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Exploring teachers' pedagogical practices employed during and post-COVID-19 pandemic in Tanzania secondary schools: The case of Mbeya City Council

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Abstract. The study explored the pedagogical practices employed by secondary school teachers in Tanzania during and after the COVID-19 pandemic, with a focus on Mbeya City Council. The study was guided by the Unified Theory of Acceptance and Use of Technology (UTAUT). The study aimed to explore the pedagogical practices used by teachers during and after the COVID-19 pandemic in Tanzania's secondary schools. A qualitative approach was utilised with a phenomenological research design. A total of 33 participants were involved, including one District Secondary Education Officer (DSEO), two Ward Education Officers (WEOs), six secondary school heads, and 24 teachers (four from each selected school). The data were analysed using thematic analysis strategies. The study revealed that teachers employed various methods, such as adaptive learning platforms, collaborative learning, interactive presentations, online discussions, and tools for assessment and feedback. However, these efforts were hindered by challenges such as unreliable internet access, insufficient infrastructure, and inadequate administrative and technical support. The study concludes that teachers' capacity for technology-enhanced pedagogy should be strengthened. The study recommends that the government and education stakeholders provide support to secondary schools in adopting digital tools for teaching and learning to ensure high-quality education that can compete in the global market.

Keywords: digital teaching, pedagogical practices, COVID-19 pandemic, digital learning, digital divide

1. Introduction

This paper was prompted by the various concerns on learning strategies for students in secondary schools during the response to the COVID-19 pandemic. By mid-April 2020, 94 per cent of learners worldwide were affected by the pandemic, representing 1.58 billion children and youth, from pre-primary to higher education, in 200 countries due to school closures [57]. In this situation, continuity in learning among students in secondary schools was jeopardised as the majority of low-income countries, including Tanzania, could not access digital learning resources [29]. Perhaps the school closures posed new risks to teachers' pedagogical practices in the sense that most of them were not integrating technology into their teaching. Thus, the sudden shift to online teaching disturbed their practices [43]. Teachers in low-income countries, including Tanzania, lacked adequate digital competencies to integrate technologies in their teaching due to limited access to digital resources and lack of necessary infrastructure, such as reliable internet access and sufficient hardware like computers and tablets

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[18, 32, 39]. Likewise, a study conducted in Nigeria by Wordu [66] revealed that literacy or skills, physical infrastructure, and the level of social support were among the factors that hindered the use of technologies during and post-COVID-19 pandemic.

It makes sense to note that many schools during the outbreak of COVID-19 lacked alternative teaching practices, such as online or remote learning, to keep the students on track while at home [51]. Teachers' pedagogical skills in using technologies to enhance online learning were compromised due to poor access to digital content, inability to develop digital content, negative attitude towards technology, limited digital instructional skills and limited financial constraints to support internet connectivity among parents [46, 64]. Poor access to digital content limits educators' ability to find and utilise high-quality resources, which is essential for engaging learners in online learning. Many teachers face challenges in developing their own digital content, often due to a lack of training in digital tools and content creation [18, 28]. It is possible to note that without adequate professional development in teaching through technologies, teachers may struggle to implement best practices in online pedagogy, impacting student engagement and learning outcomes. Thus, during the outbreak of COVID-19, many teachers were struggling to offer online teaching without adequate pedagogical skills, which resulted in ineffective learning among students at home [35]. One of the reasons for limited pedagogical competence in using technologies to support online learning is the inadequacy of initial teacher education and professional development programs [22]. Contemporary teaching and learning requires the use of digital technologies, in this study, meaning digital applications and digital hardware, that can require new knowledge and skills from teachers.

While the outbreak of the COVID-19 pandemic affected teaching and learning at all levels, including secondary education, some successes could be noted as a result of digitalisation. Evidence indicates that technologies have brought about digital transformations in teaching and learning in the sense that both teachers and students can access educational resources and opportunities for self-directed learning and learning at schools and elsewhere [45]. While many studies indicate that the COVID-19 pandemic increased digital transformation, some evidence indicates an increased risk for digital addiction due to increased time on screen while at home under quarantine conditions, lockdowns, and a general worldwide extended period of remote working/schooling [8, 19, 30]. The pandemic has had a crucial impact on web survey responses due to the sudden transition to a fully digital work and life environment. This shift has led to a dramatic increase in the number of web surveys conducted, prompting researchers and organisations to implement diverse approaches to adapt to the new realities of data collection in a digital-first context [2, 24, 61]. Although many educational institutions considered MOOCs as an alternative to the traditional education system due to the flexibility of learning time during COVID-19, it contributed to high dropout rates and reduced user participation in learning activities such as forums and comments [44]. Further evidence indicates that some students from low-economic-status families could not benefit fully from learning through MOOCs as they needed internet access and technological devices [67]. This could be an indication that students from marginalised families were somewhat excluded from digital learning opportunities introduced to support distance learning during the COVID-19 pandemic.

