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The Impact of the Pandemic on Digital Literacy Skills for Online Teaching in Zimbabwean Schools: A Mixed-Methods Research Approach

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ABSTRACT

The COVID-19 pandemic has forced a rapid shift to online teaching and learning, presenting challenges for teachers in developing countries such as Zimbabwe. This study employed a sequential mixed-methods research approach to explore how rural Zimbabwean teachers relate to digital technologies and how their digital literacy skills impacted their online teaching during the pandemic. An online questionnaire was administered to a purposeful sample of 100 teachers, followed by telephone interviews with ten key informants selected through cluster sampling. The findings revealed that limited digital literacy skills and socioeconomic factors were major barriers for rural secondary school teachers in accessing, creating, evaluating, and sharing teaching information with their learners. This study highlights the need for increased support to enhance teachers' technological knowledge in the face of complex demands for digital literacy, exacerbated by unprecedented challenges such as worldwide pandemics. The mixed-methods research approach allowed for a comprehensive investigation of this complex educational problem, drawing on qualitative and quantitative perspectives to capture the historical context and multifaceted nature of teachers' challenges in integrating digital technologies into their teaching practices.

KEYWORDS

Digital literacy; Online teaching; COVID-19; Mixed-methods research; ICT integration; TPACK model; curriculum

INTRODUCTION

There has been an increase in social science and interdisciplinary researchers interested in asking several research questions about a phenomenon that covers both qualitative and quantitative perspectives. In this regard, such researchers are considering mixed-methods research (MMR) to address the problems under investigation. The development and use of MMR came about partly due to paradigm wars in which constructivist and positivist researchers attack one another based on the limitations of the two major research paradigms. Paradigm wars have also infiltrated the field of educational research, where the most complex educational problems, such as the MMR approach, are required Scoles et al. (2014). Thus, a large toolkit of methods is required in the educational landscape to address complex issues (Creswell & Garrett, 2008). Teachers face multifaceted challenges in the era of digital technological advancement, making it imperative for education practitioners to integrate information technologies, teaching, and learning. The complex demands for digital literacy are surrounded by unprecedented, challenging contexts, such as worldwide pandemics, that force teachers to utilise digital technologies in their work execution. The use of MMR to conduct investigations is slowly gaining traction in such contexts.

Sequential mixed-methods research was used to explore the context of the study. World Wide Web, Information, and Communication Technology (ICT) have affected many domains of life, including the education sector is one such domain (Wen et al., 2012). The use of technology in education has evoked a paradigm shift from traditional face-to-face teaching and learning to the creation of virtual learning interactions, which has promoted teaching and learning outside the physical boundaries of the four walls (Maphosa, 2021). Traditional teaching and learning are based on traditional modes that are strongly reliant on face-to-face human interfaces. Electronic teaching and learning are mainly perpetuated by new media forms of information dissemination using a computer screen interface without human faces. The new media seems politically supported (Soules, 2007).

The shift from conventional face-to-face to online and virtual learning has afforded much educational instruction, which has integrated ICT into the curriculum to switch to remote-based teaching and learning during the outbreak of Coronavirus disease 2019 (COVID-19) worldwide. The demand for know-how to access, use, share, and evaluate information has been highlighted by the outbreak of the COVID-19 pandemic, which saw nations worldwide closing education institutions due to national lockdowns. Although online teaching has proven to be a way to go, especially during crises such as COVID-19, teachers in most developing countries face challenges in using digital technologies to support teaching and learning (Lengwadi et al., 2024; Mhlanga & Moloi, 2020; UNESCO, 2020).

Mhlanga and Moloi (2020) and UNESCO (2020) concur with Nguyen (2015) that online teaching and learning may not be as good as traditional face-to-face teaching and learning. The argument is that traditional resources with curriculum information are usually printed materials, such as published textbooks, accredited resources, and teaching and learning materials. They

suit the context and intent of curriculum needs. In contrast, online teaching and learning information and materials may not always satisfy the prerogative. Consequently, consumers of such information, especially learners, may be unable to identify appropriate content for their educational needs at a particular time. It calls for well-informed, disciplined learners who can evaluate the information they encounter in their endeavours to acquire, internalise, or share it with their peers, schoolmates, or classmates.

Challenges in using digital technologies in eLearning are typical of most African nations, including Zimbabwe. E-learning is concerned with using computer technologies to support learning, whether that learning is local (on campus) or remote, at home, or in the workplace. The use of technology throughout people's lives, particularly in school, college, and work environments, means that learners expect to encounter technology, which is no longer innately new (Gordon, 2014). Little has been done by information and knowledge management science professionals and interdisciplinary researchers to critically articulate the challenges faced in supporting online teaching and learning during pandemics in developing countries. The shift to online teaching and learning has occurred in a context where most schools in developing countries use traditional teaching methods. MMR was used because the problem is historical, complex, and investigative. To fully cater to the problem, there is a need to utilise the MMR approach to explore how Zimbabwean teachers relate to digital technologies and how their digital literacy skills impact their online teaching during pandemics.

Research Problem

In the field of social sciences, there is controversy that qualitative research is not scientific by groups of people (Denzin, 2009) and that scientific research means quantitative research (Walters et al., 2009). In recent years, however, there has been noticeable growth in scientific awareness of the need to reconcile the traditional binaries of qualitative and quantitative research paradigms in social and behavioural sciences. In its endeavour to effectively capture the complex nature of educational research, MMR is regarded as a significant research approach, combining insights from constructivist and positivist perspectives in a single study. Such reconciliation is attracting researchers to draw on mixed-methods research.

