICT tools in delivering contents	Teachers	Public & Private	Mazoya et al. [25]
3.	Low	Dodoma Municipal	Inadequate ICT facilities in schools, and low capacity for using ICT by both teachers and students	Teachers	Public	Crallet et al. [26]
4.	Low	Pwani	Inadequate ICT facilities, low knowledge of using ICT facilities in teaching, and learning among teachers	Teachers	Public	Kazoka & William [27]
5.	Low	Morogoro	External limitations (e.g. accessibility to hardware and software), and internal limitations (e.g. personal attitudes, skills and perceptions about a technology).	Teachers	Public	Kihoza [28]
6.	-	Ilala, Dar es Salaam	Teachers' attitude, teacher competence in ICT use, accessibility of ICT facilities, professional development, and availability of technical support	Teachers	Public	Mafang'ha [29]
7.	Low	All educational zones[1]	Limited ICT infrastructure, low ICT skills and knowledge among teachers	Teachers	Public	Ngeze [30]
8.	Low	Hanang, Manyara	Inadequate ICT facilities, inadequate computer labs in schools, and inadequate pre-service, and in-service teachers training	Teachers	Public	Kweka & Ndibalema [31]
9.	Low	Morogoro Municipal	Inadequate ICTs facilities, no in-service training on using ICTs in teaching and learning, lack of standby power, and lack of a policy and training schedule	Teachers and students	Public	Malekani [32]
10.	Low	Ilala, Dar es Salaam	Owning personal ICT tools at school, and usage of computers in teaching other (non-computer) subjects	Students	Public	Daudi & Nzilano [33]

S/N	Level of Use of ICT	Geographical scope	Factors influencing adoption and usage of ICT	Target population	Type of school ownership	Sources
11.	-	Kaliua, Tabora	Teacher's past experience on the use of ICT, the presence of technologies such as internet and smartphones, and expected benefits of using ICTs	Teachers	Public & Private	Pima [34]
12.	Low	Kibaha, Pwani	Inadequate ICT Infrastructures, unsustainable ICT training and lack of institutional support to teachers	Teachers	Public & Private	Banele, [35]
13.	Low	Morogoro Municipal	Inadequate resources, inadequate ICT knowledge and skills among teachers, poor management support, and lack of motivation	Teachers	Public & Private	Simbeye [36]
14.	Low	Mikindani, Mtwara	Inadequate ICT infrastructure, lack of ICT skills and knowledge among teachers, lack of technical support, and lack of teachers' training	Teachers	Public & Private	Joseph [37]
15.	Low	19 regions of Tanzania Mainland	Inadequate ICT infrastructure (such as insufficient number of computers/lap tops, Internet bandwidth), limited ICT knowledge and skills to teachers in learning and teaching	Teachers and students	Public	Ndume et al. [38]
16.	-	Iringa	Physiological factors, professional development, behavioural intentions, and demographic factors	Teachers	Public & Private	Wanjiru et al. [39]
17.	-	Ilala, Dar es Salaam	Capacity building for teachers, building and equipping computer labs with ICT facilities, maintaining and repairing defective computers, and deploying educational technology experts	Teachers	Public	Ngodu et al. [40]

[1]*include Dar es Salaam, Shinyanga, Dodoma, Kilimanjaro, Lindi, Arusha, Mtwara, Iringa, Kagera, Singida, Tanga, and Njombe*

4.3 The Level of Adoption and Usage of ICT in Tanzanian Secondary Schools

The qualitative analysis of all 11 studies in this review which assessed the level of adoption and usage of ICT in Tanzanian secondary schools indicated that, in general, there was low adoption and usage of ICT (Fig. 3). This qualitative consensus highlights the consistent challenges faced by secondary schools in integrating ICT into teaching and learning processes.

