Research Article

Digital Skills and Learning in Tanzania Secondary Schools: Students and Teachers' Influence

Malima Patrobas[1], Haruni J. Machumu[2], Ntimi Mtawa[3]

1. Independent researcher; 2. Mzumbe University (Chuo Kikuu Mzumbe), Tanzania, United Republic of; 3. University of the Free State, South Africa

This study investigated the use of digital skills in enhancing learning among teachers and students in Tanzanian secondary schools. The study used a sequential exploratory design to collect data through semi-structured interview and questionnaire techniques. Eighty-five participants, including school leaders, students, and teachers, informed the study. Quantitative data were subjected to descriptive statistics and presented using graphs, percentages, and frequency tables, while thematic analysis informed qualitative data and was presented in excerpts. The study revealed that teachers' and students' digital skills, such as basic computer skills, internet skills, technical skills, and collaborative skills, influence the teaching and learning process in secondary schools. Further, the study reveals that digital infrastructure, availability of the internet, professional development, electricity, technical support, readiness, awareness, overcrowded classrooms, and socio-economic conditions are factors central to enabling and/or impeding the effective use of digital skills in secondary schools. Based on the findings, the study concludes that teachers and students possess and use basic digital skills for teaching and learning. However, the study calls for education stakeholders to continue to put in place enabling digital learning environments that strengthen the integration and use of technology for teaching and learning in secondary schools. As such, the study offers some theoretical and practical insights for all education stakeholders on effective and sustainable ways of integrating digital technologies into pedagogical arrangements and broader education endeavours.

Correspondence: papers@team.qeios.com — Qeios will forward to the authors

 doi.org/10.32388/QJU9PS.2

Introduction

The digital world is constantly changing, and technology is permeating every aspect of our lives, including the education sector[1]. Professionals who can work comfortably in digital working environments are in high demand. Studies indicate that the workforce that can navigate the fast-paced working environment is digitally informed. The term digital skills refers to the ability to find, evaluate, use, share, and create content using digital devices, such as computers and smartphones[2][3]. Educational institutions such as schools play an essential role in developing learners' digital skills. Digital skills enable people to live and work well in an era of rapid technological change. The importance of digital skills has been recognised, often as a new literacy alongside reading, writing, and Mathematics[4]. Having adequate digital skills provides a great opportunity for teachers and students to use digital technology[5]. However, the changing nature of students and the increasing presence of technology and digital resources pose challenges for schools striving to adapt and embrace digital learning and teaching environments. This, as described by Clement[6], demands enhancing access and resources, teacher training, capacity building, infrastructure, and delivery methods in order to harness the value of technology in the education context. Several countries in the world have embarked on formulating strategies to cultivate digital skills for learners and the community.

In Europe, the European Training Foundation (ETF) contributes to the European Union (EU) and international dialogue on the effective integration of digital technologies in education and training, as well as the development of digital skills and competence standards that are increasingly important for the future[1]. The European Framework for the Digital Competence of Educators, which is directed at all education levels, provides a general reference frame to support the development of educator-specific digital competencies in Europe[7]. Students in secondary schools are regarded as 'digital natives,' capable of freely navigating the internet and possessing all necessary digital skills. Yet, studies show that young people, 95% of whom access the internet on a daily basis, do not possess the skills required for the safe and effective use of digital technologies[8]. In terms of the link between digital skills, the job market, and job efficiency, there is growing evidence to support that the lack of digital skills among graduates contributes to many having limited opportunities to be absorbed by the labour market. Besides that, several studies indicate that 75% of low-skill jobs, 85% of middle-skill jobs, and 83% of high-skill jobs need digital skills[9].

In many African countries, the integration of technology and the use of digital skills in learning are hindered by many factors. For example, Sife[10], Kira, and Mahumbwe[11] listed factors such as poor telecommunications infrastructure, difficulties in accessing relevant digital materials, insufficient power supply, and limited computer skills. Others include high costs of digital equipment such as computers, inadequate mastery of the English language, lack of connectivity, competition, and low income, among many other factors. Regardless of the shortcomings, African countries have taken significant steps towards the use of digital skills. For example, in Namibia, several internet providers have mushroomed, allowing schools to have access to internet connectivity, stimulating learners' interest, and promoting the development of digital skills[12]. Through the Developmental Vision of 2030, the Kenyan government is implementing a policy to improve the education of all Kenyans. This policy includes the provision of one laptop per child in standard one[13]. In fact, there is general agreement that technology is increasingly becoming a driver of education provision.

The policy aims to ensure that all children in standard one get access to laptops regardless of where they are in the country, whether urban, semi-urban, or rural. In this context, we echo the idea that using this digital equipment enhances learners' learning skills and makes them become active in transforming the global digital age[14]. In Tanzania, the government formed the Universal Communication Services Access Fund (UCSAF) under the Ministry of Information, Communication and Technology (MICIT) to ensure reliable communication in underserved rural and urban areas. In addition, the government has constructed the National Fibre Optic Network to facilitate communication and lower airtime costs across the country[15]. The government has also partnered with the World Bank to implement the Secondary School Quality Improvement Program (SEQUIP). The project will introduce digital technology to enable Mathematics and Science teachers to improve digital skills. In the financial year 2021/2022, a total of 245 community secondary schools are expected to be constructed. These schools are expected to be furnished with technological infrastructure to enable learners to acquire digital skills[16].

Although Internet connectivity in most semi-urban and rural parts of Africa, and Tanzania in particular, is limited, digital skills opportunities are expanding rapidly across the continent. For instance, non-voice applications such as text messaging are now widely used. Studies in most developing countries show technology infrastructure shortfalls and inadequate digital technology devices as major obstacles to integrating technology and the use of digital skills by teachers and students. In addition, the lack of qualified teachers with the right digital skills is a major obstacle in many African countries. This problem is worsened by elements of extreme poverty, enduring inequality, and a lack of funding for education[17].

While there are many studies on digital technologies in education, research on the use of digital skills and their application in secondary schools in developing countries such as Tanzania remains limited.

Literature Review

An Overview of Digital Skills

The ability to find, evaluate, use, share, and create content by using digital devices such as computers and smartphones entails "digital skills." These abilities are required to "access and manage information by means of digital devices, communication applications, and networks," ranging from basic online searching and emailing to specialized programming and development[3]. This is because we live in a digital world, where learning resources such as books are stored as e-books on the internet. To ensure effective communication, our students and teachers must adapt to changing skill demands. These skills enable people to communicate and collaborate, create and share digital content, and solve problems at work from anywhere across the world. Some studies argue that digital skills can be divided into two categories: entry-level digital skills and advanced digital skills[18]. On the one hand, entry-level digital skills include computer literacy, data entry, social media, web-based communications and research, word processing, email and chat, and secure information processing. On the other hand, advanced digital skills include programming, web and app development; digital content creation, digital design, data visualization; data science; and user experience design.