1.1. Context of the study

There have been various initiatives in Tanzania to support teaching and learning in secondary schools through technology. The establishment of the ICT Competency Standards for Teachers Framework based on the UNESCO ICT Competency Framework for Teachers (ICT-CFT) of 2015 signifies the government's willingness to embrace technology in teaching and learning [53]. Further emphasis on integrating ICT in

teaching could be reflected in the Sustainable Development Goals (SDGs), specifically Goal number 4, which emphasises the key role of ICT in fostering inclusive and high-quality education for everyone, addressing educational disparities, and reaching marginalised populations [55]. Also, the United Republic of Tanzania insists on using digital teaching through the Educational and Training Policy of 2014, the revised Edition of 2023 and ICT competency standards for teachers [53, 58]. Some of the most recent initiatives are the digital learning strategy and the revised curriculum, which emphasise the need for integrating digital technologies in all education levels [56, 58]. While the integration of technology in teaching and learning in Tanzania has been the focus, still the implementation is not very convincing as teachers feel having a low level of ICT competence, lack of technical support, insufficient ICT resources and inadequate ICT training [20, 39]. However, the government distributed technological devices, especially tablets, which have increased teacher awareness of the technologies for their professional growth. Still, the costs of internet bundles and electricity for charging devices are unmanageable by most secondary schools [23].

Further evidence indicates that digital learning in Tanzania is constrained by a number of challenges in the sense that online learning during the COVID-19 pandemic was not possible for many educational institutions. The study conducted by Ndibalema [37] found that the challenges encountered by e-learning during the COVID-19 pandemic, such as unreliable electricity and the internet, made teachers cope with digital teaching properly, hence leading to a lack of digital culture to teachers. Other studies indicate that during COVID-19, Tanzania had a challenge of the digital divide between urban and rural regions in which many students, particularly in remote areas, could not access the internet and digital tools such as laptops, projectors, smartphones, or even electricity [16, 28, 40]. Also, the Basic Education Statistics in Tanzania of 2020 reveals the problem of the digital divide in Tanzanian Secondary Schools, whereby ICT facilities do not correspond with the number of teachers [59]. This is an indication that using digital tools for teaching and learning is still an issue of concern.

In March 2020, schools, universities and educational institutions were closed to control the spread of COVID-19, stopping in-person classes. Unlike many countries, Tanzania did not adopt nationwide online learning due to limited ICT facilities and internet access, particularly in rural areas. However, teachers were encouraged to stay connected with their schools and students. Some non-government secondary schools with sufficient ICT resources did offer online learning. The Ministry of Education also promoted remote learning via radio and television, with teachers delivering content, particularly for students preparing for national exams [50, 59]. A study by Ndibalema [36] suggests that deliberate efforts are required for critical investment in ICT at all levels of education. Despite the efforts to incorporate ICT into educational programmes, the digital gap continues, thus hindering effective responses to emergencies [50]. However, the implementation of those initiatives based on the policies and framework is still minimal. Therefore, this research focused on exploring teachers' pedagogical practices and factors that affect digital teaching employed during and after the COVID-19 pandemic in Tanzania. This study identifies effective pedagogical practices secondary school teachers may use to support the students during teaching and learning in a digitalised way.

1.2. Research question

1. What are the teachers' pedagogical practices employed during and post-COVID-19 pandemic in Tanzania secondary schools?

2. Theoretical model

This study was guided by the Unified Theory of Acceptance and Use of Technology (UTAUT) model, developed by Venkatesh et al. [62]. The model aims to explain and predict individuals' acceptance and adoption of information technology, and it has been widely used in research on technology acceptance. The UTAUT model seeks to provide a comprehensive understanding of the factors that influence people's behavioural intentions and actual technology usage. Key assumptions of the model include Performance Expectancy, where users adopt technology when they believe it will enhance their performance. The findings revealed that using digital teaching in secondary schools enhanced students' academic performance, although there were minimal efforts to encourage technology adoption during the COVID-19 pandemic.