The geographical scope of the included studies reveals a comprehensive and diverse representation across various regions and educational zones in Tanzania. Specifically, the reviewed studies covered regions such as Dodoma, Pwani, Morogoro, Manyara, Tabora, Mtwara, Dar es Salaam, Shinyanga, Kilimanjaro, Lindi, Arusha, Iringa, Kagera, Singida, Tanga, and Njombe. By integrating central and peripheral areas, these studies captured a blend of urban and rural contexts, reflecting diverse socio-economic and infrastructural conditions. This broad geographical coverage ensured a comprehensive understanding of level of ICT adoption and usage in secondary schools across Tanzania, providing a national perspective.

Moreover, the studies encompassed both private and public secondary schools, highlighting the different institutional settings. The inclusion of both sectors (private and public) ensured a more thorough review of ICT adoption and usage, as private and public schools often vary significantly in terms of resources, infrastructure, and their ability to implement ICT initiatives. By exploring these differences across diverse educational settings, the studies offered valuable insights into how different types of schools address the challenges of integrating ICT into teaching and learning.

The extensive geographical and institutional coverage of these studies enhances the relevance and applicability of their findings, making them highly valuable for informing national policies and interventions aimed at improving ICT integration in schools across Tanzania. This broad representation increases the generalizability of the findings, ensuring they address the diverse ICT needs of both private and public secondary schools in the country. Previous research has shown that there is a notable variation in the level of adoption and use of ICT in secondary schools which is attributed to location and type of ownership of the schools.

Research have consistently indicated that urban schools generally exhibit a higher level of ICT adoption compared to their rural counterparts. This discrepancy is often attributed to several factors, including better infrastructure, access to resources, and more extensive training opportunities for teachers [41]. Similarly, privately owned schools tend to adopt ICT more readily than public schools, partly due to better funding and resources, which enable them to invest more in technology and training for teachers [24]. In addition, the ownership structure of schools plays a significant role in determining the level of ICT integration. This reflects the influence of financial resources and administrative support in promoting technology in education [24].

4.4 Factors Influencing Adoption and Usage of ICT in Secondary Schools

Analysis of the factors influencing the adoption and usage of ICT in secondary schools reveals that inadequate ICT facilities (94.1%), limited ICT skills and knowledge among teachers (47.1%), inadequate teacher training (29.4%), teacher's attitudes, perceptions and experience (23.5%) and lack of technical support (23.5%) are among the most significant challenges hindering effective integration. Various factors (both enablers and barriers) for adoption and usage of ICT in secondary schools are displayed in Fig. 4.

The identified factors influencing the adoption and usage of ICT in secondary schools have various implications. The major concern regarding inadequate ICT facilities emphasizes the need for substantial investment in technological infrastructure. Schools must prioritize the acquisition of reliable internet access, computers, and essential software to create a conducive learning environment that supports effective teaching and learning. Also, the significant challenges in ICT skills and knowledge among teachers highlight the necessity for comprehensive professional development programs. Educational institutions should focus on providing ongoing training and support to educators, ensuring they are equipped with the necessary competencies to utilize ICT tools effectively in their teaching practices. This investment in teacher development can lead to more innovative instructional methods and improved student engagement [42-45].

Moreover, the recognition of insufficient pre-service and in-service training programs for