Digital Skills Influencing Teaching and Learning

For teachers, basic digital skills lay the foundation for their professional development, which assists them in teaching using digital tools. For students, these skills are important as they assist them in enhancing learning experiences. This is to say, as a precondition, teachers need to have basic digital skills at their disposal to apply digital technology in the classroom and nurture their students' basic digital skills[19]. Basic digital skills have been integrated and found their way into school curricula for students and teacher training programmes in some parts of the world. Teachers who are confident in their personal use of technology are more capable of integrating technology and using digital skills in their teaching compared to those who are less competent[20]. Boholano[21] concluded that when teachers have enough skills, the educational systems must have the necessary prerequisites of ICT resources, hardware, and software; and that curricula must be designed to promote a collaborative learner-centred environment to which students will relate and respond. Moreover, Astuti et al.[22] conducted a study on the competency of digital

technology and the maturity levels of teachers and students in vocational education in Indonesia. In this study, the results show that the maturity level of digital technology for teachers and students is sequential, starting from caring, literacy, capability, creativity, and critical use of digital technology. Various training and learning innovations relevant to digital technology mastery competencies must be improved significantly in contexts such as Tanzania.

Factors Relating to the Use of Digital Skills among Teachers

Having access to digital tools such as computers, laptops, telephones, printers, calculators, and video cameras is not enough for the effective use of digital skills. However, the use of such devices for pedagogical purposes depends on factors such as the availability of infrastructure that supports digital technologies, individual teachers' interests and attitudes, school policy, knowledge and skills, and access to the Internet. In some countries, schools with access to digital technologies have made it mandatory for teachers to make use of them for teaching purposes. Kihoza et al.[23] outlined challenges associated with infrastructure shortfall, readiness to change, and lack of competencies in applying ICTs in pedagogical arrangements.

Similarly, Mathayo[24] revealed that unlimited access to ICT resources and facilities, lack of technical support, inadequate ICT infrastructure, and lack of professional development were key barriers hindering teachers from using ICT to facilitate teaching in secondary schools. Factors determining the use of ICT in teaching in secondary schools were teachers' positive attitudes, teachers' competence in ICT use, accessibility of ICT facilities, professional development, and availability of technical support. In the same vein, factors related to the use of digital skills were exposed by Mtebe and Raphael[25] in their study on 'key factors in learners' satisfaction with the e-learning system at the University of Dar es Salaam, Tanzania'. The study found that system quality, instructor quality, and service quality positively affect students' satisfaction with the utilisation of digital technologies for learning purposes.

Theoretical Framing

Connectivism

Connectivism is a theory of learning introduced by George Siemens and Stephen Downes in 2005. It was proposed as a learning theory for the digital age, a successor to behaviourism, cognitivism, and constructivism. The theory describes that technology is a foremost part of the learning process and that

constant connectedness provides teachers and students opportunities to make selections about learning. This conceptual framing views learning as a network phenomenon influenced by technology and socialization. It also argues for technology to be central to group collaboration and discussion, allowing space for different viewpoints and perspectives regarding decision-making, problem-solving, and making sense of information[26]. Connectivism theory relies heavily on technology, so an important process is to create a connected classroom and introduce more opportunities for digital skills such as online courses, webinars, social networks, and blogs[27]. This implies that connectivism has the potential to stimulate individual and group learning through social media, online networks, blogs, or information databases. Within connectivism, learning occurs when peers are connected and share opinions, viewpoints, and ideas through a collaborative process. The theory has been built upon a major assumption that learning and knowledge rest in the diversity of opinions and that learning is a process of connecting and resides in non-human appliances. It posits that learning is more critical than knowing and that nurturing and maintaining connections are needed for continued learning[28].

Today, people rely on technology to seek answers and find information by simply asking their smartphones or typing questions into search engines and digital platforms. It is notable that technology is changing how students learn and experience learning in and out of the classroom. Rather than learning from teachers and textbooks, digital tools serve as important sources of information for today's students. One of the ways teachers apply and implement connectivism is through the use of classroom social media. For instance, a class WhatsApp account can be used to share information, engage in discussion, or announce learning tasks. This enables students' class engagement remotely and opens up opportunities for discussions between and among students, content, technologies, and teachers[29][30].

Connectivism theory is used in this study because it focuses on using digital skills to influence learning among teachers and students, and between students and content through the use of available digital technology. In addition, most of the digital technologies used in teaching and learning are within the connective frameworks as they connect people and open up possibilities for knowledge sharing among learners and teachers. In that case, possibilities for effective teaching and learning in the digital age are realised based on connected digital skills endowed by practitioners. Therefore, teaching and learning in the digital age are considered to occur by forming connections through technology. Such a tactic reduces teachers' workload as most of the activities are done by students themselves through digital technologies. Consequently, this paper investigates the use of digital skills in influencing teaching and learning among teachers and students in secondary schools in Tanzania. Specifically, the paper responds to the following

research questions: (i) What types of digital skills influencing learning are possessed by teachers and students in secondary schools? (ii) What factors are related to the use of digital skills in schools?

Methods

Research Design

This study involved an exploratory sequential design. The design focused on gathering and analysing qualitative data to inform the collection and analysis of quantitative data. Priority was given to the qualitative data, as the focus of this design was to provide some insights. The findings were merged at the interpretation stage of the study. The design helped to collect in-depth information by using various data collection techniques, including questionnaires and interviews, in order to obtain rich and contextual data on digital skills and their influence on teachers. Lindi Municipal in Tanzania was selected as a research site because it has many schools integrating technology and using digital tools such as tablets, the internet, and smartphones for teaching and learning purposes[31]. Besides, at the end of every year, secondary schools in Lindi Municipality perform a digital skill performance review for the teachers that aims to understand teachers' digital skills' competency for on-job training in digital skills by the Universal Communication Services Access Fund (UCSAF) and the Secondary School Quality Improvement Program (SEQUIP). Students' digital skills status is known to this group of teachers since they are teaching them and closely monitoring their academic performance. As such, teachers and students are expected to be using digital tools for preparing materials, assessment tasks, and engaging with students. That is to say, the use of digital tools requires stakeholders to have a significant level of digital skills.

Participants and Sampling

The study used (n=85) respondents to collect data from five public secondary schools. Respondents included (n=45) students, (n=5) ICT teachers, (n=25) classroom teachers, (n=5) academic teachers, and (n=5) heads of schools. Academic teachers, ICT teachers, and heads of schools were purposefully selected because it was expected that they possess relevant information regarding the availability of ICT tools and the digital learning status at their schools. Furthermore, purposive sampling was used to obtain five heads of schools, five ICT teachers, and five academic teachers since the researchers believed that these specific participants had relevant information based on their work and responsibilities. A simple random sampling was used to obtain 25 classroom teachers involved in the study to collect quantitative data.

Instruments

The study employed interviews and questionnaires to collect data. Interviews were conducted with heads of schools, academic teachers, and ICT teachers. Questionnaires were administered to classroom teachers and students. The validity and reliability of this study were ensured through the use of multiple data collection techniques, pre-testing of the instruments (piloting), and triangulation. Similarly, two research specialists in secondary education and digital literacy were consulted to evaluate and recommend the quality of the research instruments. The questionnaires for students were translated into Kiswahili since the majority of secondary school students are more conversant in Swahili than in the English language, though English is the medium of instruction. The study followed ethical standards in terms of confidentiality, no harm, and anonymity of the participants. This involved the use of informed consent for participants to sign and indicate their voluntary participation in the study. In reporting, pseudonyms were used for schools and respondents.