Additionally, the findings of this study indicate that both teachers and students made significant efforts to utilise digital teaching tools, adapting to their use during and after the COVID-19 pandemic. Moreover, the findings of the current study indicate that digital teaching improves social influence in the real context during and after the COVID-19 pandemic. This study revealed that using digital teaching increases teachers' and students' confidence to use it during and after the COVID-19 pandemic, depending on learning conditions. The findings highlight the need for social support and collaborative environments in schools by encouraging a culture that promotes technology use among teachers. In this sense, teachers seem to be motivated to integrate technologies into their teaching and share effective practices. By applying the UTAUT model, this research sought to identify the factors that affected or affected teachers' acceptance and use of digital teaching tools during and after the post-COVID-19 pandemic, respectively. The purpose behind this is to give valuable insights into the key determinants of successfully implementing digital teaching strategies in secondary schools in Tanzania. It is possible to note that several factors influence teachers' acceptance of technology, such as performance expectancy, effort expectancy, social influence, and facilitating conditions. This study, therefore, provides insights into understanding these elements, which may inform educational stakeholders to tailor professional development programs that address specific concerns and enhance teachers' confidence in using technology.

3. Methodology

3.1. Research approach and design

This research adopted a qualitative methodology to explore the phenomena in question. As previously noted, the investigation focuses on understanding the varied viewpoints and experiences of participants in Tanzania regarding the use of ICT as a pedagogical tool during and after the COVID-19 pandemic. It was expected that this qualitative approach would help the research team to delve into the depth and distinct lived experiences of the participants, as they are the individuals who engage in teaching and instructional leadership and have felt the consequences of those practices [27]. The phenomenological design was also employed in the sense that it allowed for a rich and detailed exploration of pedagogical practices and factors that affected using digital teaching in Tanzania's secondary schools during and after the COVID-19 pandemic. Also, it sought to explore and understand the essence of individuals' lived experiences related to a particular phenomenon by focusing on how they perceive and make sense of their experiences [9]. Moreover, it provided a deeper contextual understanding of the challenges, successes, and strategies employed by teachers in Tanzania's secondary schools, giving insights that quantitative research may not capture. It was selected to gain a deeper understanding of the phenomena being investigated [7]. Also, the qualitative approach enabled the researchers to gather

rich information from participants' experiences related to digital teaching in Tanzania's secondary schools during and after the COVID-19 pandemic.

3.2. Participants and data collection

Thirty-three (33) participants were involved in this study. The study employed a purposive sampling technique for choosing one District Education Officer (DSEO), two Ward Education Officers (WEOs), six heads of schools (HoS), and twenty-four secondary school teachers (four from each selected school). These individuals were deemed to have rich information about the study. The study chose all of the participants from six respected schools in Mbeya City Council (Tanzania) because Mbeya City is one of the districts where teachers employed digital tools in teaching during and post-COVID-19 pandemic. Teachers who were engaged in the study were the ones who engaged their students in the digital learning environment and were assumed to experience pedagogical challenges in teaching through technology. The involvement of school leaders in this study was based on the fact that they are responsible for providing instructional leadership support to their schools, and they were expected to provide rich information about the topic.

Multiple methods of data collection were utilised to understand the phenomenon. The methods include interviews, observations, and a documentary review of the lesson plans. DSEO, WEOs, HoS, and teachers were involved in individual one-to-one interviews for 30-45 minutes. The interviews allowed the research team to obtain responses in a comfortable environment where respondents felt free to share their thoughts, feelings, and experiences honestly [13]. While conducting the interviews, the research team had an opportunity to tailor probing and follow-up questions based on the participant's responses, which led to a deeper exploration of lived experience in teaching through technology during and after the COVID-19 pandemic. The classroom observations and the documentary review were used to generate data to complement the information obtained from the interviews. While interviews provided personal narratives and perspectives on experiences on the use of technology as a pedagogical tool during and after the COVID-19 pandemic, documentary review allowed the research team to examine curriculum documents (i.e., lesson plans), which helped to validate the claims made by respondents by providing concrete evidence. Additionally, classroom observations offered a real-time assessment of teaching practices through technologies, which helped to understand better and identify gaps and discrepancies between what respondents said and the actual practice.

3.3. Quality checks

In order to ensure the quality of data, the research team employed several strategies in different stages of the study. The first strategy was to ensure the credibility of the research tools, which were developed and reviewed by senior researchers at the University before actual data collection. Further consultations were made with the District Statistics and Logistics Officer (SLO) to ensure the proper data collection process and identify suitable respondents and data were gathered from multiple locations, including schools, the DSEO office, and the WEOs office, to check the consistency of the findings across different settings. This was important because it helped the researchers collect various perspectives about the participants' experiences of using digital solutions in teaching in the selected areas.

Other strategies that ensured the quality of data were building rapport and debriefing. The research team built trust with participants over time, which allowed them to feel comfortable sharing their experiences with the integration of technology in teaching. Moreover, the research team actively involved participants by clearly explaining the purpose of the study before the interview sessions and had the chance to clarify their

responses [1]. Bracketing was another technique employed by the research team to ensure our assumptions and notions were set aside by creating a safe space where each participant had a chance to share the experience in the natural setting.