teachers indicates a critical area for reform. Educational bodies must develop structured curricula that incorporate ICT integration strategies, enabling teachers to gain confidence and proficiency in using technology from the outset of their careers. By addressing this gap, schools can enhance teachers' readiness to embrace ICT in their classrooms. The lack of adequate technical support identified as a barrier to ICT adoption further underscores the need for schools to establish robust assistance systems. Providing accessible technical help for teachers and students will enable them to troubleshoot and maintain ICT resources effectively, fostering a supportive environment for technology use [46-48].
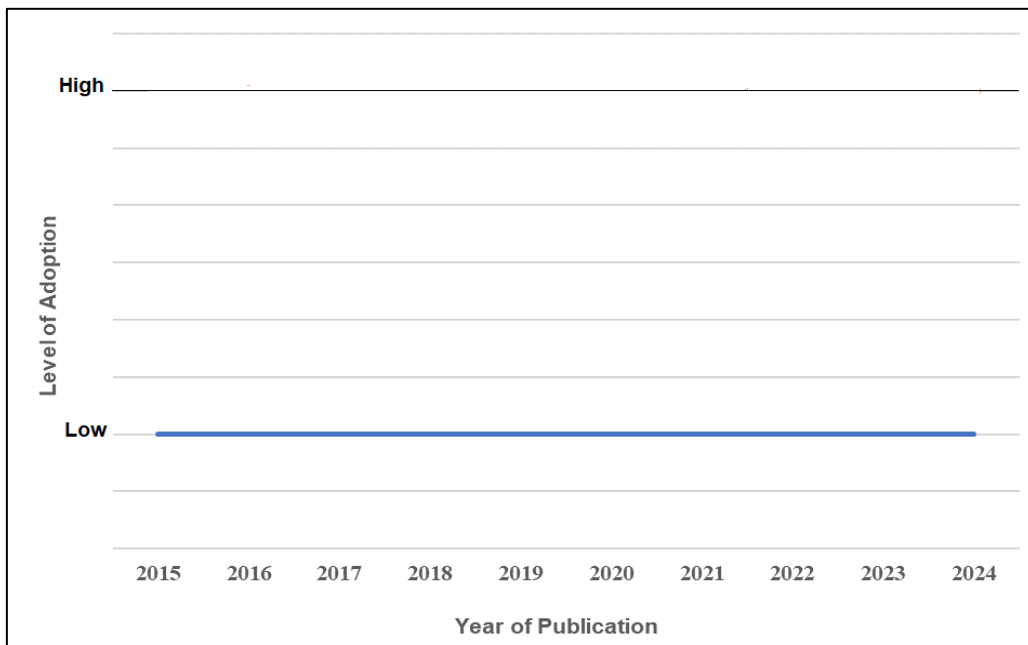

Fig. 3. The Level of Adoption and Usage of ICT in Tanzanian Secondary Schools
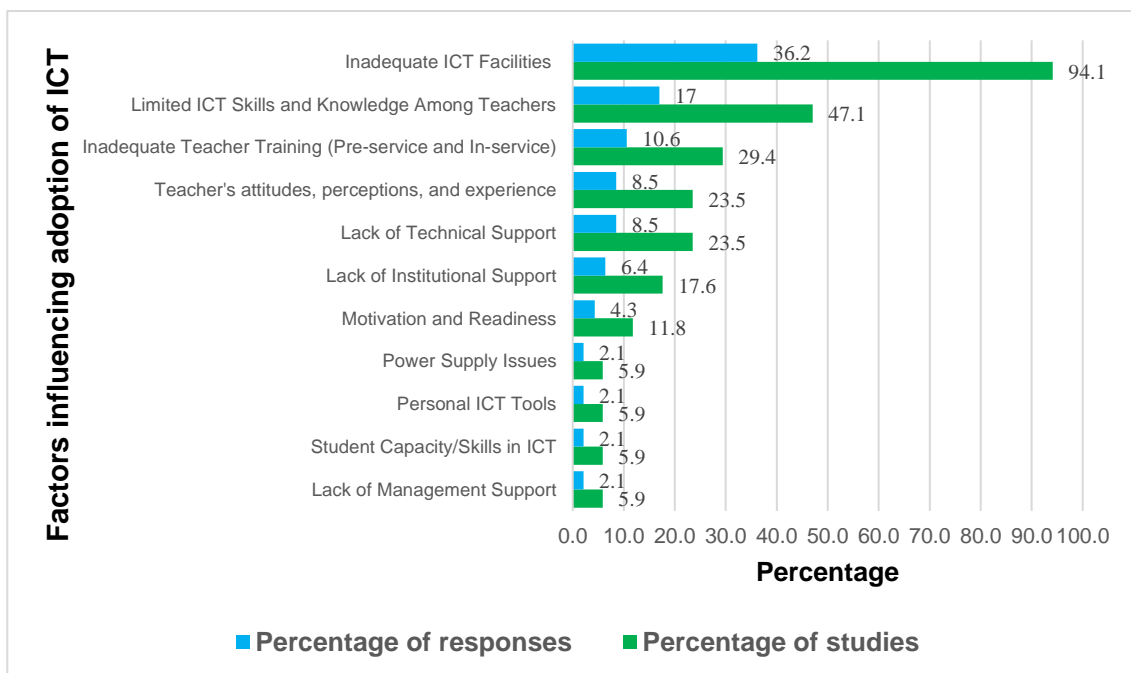