Data Analysis

Descriptive statistics were used to analyse quantitative data through frequency distribution, while thematic analysis was used to analyse qualitative data. Qualitative (interview) data were transcribed verbatim and coded manually in order to allow the views and voices of participants to dictate the analysis. The interpretations and theorisation of the themes that emerged from both sets of data were guided by the theoretical framework of the study. Selection of quotes that are poignant and/or most representative of the research findings was used to present data from the interviews.

Results

Types of Digital Skills Influencing Learning Possessed by Teachers and Students

To examine the types of digital skills influencing learning possessed by teachers and students, several structured one-to-one interviews were conducted among heads of secondary schools, academic teachers, and ICT teachers. Findings from interviews are presented in Tables (i.e., Table 1, 2 & 3) respectively using representative quotes whereby subthemes and themes possibly signifying types of digital skills possessed by teachers were identified and generated for further discussion. Moreover, data from quantitative sources are statistically presented in frequencies and percentages.

The heads of schools were asked about the type of digital skills influencing learning possessed by teachers in secondary schools. Their responses are shown below in an interview excerpt in Table 1.

	Interview excerpt	Sub-themes	Themes
1	*Teachers are using computers and projectors to display some materials to students; therefore, we do possess basic computer skills. Due to the nature of our school, environment, and number of students, we do group students into groups and use a few available digital devices (HoS_02, 23rd February 2022)*	*PowerPoint presentation*	*Basic computer skills*
2	*There are many kinds of digital skills that teachers can possess to teach students; among those is the use of the computer, which is used to access materials and prepare lessons... they can share from one teacher to another, and they can share through WhatsApp, Bluetooth, etc., to be an effective and efficient teacher, you must retrieve these platforms to update yourself and to look for current materials because things do change day after day (HoS_01, 22nd February 2022)*	*Browsing skills* *Ms Word* *Sharing skills*	*Internet skills* *Basic computer skills* *Online collaboration skills*
3	*We normally use the internet for online research for the material, then print and photocopy for teachers and students. Through the ICT teacher, we look and evaluate on the internet; some special websites and platforms have digital content and learning materials that are relevant to our students (HoS_04, 26th February 2022)*	*Excel skills* *Browsing and searching skills* *Online research skills*	*Basic computer skills* *Digital assessment skills*
4	*The laptop is used to access materials and prepare lesson notes. Also, they can share learning materials from one teacher to another through WhatsApp/ (HoS_03, 1st March 2022)*	*Digital communication* *Sharing skills*	*Online collaborative skills* *Digital communication*
5	*We use Excel and Word for assessing the exams, in which we get the examination results and grades easily. (HoS_05, 28th February 2022)*	*Excel and MS Word* *Digital assessment*	*Digital assessment skills*

Table 1. Digital skills influencing learning possessed by teachers and students

doi.org/10.32388/QJU9PS.2

Key: HoS = Head of School

Information presented in Table 1 revealed that teachers in the studied schools had the following types of digital skills: basic computer skills, digital assessment, digital communication, online collaboration, basic computer skills, and internet skills. Similarly, the academic teachers were interviewed about the types of digital skills influencing learning possessed by teachers in their secondary schools. They avowed what has been presented in Table 2.

Sn	Interview extract	Sub-themes	Themes
1.	*I do use video clips for some lessons to allow the students to see and learn about the lesson. I do get these videos from YouTube for specific lessons I want to deliver to my students, for example, how the transformer works rather than teaching them theoretically. (AC2, 23rd February 2022)*	*Searching skills* *Sharing skills*	*Basic computer skills*
2.	*Aaaah! For teachers, they are using their mobile phones, and sometimes they use a laptop to teach students. To students, they use tablets for searching the materials. We have almost twenty tablets at this school. (AC1, 26th February 2022)*	*Searching skills* *Ms words* *Printing*	*Internet skills*
3.	*In this school, we normally use our smartphones and some computers that we privately own. We used to receive our examination via email, then we print and make the copies for the students...also, we do visit digital libraries such as Tanzania Institute of Education (TIE), & Shul direct (AC3, 23rd February 2022)*	*MS Word and PowerPoint* *Email skills* *Browsing skills* *Sharing skills*	*Digital communication* *Online collaboration skills*
4.	*In our school, we don't have any facilities related to digital, so I used a computer owned by the headmistress to prepare the duties and the teaching timetable and even students' reports. But sometimes, I used mobile phones to search for the materials and chat with other teachers through WhatsApp to get the materials to assist my students. I used Google Chrome and Mozilla Firefox as my browsers. (AC1, 22nd February 2022)*	*Typing* *PowerPoint* *Searching skills*	*Presentation skills* *Browsing skills*

Table 2. Digital skills influencing learning possessed by teachers and students

From Table 2, academic teachers unveiled several types of digital skills influencing learning possessed by teachers, such as browsing skills, presentation software, digital communication, internet skills, and basic computer skills. Furthermore, ICT teachers were examined regarding the type of digital skills influencing learning possessed by teachers in their secondary schools. Their responses are presented in Table 3.

Sn	Interview extract	Sub-themes	Themes
1	*To have knowledge related to the use of digital devices; for example, the skills of using MS Office and its packages; and the aspect of database (ICT_5, 28th February 2022)*	*MS Office* *Information literacy*	*Basic computer skills*
2	*Ms offices and all its packages are used often. Also, they should be able to use email and websites to browse for materials (ICT_4, 26th February 2022)*	*MS Office* *Email skills and Browsing skills*	*Basic computer skills*
3	*Aaaah! the teacher in this secondary school has MS Office and the capability of using MS Office and its packages as well as Internet and other conferencing programs like Skype, Google Docs and other modes. We normally share materials through WhatsApp, Telegram, and YouTube (ICT_3, 23rd February 2022)*	*Sharing skills* *Internet, Skype, Online collaborative skills*	*Digital content creation* *Digital communication*
4	*I can mention a few the first skill is on how to use those devices, the second is how to find materials in those devices, and the third one is how to maintain and keep those devices for future learning purpose (ICT_2, 23rd February 2022)*	*Searching skills* *Maintenance skills*	*Basic computer skills* *Internet skills*

Table 3. Digital skills influencing learning possessed by teachers and students

Results presented in Tables (1, 2, and 3) reveal several types of digital skills possessed by teachers in the studied secondary schools, including basic computer skills, internet skills, information retrieval, technical skills, and collaborative skills. Additionally, by the use of a questionnaire, students were asked to identify

doi.org/10.32388/QJU9PS.2

types of digital skills influencing learning possessed by their subject teachers and themselves. Students' responses are illustrated in Figure 1.