3.4. Data analysis procedures

The data were analysed thematically by involving six stages proposed by Braun and Clarke [4], which are familiarisation of data, generation of initial codes, combining codes into themes, reviewing themes, determining the significance of themes and reporting of the findings. This allowed the researchers to explore the rich descriptions provided by participants and uncover themes related to experiences, challenges, and opportunities in experiences of technology integration in teaching. Initially, data were recorded in the digital recorder, then transcribed and translated into the English language by the language expert (a linguist), and initial codes were generated. The codes were frequently examined to determine how each piece of information aligned with the themes. Themes were derived by recognising and categorising codes that exhibited similar patterns relevant to the research question. These themes were then reported, analysed, and interpreted in connection with the existing literature, bolstered by direct quotes from the participants' responses.

The analysis for the observation rubrics was done by determining the frequency of the aspects observed on the integration of technologies in the actual teaching. Additionally, the content analysis of a lesson plan centred on digital teaching practices included reviewing essential elements such as the integration of ICT skills, pedagogical strategies for teaching with ICT, and the criteria for assessment [9].

3.5. Ethical considerations

Before starting the recordings, the researchers explained to participants that their participation was voluntary and obtained their consent to record the interviews using a cell phone. Only participants who signed informed consent forms were included in the study. To ensure privacy and confidentiality, no personally identifiable information was gathered during the interviews, and all participants were assigned pseudonyms. Again, all participants were assured that their responses would be kept confidential. Ethical approval was granted by the University of Dodoma Research Review Ethics Committee (IRREC) on behalf of the Tanzania Commission for Science and Technology (COSTECH), under reference number (MA.84/261/70/18).

4. Findings and discussion

The study aimed to explore teachers' pedagogical practices regarding the use of technology during and after the COVID-19 pandemic. The rapid shift to online and hybrid learning environments necessitated by the pandemic has profoundly impacted instructional strategies and classroom dynamics. The results presented in this chapter highlight the different perspectives of teachers, heads of schools, Ward Educational Officers, and District Educational Officers.

4.1. Teachers' pedagogical practice on using technology during and post-COVID-19 pandemic for teaching and learning

Analysed data were categorised into four sub-themes, namely, adaptive teaching and learning platforms, collaborative learning, interactive presentation, and online discussion, as well as assessment and feedback tools guided by the discussion of the study findings as shown in table 1.

4.1.1. Adaptive platforms

The results from the data generated through the interview with the respondents described the adaptation and innovation of using technology in teaching and learning

Table 1
Pedagogical practices employed.

Sub-theme	Representative quotes
Adaptive platforms	Using technology in teaching and learning in secondary schools support both teachers and students because they bring long-term memory among students and reduce the teaching workload. In our school, we used digital teaching materials during and after the COVID-19 pandemic. We used WhatsApp groups, TBC radio and television and online teaching. However, some of us currently use technology to teach in the classroom (Head of School A, April 2024).
Collaborative learning	Using technology encourage teachers to adopt pedagogical approaches that promote active learning, collaboration and critical thinking skills (Teacher 19, April 2024).
Interactive and online learning	I think technology enhances students' attention and understanding of the lesson. Moreover, it encourages self-directed learning among students. Therefore, teachers should be encouraged to use digital teaching in secondary schools to support students. This facilitates learner-centred learning (Ward Educational Officer 2, April 2024).
Assessment and feedback tools	I noted that during the COVID-19 pandemic, we were using technology to assess students, and we provided prompt online feedback. We used WhatsApp groups, home packages and online tests and examinations. Also, we marked online, and students received prompt results. We are still using the platform to support online assessment (Teacher 10, April 2024).

in secondary schools. Participants were of the view that using technology enhances the use of instructional methods and tools that engage students in active learning. It was, however, argued that the use of technology in teaching and learning in secondary schools depends on the availability of infrastructure, such as computers and projectors, as well as reliable internet connectivity to support its implementation. This was evidenced by the comments of one of the teachers:

> The use of technology encourages us to adopt pedagogical strategies that aim at fostering active learning, collaboration, and critical thinking. Also, using technology facilitates the design of instructional materials that enhance interactive teaching and learning. (Interview with Teacher 1 from School A, April 2024)

Also, the findings align with the key construct of performance expectancy, through which teachers believed that using digital tools would improve their teaching efficiency and enhance student learning outcomes. The findings further show that digital teaching helped to simplify tasks and improved students' engagement, suggesting that teachers expected better performance when integrating technology into their classrooms. One of the heads of School B commented:

> The use of technology in secondary school teaching benefits both teachers and students by enhancing students' long-term memory and reducing teachers' workload. During the COVID-19 pandemic, our school utilised

> several digital platforms for teaching, including WhatsApp groups, TBC radio and television, and online teaching. Some of us continue to use technology in the classroom even now. (Interview with the Head of School B, April 2024)

The quote above shows that some teachers used or have been using technology in teaching and learning during and post-COVID-19 pandemic, respectively. The study found that various pedagogical practices were used to engage learners in interactive learning through various digital platforms such as Google Classroom. It was reported that these digital platforms provided room for learners to access learning resources while at home. It is possible to note that such practices enhanced students' essential digital skills, which are necessary in a current digital era where most activities in the work environment are technologically driven.