Fig. 4. Factors influencing adoption and usage of ICT in secondary schools

Additionally, cultivating positive attitudes towards technology among teachers is essential. Schools should implement initiatives that encourage enthusiasm and a willingness to engage with ICT, as positive perceptions can significantly impact adoption rates. Furthermore, Additionally, the importance of institutional support cannot be underestimated. Strong leadership from school management is vital for creating policies that prioritize the use of technology in education. Such support will empower teachers and students to embrace ICT and integrate it into their learning experiences [49,50].

Lastly, addressing the skills and capacities of students is crucial for successful ICT integration. Schools must ensure that student training on ICT usage is aligned with the technological tools available in their learning environments. This dual focus on teacher and student competency development will prepare all stakeholders for a technology-driven educational landscape. In general, addressing these implications through strategic planning and resource allocation will enhance the overall integration of ICT in secondary schools, leading to improved educational outcomes for both teachers and students [51].

Previous research has shown that effective integration of Information and Communication Technology (ICT) in secondary schools is influenced by various interconnected factors, including infrastructure availability, teacher training, and institutional support [52]. Research indicates that schools equipped with robust technological resources are more likely to effectively adopt and utilize ICT in their teaching practices. For instance, Sullivan et al. [53] emphasize that professional development programs designed to enhance faculty proficiency in technology use foster a supportive learning environment, which positively impacts student learning outcomes. Furthermore, studies by Wang, Ertmer, and Newby [54] highlight that hands-on training significantly boosts preservice teachers' self-efficacy in technology integration, ultimately encouraging them to incorporate ICT in their classrooms.

Despite the potential benefits, barriers such as limited ICT skills among teachers and inadequate facilities often hinder successful integration. Dursun and Tugtekin [55] found that when teachers lack confidence and skills, their willingness to adopt new technologies diminishes. Additionally, Skaalvik and Skaalvik [56] point out that self-efficacy plays a crucial role in mitigating job-related stress, allowing teachers to embrace innovative teaching methodologies. To enhance ICT adoption, schools must prioritize comprehensive professional development programs that build technical skills and foster positive attitudes toward technology. By addressing infrastructure and training needs, educational institutions can create a conducive environment for integrating technology, thereby enriching the educational experience for both teachers and students [57,58].

While this review provides valuable insights into the factors influencing the adoption and usage of ICT in secondary schools, it is essential to acknowledge its limitations. Firstly, the review was primarily based on the accessible studies, which may not encompass all relevant studies on the topic. The landscape of educational technology is rapidly evolving, and as such, some recent developments or emerging trends may not be adequately represented. Furthermore, the reviewed studies were conducted at different times, adopting various research methodologies that may limit the comparability of their findings. Lastly, while the reviewed studies provide a foundation for understanding the adoption and use of ICT in teaching and learning, the selection bias inherent in the systematic reviews must be carefully considered.

5. CONCLUSION

This review concludes that the adoption and use of ICT in secondary schools in Tanzania is at a low level. Key factors affecting the adoption and utilization of ICT in these schools include inadequate ICT infrastructure, limited skills and knowledge among teachers, insufficient teacher training, teachers' attitudes, perceptions, and experiences, as well as a lack of technical support for teachers and students in the schools.

6. RECOMMENDATIONS

This paper recommends that there is a need for investment in ICT infrastructure to ensure that, public secondary schools in particular, have access to the necessary technological resources for teaching and learning. Policymakers should prioritize funding for the development and maintenance of ICT facilities, including computers, reliable internet access, and other essential tools. Additionally, targeted professional development programs for teachers should be implemented to improve their ICT skills and confidence in using technology effectively in the classroom particularly for the public secondary schools. These programs should be continuous

and include hands-on training to ensure teachers can integrate ICT into their teaching practices meaningfully.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of this manuscript.

COMPETING INTERESTS

Author has declared that no competing interests exist.

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