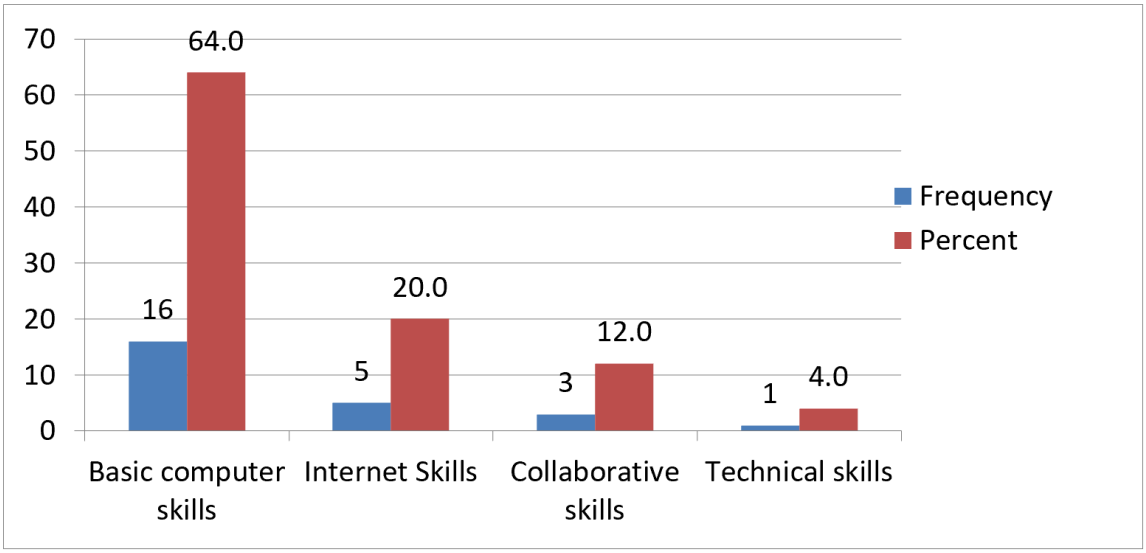

Figure 1. Digital skills possessed by classroom teachers

Figure 1 illustrates several types of digital skills influencing learning possessed by classroom teachers in the studied secondary schools. Basic computer skills 16(64.0%), internet skills 5(20.0%), collaborative skills 3(12.0%), and technical skills 2(4.0%) were different among digital skills influencing learning possessed by classroom teachers: the most digital skills influencing learning possessed by classroom teachers. In the same vein, students declared the following information in response to the types of digital skills influencing the learning they possess. Their response is presented in Figure 2, including basic computer skills 25(55.6%), internet skills 10(22.2%), collaborative skills 6(13.3%), and technical skills 4(8.9%). Figure 2 illustrates the distribution of types of digital skills influencing learning possessed by students.

doi.org/10.32388/QJU9PS.2

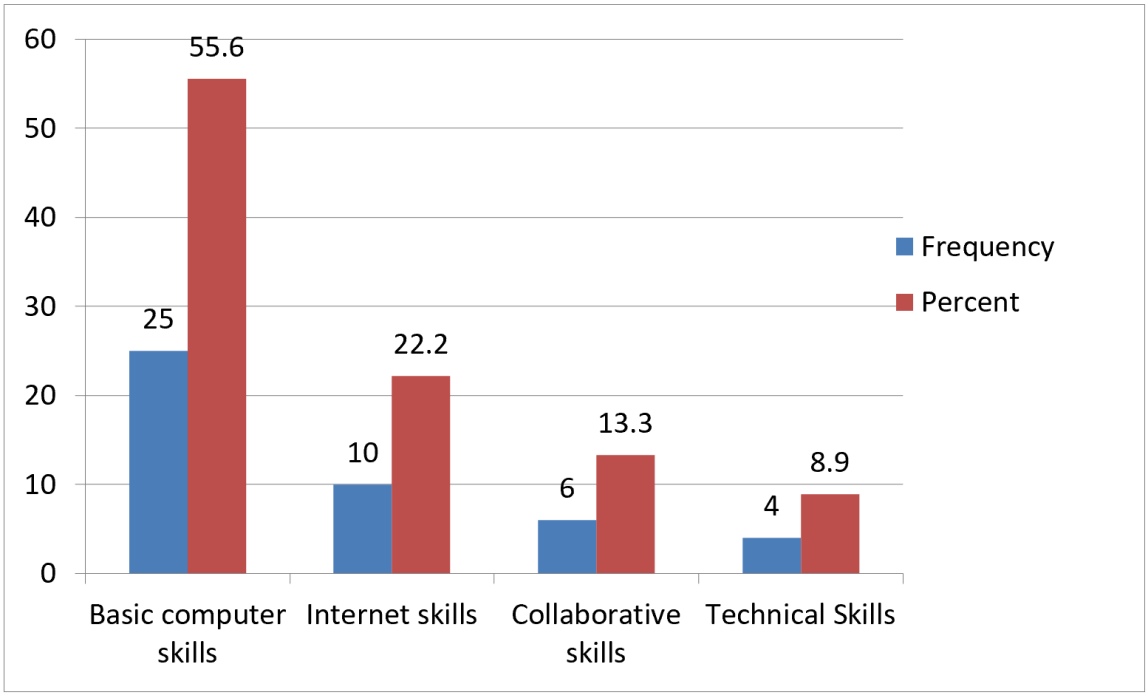

Figure 2. Digital skills possessed by students

Digital technological tools enhancing teaching and learning in secondary schools

To identify digital technological tools that enhance teaching and learning in secondary schools, we collected data through interviews and questionnaires from heads of schools, academic teachers, ICT teachers, subject teachers, and students. First, subject teachers and students were surveyed via self-made questionnaires. Second, school leaders, academic teachers, and ICT teachers were interviewed. Their responses are presented step-by-step. Heads of schools were asked to identify digital technological tools that enhance teaching and learning in their schools. Table 4 summarises their responses.

doi.org/10.32388/QJU9PS.2

Sn	Interview extract	Sub-themes	Themes
1	*Digital technological tools that enhance learning include computers and tablets, projectors, and flash disks... Also, I can tell you that several educative apps and software are available across different subjects and learning areas. These tools provide interactive exercises, simulations, and games (HOS1, 22nd February 2022)*	Tablets, computers, projectors. Flash disks	Audio-visual tools Video-sharing tools
5	*The easiest way is the use of a projector in which a large number of students can access those materials at once instead of teaching manually ... Another technology is the use of a television in which a teacher can prepare a program on a television ... The social network that is commonly used here is WhatsApp; Facebook is used more depending on the access to the internet we have (HOS5, 28th February 2022)*	Projector and television WhatsApp and Facebook	Audio-visual tools Video-sharing tools

Table 4. Digital technological tools enhancing teaching and learning – Head of School responses

Table 4 reveals that several digital technological tools enhance teaching and learning in the studied secondary schools, as stipulated by heads of schools, such as audio-visual tools and video-sharing applications. Moreover, ICT subject teachers were asked to identify digital technological tools that enhance teaching and learning that were available at their schools. Their responses are summarised in the interview extracts in Table 5.