These findings are in line with a study's findings, which indicate that using technology during the COVID-19 pandemic encouraged teachers to innovate and adapt new teaching and learning pedagogical techniques [15]. Also, a study conducted by Samad, Ihsan and Khalid [48] observed that during the COVID-19 pandemic, teachers got the opportunity to use digital learning, such as mobile phones and tablets, for teaching and learning. In this situation, teachers increased their creativity and innovation to support their teaching and learning strategies. Other studies also indicate that teachers and students adapted to new teaching methods and became more proficient in using various digital tools, which in turn prepared them for future educational challenges [11, 47, 60]. This experience has highlighted the importance of incorporating technology into the curriculum, as it not only enhances learning outcomes but also equips students with the necessary skills for the workforce. It makes sense to note that the forced adoption of technology during COVID-19 has paved the way for a more flexible and innovative educational landscape in secondary schools; still, learning quality was compromised. This is because most teachers were forced to migrate to digital platforms for teaching without adequate preparations and, thus, had inadequate digital competency to run digital learning sessions [20, 39, 41]. It is possible that some students were discriminated against from the learning process as the delivery mode was not fully favourable to all learners due to the low technological competence possessed by teachers. In order to promote effective digital learning, teachers should be exposed to adequate professional development programmes embracing their digital competencies before they work in the digital learning environment.

It should be understood that technology-enhanced learning depends on the availability of infrastructures (such as computers, learning management systems, and digital content) and internet connectivity. Some respondents argued that some secondary schools lacked internet connectivity from school, but they were buying internet bandwidth at their own costs. This led to some difficulties for teachers in using digital platforms for teaching during and post-COVID-19 pandemic. In this regard, one of the teachers from School B said:

> During the COVID-19 pandemic, the government announced the closure of all schools and emphasised that all levels of education should use digital solutions to support online teaching. However, we miss reliable internet connectivity and a standby generator. This affected teaching and learning during the pandemic and until now. This has remained a challenge in many secondary schools, especially in public ones. (Interview with Teacher 7 from School B, April 2024)

The above quote indicates that unreliable internet connectivity and unreliable electricity or not having a standby generator are still among the hindrances to using

technology in teaching and learning among secondary schools in Tanzania, especially public secondary schools. Unreliable internet connectivity and inconsistent electricity supply, compounded by the lack of standby generators, remain significant barriers to the effective use of technology in teaching and learning within public secondary schools in Tanzania. These challenges hinder both teachers and students from fully engaging with digital resources and online platforms, ultimately limiting access to quality learning. The frequent disruptions can lead to frustration and disengagement, preventing students from benefiting from the innovative teaching methods that technology can offer. Further results from the classroom observations indicate that the majority of public secondary schools rarely used digital tools to prepare schemes of work, lesson plans, and lesson notes for their teaching when forced to do so. Table 2 provides some gaps as were observed in the classroom.

Table 2
Classroom observations on the integration of ICT in teaching [21].

Aspects of teachers' ICT integration	Most conducted	Somehow conducted	Rarely conducted	Not conducted
Teachers' preparation before classroom presentation	5	4	1	2
Teachers' activities during the introduction of the lesson	3	6	2	1
Teachers' effective utilisation of digital tools in the classroom	2	2	8	0
Teachers use of interactive methods through digital tools	4	6	2	0
Teachers' use of digital tools in engaging students in online assessment	2	2	10	0

This indicates that during and after the COVID-19 pandemic, secondary school teachers benefited from adapting to using digital teaching to prepare work schemes, lesson plans, and lesson notes. The observation results indicate somehow that teachers were integrating digital solutions into their classroom teaching. This is an indication that teachers' experiences in teaching with digital solutions during and post-COVID-19 pandemic were somewhat successful. Digital teaching encouraged innovation, simplified tasks for teachers, improved student understanding, and increased engagement through varied instructional methods. It was further observed that teachers rarely utilised digital tools effectively in teaching. This is because teachers faced challenges such as limited access to digital tools and unreliable internet and had limited digital skills in teaching. Lack of adequate digital skills among teachers usually hinders effective teaching methods, as they struggle to integrate technology into their teaching while providing minimal interactions. It is possible that these skills gaps may affect students' learning attainment as they inadequately acquire essential digital literacy skills for them to work in the future digital working environment. Evidence indicates that teachers who lack adequate digital skills usually find it challenging to adapt to emerging technology-enhanced learning, leading to increased frustration and dissatisfaction [26, 65]. In Tanzania, teachers' competence to teach in technology, several factors have compromised enhanced teaching's lack of reliable internet and digital infrastructures in schools that can effectively support learning [17, 18]. Similar challenges have been persisting in several sub-Sahara African countries such as Nigeria, indicating that digital learning in schools is compromised by lack of access to digital infrastructure, which was a main challenge during and post-COVID-19 pandemic

[25, 66]. Many educational institutions in sub-Saharan Africa inadequately integrate technology in teaching due to limited access to reliable internet [16, 28, 40]. It makes sense to note that internet connectivity should be given priority in many educational institutions, including secondary schools, so as to support teachers and students in teaching and learning through digital solutions so as to meet the 21-century skills needed in the job market.

4.1.2. Collaborative learning

The participants explained that technology allowed them to learn through virtual groups, peer-to-peer learning, simulation, and interactive activities. One teacher from School C said:

> During the COVID-19 pandemic, we shared home package assignments with students through Google Classroom. After the pandemic, I continued using the same platform to share learning resources with my students, and their performance has been better compared to other students who are not exposed to virtual learning platforms. (Interview with Teacher 10 from School C, April 2024)

In contrast, a teacher from School D commented:

> Using technology is a good approach, but we lack administrative and technical support. I think we need strong support in technology-enhanced teaching. It is time now for the government and educational stakeholders to devise mechanisms for teachers to develop digital literacy skills to enhance teaching and professional growth. We just need strong internet, and schools must be connected so that students can access digital resources easily while they are at school. (Interview with Teacher 13 from School D, April 2024)

The above quotes indicate that some initiatives to support collaborative learning through virtual platforms such as Google Classroom are in place, but they are constrained by poor internet accessibility. Other researchers also found that collaborative learning through technologies is important for improving students' abilities in inquiry learning tasks [6, 63]. While the national digital strategy in Tanzania emphasises engaging learners in technologies that support collaborative learning [56], evidence indicates that little has been done in secondary schools. Throughout the schools visited in the study, few teachers in non-government schools were the ones who used digital tools for enhancing collaborative learning. Although technological solutions employed during and post-COVD-19 in teaching were perceived to promote collaborative learning, evidence indicates that students worked autonomously without adequate guidance from their teachers and they lacked proper infrastructure and access to technology, proper motivation to engage with online learning [3, 12]. This may highlight a critical gap in the effectiveness of technology integration during and post-COVID-19 in many educational institutions. Lack of adequate guidance from teachers suggests a need for more structured support systems and capacity strengthening among teachers, as it is possible that when there is no proper direction, students' engagement in learning can be compromised. Furthermore, the absence of motivation strategies and inadequate skills to engage with online learning signifies the need to develop strategies that not only enhance access to digital tools but also actively encourage and facilitate student participation. Inadequate skills among teachers to support collaborative learning has not been affecting secondary schools only but also other levels of education, such as universities, where the adoption of technologies in teaching in many low-income countries is not satisfactory [33, 34, 37]. This situation emphasises the need for systemic

improvements in infrastructure to support technology integration in education, not only in secondary schools but also in all levels of education.

4.1.3. Interactive online learning

The results from the interview revealed that teachers were creating online discussions and interactive presentations using digital platforms to facilitate learning during and post-COVID-19 pandemic in secondary schools. The teachers were of the view that technology enhances active learning and interactions among students in virtual classrooms. This was made clear by Teacher 9 from School C, who said:

> When I engage my students in learning through digital platforms, they become more active. My students have the chance to ask through online discussions on various topics I post on the platform. (Interview with Teacher 9 from School C, April 2024)

In addition, the Ward Education Officer (WEO) 1 commented:

> I think technology enhances students' attention and understanding of the lesson. Moreover, it encourages students to be self-directed learners. I normally encourage teachers in my school to harness the available digital tools and utilise them in their teaching so as to promote students' engagement in interactive lessons. (Interview with WEO 1, April 2024)

Other respondents were of the view that using technology needs a good learning environment, such as special computer labs or rooms that would encourage teachers to integrate technology effectively. Concerning this, one head of school recommended:

> The application of technologies in learning during the COVID-19 pandemic was challenged by the poor learning environment at home. Most of our students come from low-income families who cannot afford to purchase digital devices. In this situation, it was very difficult to meet their learning needs through technology. Even after the COVID-19 pandemic era, the situation is still the same. We are also witnessing that our schools have no computer labs or special rooms dedicated to facilitating virtual learning, particularly in public secondary schools. (Interview with the Head of School D, April 2024)

Although some respondents appreciated the role of technology in supporting interactive learning among students, there were several concerns about limited access to digital devices and poor digital learning environment at home due to poverty. Further results from the documents reviewed indicated that few teachers were integrating technologies in their lessons while others were not integrating at all. The results are summarised in table 3.