Sn	Interview extract	Sub-themes	Themes
1	*Apart from a projector, the other tools are smartphones and the computer. With Internet-connected smartphones, I can search and display what I need to teach students, and it also has some notes, hence facilitating teaching; the same applies to the computer (ICT1, 22nd February 2022)*	Projectors, laptop computers, and smartphones	Audiovisual tools
2	*TV is mostly used, but with poor internet, and we have a 2G. Also, we have CDs and flash disks, which are portable, and cellular phones for teachers (ICT2, 23rd February 2022)*	Television, smartphone CD, flash disk	File-sharing tools
3	*The school has a projector and photocopy. I sometimes use personal computers to prepare lesson plans (ICT4, 26th February 2022)*	Projector, laptop	Audiovisual tools
4	*I use videos from YouTube to assist me in teaching; and another website, for example, I use the TIE website to find the books which are not available in school. (ICT3Th 23rd February 2022)*	YouTube Website	Digital library Video-sharing tools
5	*I use the Tanzania Institute of Education (TIE) website to allocate learning materials like subject books which are not available in hard copy. The school does not have projectors, but printers, tablets, and personal computers, and a photocopy machine are available (ICT4, 28th February 2022)*	Audiovisual TIE Tablets and laptops	Digital library Audiovisual tools

Table 5. Digital technological tools enhancing teaching and learning - ICT teachers' responses

According to the interview extracts in Table 5 from ICT subject teachers, the types of digital technological tools enhancing teaching and learning available in their schools include audiovisual tools, file-sharing services, video-sharing, and digital libraries, particularly TIE. In connection with ICT subject teachers' responses, during the interview, academic teachers were asked to identify digital technological tools enhancing teaching and learning in their respective secondary schools. Table 6 presents some of their responses in the interview extract.

doi.org/10.32388/QJU9PS.2

Sn	Interview extract	Sub-themes	Themes
1	*The use of digital devices, for example, computers to display, maybe the video of the lesson, which makes teachers observe the lesson used by other teachers (AC1, 22nd February 2022).*	Computer	Audiovisual tools
2	*Laptop and mobile phones in searching materials. Sometimes, it is used as a teaching aid for learning; for example, when you teach students the use of phones (AC2, 23rd February 2022)*	Laptop, Mobile phones	Audiovisual tools
3	*Sometimes, we have used our smartphones, WhatsApp, Facebook, and TV for some teaching and learning. (AC4, 26th February 2022)*	Smartphones WhatsApp and Facebook	Audiovisual tools Video-sharing tools

Table 6. Digital technological tools enhancing teaching and learning – Academic teachers' responses

Table 6 reveals that digital technological tools such as audio-visual tools and video-sharing tools are most available in the studied secondary schools for enhancing teaching and learning, as postulated by academic teachers. Subject teachers were also asked about the different types of digital technological tools that enhance teaching and learning based on digital skills. Figure 3 depicts their responses with multiple responses.

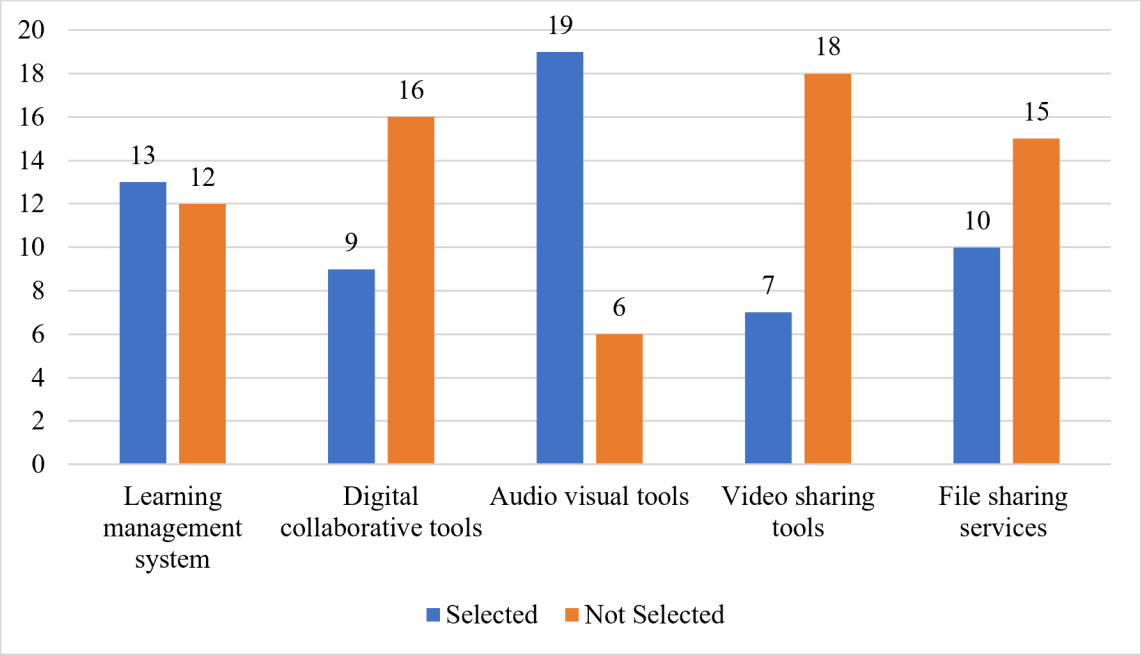

Figure 3. Digital technologies enhancing teaching and learning used by subject teachers

According to the findings depicted in Figure 3, the most used digital technological tools assumed to enhance teaching and learning among the studied subject teachers were audio-visual tools 19 (76%), learning management systems 13(52%), file-sharing services 10(40%), digital collaborative tools 9(36%), and video-sharing tools, which had 7(28%) of the respondents. In principle, students were asked about different digital technological tools used to enhance teaching and learning in their secondary schools. Their responses are shown in Figure 4.

doi.org/10.32388/QJU9PS.2

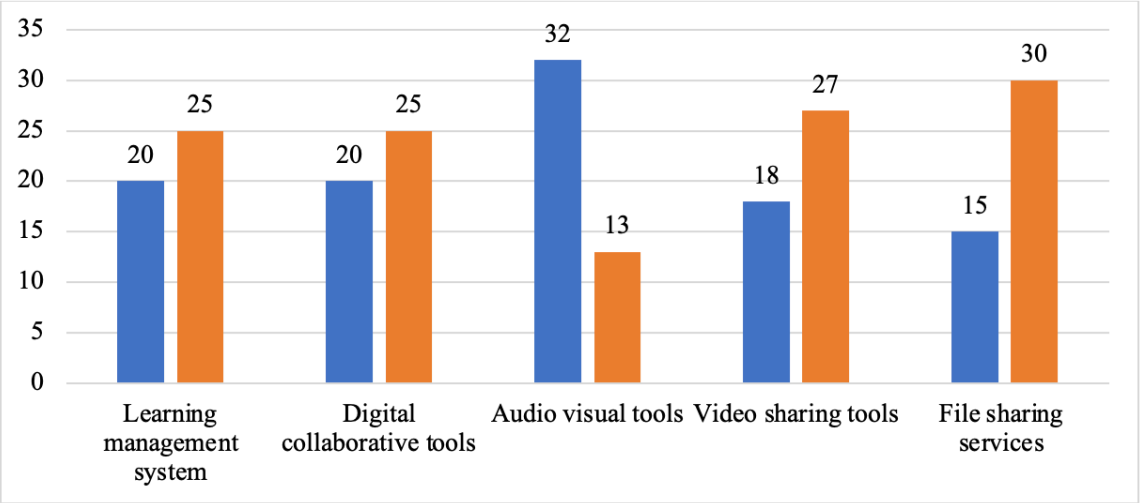

Figure 4. Students' responses to digital technological tools used to enhance teaching and learning

Factors Related to the Use of Digital Skills in Secondary Schools

The effective integration and utilisation of technological tools for teaching and learning depend on a number of factors. These factors can act as enablers or inhibitors in the process of digitalising teaching and learning. As such, teachers were asked to identify the factors related to the effective and sustainable use of digital skills in teaching and learning in secondary schools. Several factors were identified, as captured in Figure 5.