The documentary review on the integration of technologies in teaching and learning, as indicated in table 3, highlights a notable difference between government and non-government secondary schools. The findings indicated that non-government secondary schools are somewhat better at integrating technologies due to the availability of digital infrastructure compared to government schools. These findings are in line with a study conducted in Colombia by Ospina and Medina [42], who observed that a limited number of computers and a lack of computer labs and digital resources are among the challenges that affect using technology in teaching and learning during and after the COVID-19 pandemic. In Tanzania, the study conducted by Ndibalema [37] shows that there was a lack of ICT facilities and skills for teachers, and hence, they lacked

Table 3
Documentary review data (lesson plans) [21].

№	School	Type of document	Findings
1	School A*	Lesson plans (5)	• Lessons objectives were somehow fairly stated, reflecting the use of technologies • Some learning tasks reflected the use of technologies • Somehow, the assessment strategies considered technologies such as online tests and quizzes • Exam reports were prepared digitally and sent to parents
2	School B	Lesson plans (5)	• Lesson objectives hardly mentioned the use of technologies • Teaching methods hardly highlighted the use of technologies • Learning tasks hardly mentioned the use of technologies • The assessment strategies rarely mentioned the utilisation of digital tools
3	School C	Lesson plans (5)	• Somehow, the lesson objectives were stated while acknowledging the use of technologies • Somehow, pedagogical techniques of teaching highlighted the use of technologies • There was a good mention of assessment strategies reflecting the use of digital tools
4	School D*	Lesson plans (5)	• The lesson objectives somehow reflected the use of digital tools • Learning tasks somehow mentioned the use of digital tools • Assessment strategies adequately mentioned the use of digital tools
5	School E*	Lesson plans (5)	• Somehow, the lesson objectives reflected the use of digital tools • Learning tasks somehow highlighted the use of digital tools • Pedagogical techniques of teaching highlighted adequate use of digital tools • Assessment strategies rarely indicated the use of digital tools • Exam reports are prepared digitally and sent to parents
6	School F	Lesson plans (5)	• Lesson objectives did not highlight the use of technologies • Teaching strategies hardly highlighted the use of technologies • Learning activities did not mention the use of technologies • Assessment strategies did not mention the use of digital tools • Exams reports were sent to parents in a printed format

* Indicates non-government secondary schools.

digital culture as they were mostly teaching traditionally. Other studies indicate that teachers did not integrate ICT as a pedagogical tool in their teaching due to several factors, which include lack of ICT facilities, limited ICT training opportunities, and lack of context-based digital content that may support digital learning [17, 39, 40]. This could be an indication that without proper institutional support and digital resources, teachers will continue to struggle to engage students in digital learning experiences, which in turn perpetuates limited development of digital skills. It is possible that both teachers and students remain unprepared for working in the technological learning environment, which may ultimately impact digital inclusion in learning. While many countries are embracing the need for digital inclusion in learning, the results of the current study revealed some indicators of exclusions in the sense that some schools hardly integrated technologies into teaching. Many teachers who participated in this study felt unprepared to teach in the digital learning environment, and schools did not have specific programmes to upgrade their digital skills in teaching. In other studies, teachers reported that students lacked the necessary digital literacy skills to navigate their online education during the COVID-19 pandemic while their pedagogical challenges remain unsolved [14, 54]. It is on this basis that the current study highlights the need for an improved digital learning environment in schools and teachers' capacity to teach in the digital learning environment.

4.1.4. Online assessment and feedback

The participants reported using technologies for assessing students' learning and providing feedback through virtual platforms during and after the post-COVID-19 pandemic. One head of school from School E commented that:

> I noted that during the COVID-19 pandemic, teachers were using digital platforms to assess students' learning. We used Google Classroom to share resources and engage students in assessment activities. Even after online assessment, it has been a common practice for some students, though not practised frequently. (Interview with the Head of School E, April 2024)

On the same concern, one teacher from School B stated:

> Every day, I use digital platforms to assess students' progress because it is very easy to prompt marking and feedback. Since the outbreak of the COVID-19 pandemic, I have been providing online quizzes and home assignments to students. (Interview with Teacher 6 from School B, April 2024)

Other participants felt that their students had limited chances to participate in online assessment activities due to insufficient digital devices at school. On this, one of the heads of schools commented:

> Some students lack the chance to do online quizzes and assignments, as teachers have illustrated. Few of them manage to complete the online assignments timely. Some of them could not fail to attend the online assignment during the school closure due to a lack of smartphones and laptops at home. (Interview with Head of School E, April 2024)

The preceding quotes indicate that teachers somehow utilise digital tools for online assessment and reflective feedback to students. However, several concerns were reported by participants, which appear to compromise students' ability to participate effectively in online assessments. Respondents felt that some students are discriminated against from assessment activities and online feedback due to their inability

to possess their personal digital devices. Usually, students who face such challenges have digital skills acquisition delays, and their learning is not smooth. While the national standards for teachers and the national curriculum framework emphasise the need to develop a digital society by promoting digital skills among students [31, 53], digital solutions have not been harnessed fully to support the same [23].