doi.org/10.32388/QJU9PS.2

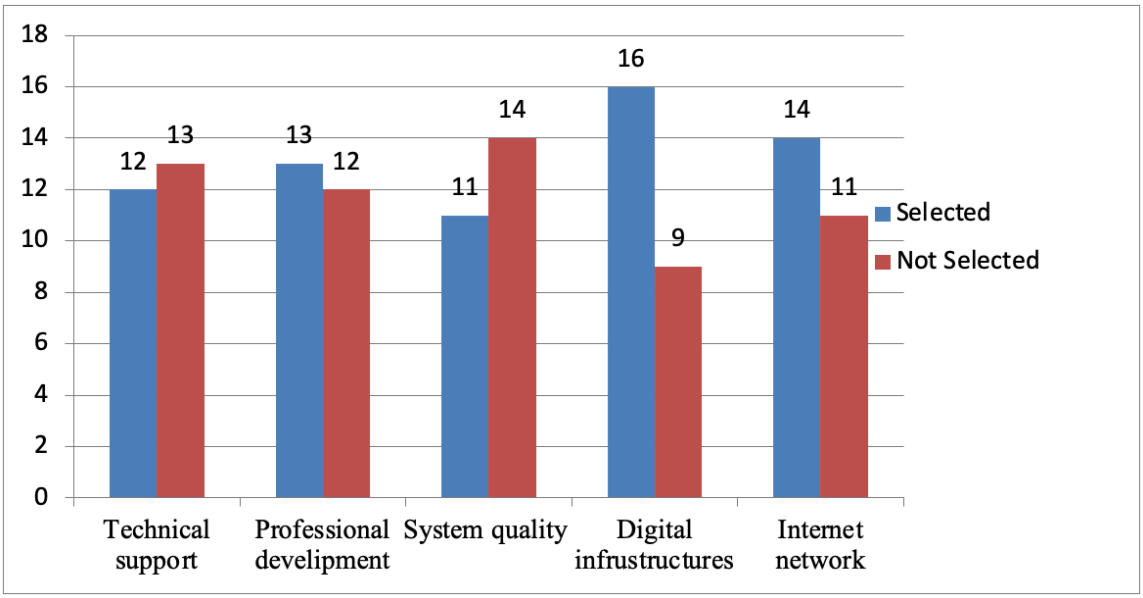

Figure 5. Factors relating to the use of digital skills among teachers

The above figure illustrates that digital infrastructure 16(64%) is the most important factor related to the use of digital skills in secondary schools, followed by internet service and accessibility 14(56%). Also, teachers' capacity building 13(52%) and technical support 12(48%) were identified as other critical factors for the use of digital skills in secondary schools. The least selected factor was system quality, which had 11(44%) of the respondents. Similarly, students were asked to identify factors related to their use of digital skills in learning. Their responses are captured in Figure 6.

doi.org/10.32388/QJU9PS.2

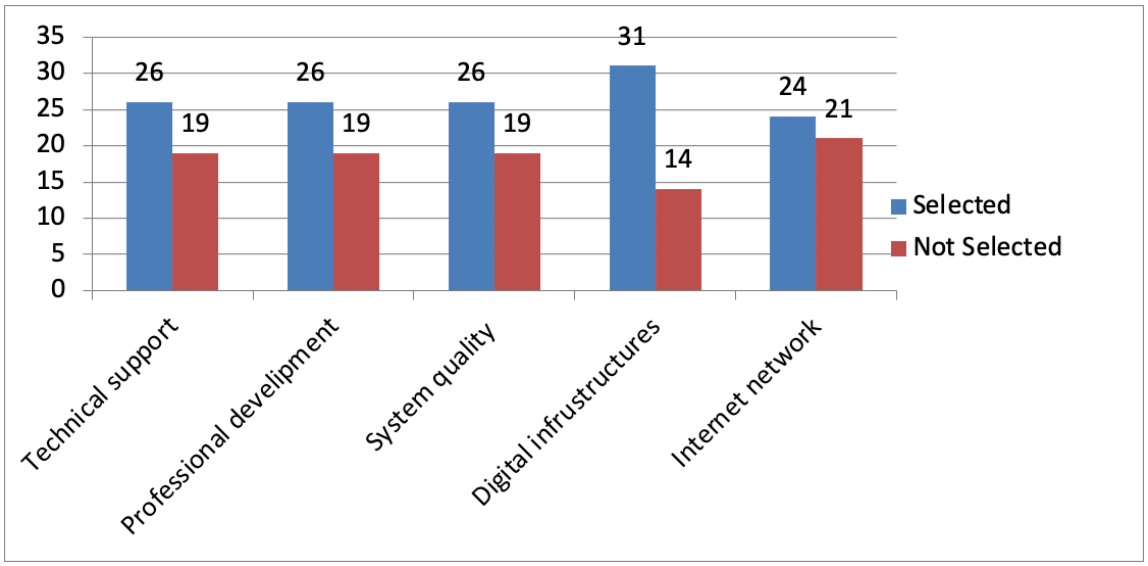

Figure 6. Factors relating to the use of digital skills among students

Figure 6 demonstrates several factors relating to the use of digital skills among students in secondary schools, such as digital infrastructure 31(69%), teachers' professional development, technical support, and system quality 26(58%), and internet services 24(53%) as the least factor.

Discussion

Types of Digital Skills Influencing Learning Possessed by Teachers and Students

This study examined several types of digital skills influencing learning possessed by teachers and students in secondary schools. The findings show that the digital skills possessed by teachers and students are basic computer skills (i.e., operating systems), digital content creation, digital assessments (i.e., online assessment tools (e.g., Google Forms, Quizizz)), presentation skills, browsing skills, digital communication (i.e., using email clients or web-based email services to send, receive, and manage emails), internet skills (i.e., using search engines, evaluating the credibility of sources), technical skills (i.e., cybersecurity, online safety practices), and online collaboration skills (i.e., using collaborative platforms like Google Drive, Microsoft Teams).

Basic computer skills (i.e., operating systems, using word processing software, using presentation software [e.g., Microsoft PowerPoint, Google Slides]) are essential for both teachers and students to effectively navigate and utilize technology in educational arenas. The finding signifies what has been revealed by

Kumi-Yeboah et al. (2020)[32], who found that digital technology users should incorporate digital technology skills, specifically sharing skills, to facilitate academic engagement and achievements of students from diverse backgrounds in online learning. This means that through sharing skills, each student will have a chance to get the required documents regardless of the different devices available. Further, the finding correlates with that of Alabdulaziz (2021)[33], who uncovered that 98% of students received reliable teaching and learning materials during COVID-19 as they possessed internet skills.

Moreover, teachers use these skills to accomplish several educational tasks, including the preparation of teaching materials, examinations, and teaching and learning-related activities. Most of these skills are essential for teachers and students to be able to exploit the advantages of digital technologies for teaching and learning. In tandem, online collaborative skills were found among the core digital skills possessed by teachers and students. As such, online collaboration skills involve sharing skills of documents and other teaching and learning materials via digital devices. Some of these digital devices are equipped with infrared, Bluetooth, and related applications that facilitate the sharing of teaching and learning materials and an easy teaching and learning process. The findings concur with several studies like Boholano (2017)[21], which found that teachers have enough skills in using hardware and software; and Perifanou et al. (2021)[34], which found that only 65% of teachers had the necessary technical skills to use digital learning devices. Among the basic digital skills revealed by this study was that teachers have the ability to use computers to investigate, create, and communicate to participate effectively at home, school, workplace, and in society. Mostly, these findings imply that teachers possess various digital skills that enhance teaching and learning among students and teachers in secondary schools.

Digital technological tools enhancing teaching and learning

The current study examined digital technological tools enhancing the teaching and learning process in secondary schools. From the findings, several digital tools, including audio-visual tools, file management tools, video-sharing tools, digital libraries, and digital collaborative tools, were reported. The findings also reveal that the most popular video-sharing tools in the form of apps were Facebook, WhatsApp, and Instagram. These digital technological tools play a significant role in assisting and supporting the teaching of subjects across the curriculum. Moreover, it was found that some of the learning management systems commonly visited by students and teachers were Khan Academy, SOMA, Google Classroom, and Shuledirect. Therefore, students could benefit from a variety of innovative learning opportunities, including access to course content and interaction with peers and professionals through these digital tools.

This finding agrees with that of Manca and Ranieri, who in 2013 stated that regardless of how it is used, Facebook as a social network is a cost-effective type of digital learning tool for the teaching and learning process. As a result, several video-sharing tools, audio-visual tools, and file-sharing services should be fully embraced for educational purposes since these digital technological tools are effective at creating an interactive learning environment; teachers and students should use them effectively in their teaching and learning.

Furthermore, the current study found that digital collaboration tools and digital libraries encompass the use of digital technologies in which teachers and students work together through online platforms. Likewise, students and teachers can rely on digital learning tools to address their collaborative needs. With digital collaboration tools, teachers can make videos, share documents, and manage to teach and learn in the cloud. The findings disclose that digital collaborative tools, audiovisual tools, digital libraries, and learning management systems have been used as digital technological tools for enhancing teaching and learning in secondary schools. These findings are in accord with what was found by [35], who uncovered acceptable positive perceptions towards the use of digital collaboration tools and audio-visual tools for teaching and learning. That is, typical digital technological tools allow teachers to create and deliver subjects, track student participation, and assess student performance.

Additionally, the system allows students to use interactive features such as threaded online discussions, video conferencing, and discussion forums. [36] supports our research findings by seconding that Google Drive, Picasa, and Dropbox are examples of digital technological tools used for transforming teaching and learning in secondary schools. However, these findings relate to the Connectivity and RAT theories since the findings enhance the use of digital learning technologies, which is the cornerstone of the two theories. For example, the use of digital libraries in learning is a transformation from depending on hard copy to soft copy contents, which are accessible at any time and any place. Digital library technology facilitates the availability of textbooks and other resources in a more convenient way than the traditional library. Also, the findings relate to both connectivism and RAT theories as the video-sharing tools technology facilitates learning through knowledge sharing and discussion among member groups. Teachers and students create WhatsApp groups in which they share subject content, videos, and questions among themselves. Video-sharing tools bridge the gap of place between teachers and students in the learning process, as connectivity theory suggests.

Factors relating to the use of digital skills in secondary schools

The study intended to examine the factors relating to the use of digital skills. Based on the findings, the study found that among the factors were the availability of digital infrastructures, awareness, system quality, technical support, income, electricity, professional development, internet network, and overcrowded classrooms. Using digital skills to influence learning among teachers and students in secondary schools needs enough digital infrastructure to implement digital skills successfully[35]. The number of digital infrastructures should, at least, meet the number of students because they are the main agents of the curriculum. These devices should be available at school and even at home. The internet is a universal network of computers linked together over a large distance. Teachers and students use the internet to search for relevant content for learning. Also, it is used to access emails to send messages and documents from one internet user to another. Furthermore, teachers and students can access social networks like WhatsApp and Facebook to write short messages and share videos through the internet. The quality of the internet influences teachers and students in learning.

This finding concurs with that of[37], who found that lack of access to digital learning facilities and technology in schools and at home negatively affects the use of digital skills in secondary schools. Also, [12] reported that internet connectivity is likely to have an intense effect on digital skills. These findings agree with[38], who found that teachers' skills possibly predispose digital utilisation in schools during teaching and learning activities. This implies that professional development will update knowledge and familiarity with digital technologies. Professional development will enable the use of digital skills to the required extent and frequency, which will positively affect the teaching and learning process.

Conclusion

Based on the findings, the study concludes that teachers and students possess several digital skills, including basic computer skills, that are used to influence their teaching and learning in secondary schools. Also, the study concludes that the use of technology-enhanced learning tools requires prior knowledge of digital skills to be possessed by teachers and students. Therefore, if the ICT subject is taught effectively in secondary schools, it may influence the use of technology-enhanced learning tools because teachers and students will have enough digital skills. From the findings, the following policy implications were drawn. First, students should be emphasised on using digital skills through digital devices (especially tablets, iPads, Kindles, and smartphones) possessed by parents, guardians, and relatives while at home. Second, collaborative learning among students should be emphasised in schools with few digital

infrastructures. The government should facilitate the availability of digital infrastructures in secondary schools for teachers and students to utilise possessed digital skills. Educational stakeholders should assist the government in providing digital infrastructures to schools to enhance access. Lastly, policymakers should amend the education circular that prohibits students from the use of smartphones when they are in school environments. This will improve digital skills in secondary schools because smartphones are cheaper than other digital infrastructures like laptops, tablets, and desktop computers.

Ethics Statement

This study involving human participants (teachers and students) was conducted in accordance with the Declaration of Helsinki. Ethical review, approval, and research clearance for data collection were obtained from Mzumbe University. Written informed consent for participation and for the publication of anonymized data, including interview excerpts, was obtained from all adult participants and from the parents/legal guardians of minor participants, with assent obtained from minors where appropriate.

Data Availability Statement

The datasets generated and analyzed during the current study are not publicly available due to privacy restrictions concerning participant confidentiality but are available from the corresponding author on reasonable request.

Author Contributions

Conceptualization, M.P., H.J.M., and N.M.; methodology, M.P. and H.J.M.; validation, H.J.M.; formal analysis, M.P.; investigation, M.P.; resources, H.J.M.; data curation, M.P.; writing—original draft preparation, M.P.; writing—review and editing, H.J.M. and N.M.; visualization, M.P.; supervision, H.J.M.; project administration, H.J.M.