Reflecting on the responses from participants, in fact some students failed to do their assignments due to poor access to digital facilities like desktops and laptops. The results from the current study support the study conducted by Singh, Singh and Nermend [52], who found that lack of access to digital devices is a factor that leads to the digital divide. This is an indication that there is a need to improve the accessibility of digital devices such as computers, laptops, and computer labs to support students' engagement in online assessment and reflective feedback. Several evidence from other researchers also indicate that many teachers faced challenges in designing and implementing online assessments that aimed to measure students' understanding of the subject matter during and after the COVID-19 pandemic [10, 49]. In this situation, students received little support in online assessment, which may imply not receiving accurate feedback on their performance and learning from the assessment.

While the national digital learning strategy emphasises the need to leverage technology to promote online assessment and feedback, many education institutions in Tanzania are lagging due to limited access to digital solutions such as learning management systems and infrastructure [5, 38–40]. This has been a challenge in most education institutions in African countries where digital learning is given little priority.

5. Conclusion and recommendations

The exploration of teachers' pedagogical practices during and after the COVID-19 pandemic in Tanzanian secondary schools reveals a significant digital transformation in instructional methodologies. The outbreak of COVID-19 facilitated a rapid adaptation to online learning, which highlighted both the challenges and innovative strategies employed by teachers. The findings indicate that teachers were obliged to embrace technology with limited resources and limited digital competence and training, leading to varied experiences of success and struggle. The experience gained by many educational institutions during COVID-19 marked the beginning of critical reflection on how technologies may support pedagogical developments among teachers in many countries. Perhaps the experiences during the pandemic have also highlighted the need to revisit the ongoing professional development programmes for teachers to enhance their pedagogical skills to reflect fully technology-enhanced teaching.

This study concludes that some critical reforms are needed regarding the ongoing professional development programmes for teachers in sub-Saharan countries where technological investments in education are given less priority. Many schools in sub-Saharan Africa face several challenges, such as a lack of infrastructure, unreliable internet connectivity and administrative support. Investing in digital solutions that aim to equip teachers with the digital skills needed for teaching in the 21st century would improve the integration of technology in teaching. The challenges posed by the pandemic in many countries prompted many educational institutions to embrace technology and alternative instructional strategies. This transition not only highlighted the importance of digital literacy but also underscored the necessity for ongoing professional development to equip teachers with technology-enhanced pedagogical skills for effective digital teaching and learning. It makes sense to note that the insights gained from this research can inform future pedagogical practices, ensuring that teaching remains responsive to both current needs and unforeseen challenges. This

study provides insights that can inform the development of professional development programs and the design of digital learning resources. The adaptive strategies teachers employ to navigate digital teaching environments highlight key competencies that can be integrated into professional development initiatives. Based on the findings of the study, it is possible to note that future professional development programmes may focus on enhancing teachers' digital literacy, promoting innovative instructional approaches, and facilitating collaborative practices that emerged during and after the pandemic. Additionally, the findings highlight the importance of designing digital learning resources that align with the diverse learning needs of students, enabling personalised learning experiences.

5.1. Limitations of the study

The study of teachers' pedagogical practices during and post-COVID-19 in Tanzanian secondary schools faces several limitations. Firstly, this research may not have captured the full dimensions of experiences during the transition to online learning as it involved a smaller sample. Further ethnographic research may be conducted to include more dimensions of the adoption of technologies, which may include culture, behaviour and interactions with technologies among teachers. Additionally, there may be a bias in self-reported data, as teachers may overstate their positive adaptations or downplay challenges faced due to external pressures and their attitudes towards the integration of technology in teaching. Limited access to technology and varying levels of digital literacy among teachers can also influence their responses, as some may have had more opportunities to adapt than others. Furthermore, the focus on secondary schools may overlook the experiences of other levels of education, limiting the generalizability of findings across different educational levels. Conducting further research employing survey design and engaging other levels of education would yield more comprehensive results that can be generalised. The research did not establish new methods of teaching but instead described limitations for technology-enhanced pedagogy. Future research may focus on establishing new methods of teaching or a new combination of methods suitable to the Tanzania educational context.

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