References

1. [a], [b] *Piwiec K (2022). "What are digital skills?." devskiller.com. https://devskiller.com/what-are-digital-skills/.*
2. [^] *World Bank (2016). World development report 2016: Digital dividends, World Bank publications. World Ban k. https://www.worldbank.org/en/publication/wdr2016.*

3. ^a, ^b Montoya S (2018). Meet the SDG 4 data: indicator 4.4.1 on skills for a digital world. sdg.uis.unesco.org. https://sdg.uis.unesco.org/2018/08/08/meet-the-sdg-4-data-skills-for-a-digital-world.
4. ^ Nason G (2014). "Information services and digital Literacy: In search of the boundaries of knowing." Program: Electronic Library and Information systems. **48**(3):317–318. doi:10.1108/PROG-05-2014-0032.
5. ^ Jannette C (2009). "Education techniques for lifelong learning: Lifelong learning in the 21st Century and beyond." Journal of Continuing Education in Radiology. **29**(1):613–622. doi:10.1148/rg.292085179.
6. ^ Clement SG (2017). "Digital learning: Education and skills in the digital age. Consultation project (ED591364)." ERIC. https://eric.ed.gov/?id=ED591364.
7. ^ Punie Y, Redecker C (2017). "European framework for the digital competence of educators: DigCompEdu." Luxembourg: Publications Office of the European Union. doi:10.2760/178382.
8. ^ Șerban AM, Stefan V, Moxon D (2020). "Social inclusion, digitalisation and young people research study." Council of Europe. https://pjp-eu.coe.int/documents/42128013/47261689/Study-SID-07-04-draft.pdf/2af54871-4567-617e-3128-c2ec1fde795f.
9. ^ Bhasin H (2020). "Top 10 digital skills you should have for a career in digital." marketing91.com. https://www.marketing91.com/top-10-digital-skills.
10. ^ Sife AS (2013). "Internet use behaviour of cybercafé users in Morogoro Municipality, Tanzania." Annals of Library and Information Studies. **60**:41–50.
11. ^ Kira E, Mahumbwe N (2015). "Utilization of the internet facility in Dar es Salaam secondary schools in Tanzania." Global Journal of Advanced Research. **2**(9):1453–1464.
12. ^a, ^b Marshall G, Ruohonen M, editors (2013). Capacity building for IT in education in developing countries: IFIP TC3 WG3. 1, 3.4 & 3.5 Working Conference on Capacity Building for IT in Education in Developing Countries, 19–25 August 1997, Harare, Zimbabwe. Springer.
13. ^ Waga D, Makori E, Rabah K (2014). "Utilization of cloud computing in education and research to the attainment of millennium development goals and vision 2030 in Kenya." Universal Journal of Educational Research. **2**(2):193–199.
14. ^ Warschauer M, Ames M (2010). "Can one laptop per child save the world's poor?" Journal of International Affairs. **64**(1):33–51.
15. ^ URT (2021). "Digital Tanzania project (DTP): Stakeholders engagement plan (SEP)." World Bank. https://documents1.worldbank.org/curated/en/428801616581523127/pdf/Stakeholder-Engagement-Plan-SEP-Tanzania-Digital-Foundations-Project-P160766.pdf.

16. ^World Bank (2020). "Tanzania secondary education quality improvement program (SEQUIP)." World Bank. https://www.worldbank.org/en/news/factsheet/2020/03/31/tanzania-secondary-education-quality-improvement-program-sequip.
17. ^Hennessy S, Harrison D, Wamakote L (2010). "Teacher factors influencing classroom use of ICT in sub-Sahar an Africa." Itupale Online Journal of African Studies. **2**:39–54. https://pdfs.semanticscholar.org/56ec/8d2248a546352fed0f520972b57034334a45.pdf.
18. ^Adams T (2022). "What is the importance of digital skills in the workplace?." highspeedtraining.co.uk. https://www.highspeedtraining.co.uk/hub/digital-skills-for-the-workplace/.
19. ^Krumsvik RJ (2011). "Digital competence in the Norwegian teacher education and schools." Hogre Utbildnin g. **1**(1):39–51.
20. ^Law N, Pelgrum W, Plomp T (2008). Pedagogy and ICT use in schools around the world: Findings from the I EA SITES 2006 study. Springer. doi:10.1007/978-1-4020-8928-2.
21. a, bBoholano H (2017). "Smart social networking: 21st-century teaching and learning skills." Research in Ped agogy. **7**(2):21–29. doi:10.17810/2015.45.
22. ^Astuti M, Arifin Z, Mutohhari F, Nurtanto M (2021). "Competency of digital technology: The maturity levels of teachers and students in vocational education in Indonesia." Journal of Education Technology. **5**(2):254–2 62.
23. ^Kihoza P, Zlotnikova I, Bada J, Kalegele K (2016). "Classroom ICT integration in Tanzania: Opportunities an d challenges from the perspectives of TPACK and SAMR models." International Journal of Education and Dev elopment using Information and Communication Technology. **12**(1):107–128.
24. ^Mathayo MH (2016). Teachers' Experience on the Use of ICT to facilitate Teaching: A Case of Ilala District Se condary Schools [Unpublished Doctoral dissertation]. The Open University of Tanzania. http://repository.out.ac.tz/1584.
25. ^Mtebe J, Raphael C (2018). "Key factors in learners' satisfaction with the e-learning system at the University of Dar es Salaam, Tanzania." Australasian Journal of Educational Technology. **34**(4):19–28. doi:10.14742/ajet.2993.
26. ^Duke B, Harper G, Johnston M (2013). "Connectivism as a digital age learning theory." The International Rev iew. **4**(1):4–13.
27. ^Anderson T, Dron J (2011). "Three generations of distance education pedagogy." International Review of Res earch in Open and Distributed Learning. **12**(3):80–97.

28. ^Corbett F, Spinello E (2020). "Connectivism and leadership: Harnessing a learning theory for the digital age to redefine leadership in the twenty-first century." Heliyon. **6**(1):23–32.
29. ^Jung I (2019). "Connectivism and networked learning." In: Open and Distance Education Theory Revisited. S pringer. pp. 47–55.
30. ^Thota N (2015). "Connectivism and the use of technology/media in collaborative teaching and learning." Ne w Directions for Teaching and Learning. **2015**(142):81–96.
31. ^URT (2020). "Pre-primary, primary, secondary, adult and non-formal education Statistics." TAMISEMI. https://www.tamisemi.go.tz/storage/app/media/uploadedfiles/BEST%202020%20Regional%20Data_Final.pdf.
32. ^Kumi-Yeboah A, Kim Y, Sallar AM, Kiramba LK (2020). "Exploring the use of digital technologies from the p erspective of diverse learners in online learning environments." Online Learning. **24**(4):42–63.
33. ^Alabdulaziz MS (2021). "COVID-19 and the use of digital technology in mathematics education." Education and Information Technologies. **26**(6):7609–7633. doi:10.1007/s10639-021-10602-3.
34. ^Perifanou M, Economides A, Tzafilkou K (2021). "Teachers' digital skills readiness during COVID-19 pandem ic." International Journal of Emerging Technology in Teaching. **16**(8):238–245. doi:10.3991/ijet.v16i08.21011.
35. a, b Coles S, Martin F, Polly D, Wang C (2020). "Supporting the digital professor: Information, training and sup port." Journal of Applied Research in Higher Education. **13**(2):633–648.
36. ^Almekhlafi AGA (2016). Preservice and inservice teachers' perceptions of the utility of e-learning digital coll aboration tools for teaching and learning. Journal of Education and Social Sciences, vol. 4.
37. ^Manyengo RP (2021). Digitalization in teaching and education in the United Republic of Tanzania. ILO Publ ishers. https://www.ilo.org/wcmsp5/groups/public/---ed_dialogue/---sector/documents/publication/wcms_78 3673.pdf.
38. ^Sailer M, Homner L (2020). "The gamification of learning: A meta-analysis." Educational Psychology Revie w. **32**(1):77–112. doi:10.1007/s10648-019-09498-w.

Declarations

Funding: No specific funding was received for this work.

Potential competing interests: No potential competing interests to declare.