Before the outbreak of the COVID-19 pandemic, the education systems in developing countries had shown the wish, zeal, and ambition to migrate from traditional face-to-face pedagogical practices to online, e-learning, and digital communication media. The pressure to transition to digital methods of communication arises, among other things, from new national policy developments that seek to promote ICT in all domains of life in third-world continents and countries such as Africa and Zimbabwe. Unfortunately, 75% of the population is technologically incapacitated in countries such as Zimbabwe. The mind-boggling puzzle researchers ask is, "Is it possible to utilise mixed methods research in studying digital literacy skills for online teaching in Zimbabwean schools during the pandemic?"

LITERATURE REVIEW

Several scholars have framed their studies on the MMR. Ngulube and Ngulube (2015) conducted a mixed-methods research in South Africa. They investigated trends in economics and management literature. In another study, Ngulube (2020) conducted mixed-methods research in knowledge management studies from 2009 to 2014, and a content analysis of journal articles was thoroughly conducted. Tashakkori and Teddlie (2010) promulgated the Sage handbook of mixed methods in social and behavioural research, a useful book which sheds light on mixed-methods research. Cohen et al. (2007) looked at research methods in education. Their study was not a mixed-methods study. However, they provided qualitative and quantitative research methods. Onwuegbuzie and Collins (2007) raised a setting of typologies of mixed-methods sampling designs in social science research, but the study is biased towards qualitative initiatives.

Nguyen (2015) conducted a vast study on the effectiveness of online learning, going beyond significant differences and future horizons of online learning and teaching. Although Nguyen's (2015) study was based on issues related to online education, it was purely a systemic literature review. Hence, using findings from only qualitative systematic literature reviews may not be sufficient for future researchers interested in conducting educational research that provides robust findings and directions. Because of such limitations, the authors of this study conducted educational research centred on online education challenges from a mixed-methods perspective. Nonetheless, Nguyen's (2015) study was relevant because it informed us regarding the context in which the research was conducted. Having informed decisions from other scholars to strengthen their academic writing is crucial. Nicole (2022), a legal scholar on South Africa's Protection of Personal Information (POPI) Act, informed this study regarding legal actions needed to protect information in an online platform, including education. This played the same role in education as a public institution which deserved protection. Wen et al. (2012) raised the concept of personalised content provision for virtual learning environments via the semantic web as an innovation in the teaching and learning of information and computer sciences. This study was limited to virtual education in specific disciplines. In the study conducted, the authors examined teaching and learning holistically. Chitanana (2009) assessed the utilisation of computers as teaching and learning resources in selected urban schools of Gweru in Zimbabwe using a quantitative approach.

Nziramasanga (1999) was tasked by the Zimbabwean Presidential Commission of Enquiry into education and training to pass recommendations, including ICT implementation. However, it has not taken a toll due to some challenges raised in the mixed-methods research investigations. Shadreck (2015) paved the way for our study by researching the integration of ICTs into primary school environmental science classrooms in the Chegutu District of Zimbabwe. This study focused on problems and solutions. This study was echoed by Shilenge and Ramaila (2020), who assessed technological pedagogical and content knowledge (TPACK) integration in senior-phase science teaching and learning in South African township schools. This study is

limited by its ideological approach, looking at science teaching as if science is the only subject deserving of online teaching and learning.

Smits (2006) simulated online teaching and learning to tame monsters in the cultural domestication of new technology using technology. Soules's (2007) study of the bias of communications and a monopoly of power is vital for the Zimbabwean education system to understand the consequences of online education on our societal ecosystems. Twenge (2013) seems to support the complexities of taming monsters by looking at the cultural deformities resulting from the use of technology in teaching and learning by highlighting the evidence for a generation "me" and against generation "we" from emerging adulthood. UNESCO (2020) seems to question the sustainability of education post-COVID-19.

Isaacs (2007) surveyed ICT and education in Africa, focusing on South Africa, and compiled a country report demanded by the World Bank. Padayachee (2017) conducted a snapshot survey on ICT integration in South African schools. Slonje et al. (2013) exposed the nature of cyberbullying and strategies for prevention from the broad perspective of computers and their influence on human behaviour. Taplin (2017) appeared to be elaborating that if the world moves fast, it has chances to break things. This was investigated through how Facebook, Google, and Amazon have cornered culture and what it means for everyone worldwide. The studies reviewed in this study were largely a single method, either purely qualitative or quantitative. An MMR approach was used to obtain more balanced results.

RESEARCH METHODOLOGY

The study employed a mixed-methods approach to illustrate how teachers relate to digital technologies and the effects of their digital literacy skills in work execution and in times of pandemic crisis and the growth of e-learning. Mixed methods refer to emergent research methodologies that systematically integrate quantitative and qualitative data into a single study. Integrating both quantitative and qualitative elements allows a more synergetic utilisation of the data than when the data analysis is done separately for quantitative and qualitative collection and data analysis. Ngulube and Ngulube (2015) and Ngulube (2020) emphasised that mixed methods research guarantees the authenticity of findings because no stone is left unturned during data, information, and knowledge enquiry. As Ngulube (2019) and Teddlie and Tashakkori (2010) illustrated, the research question determines the specific methodology to investigate reality. As already indicated, the purpose of the case study was to describe teachers' relationships with digital technologies and online teaching, the effects of digital literacy on work execution, and teachers' opinions on digital technology concerning effective teaching and learning in times of pandemic crisis and the growth of eLearning. This guarantees the use of both qualitative and quantitative methods.

This study used an explanatory sequential design involving quantitative and qualitative data collection phases (Creswell & Garrett, 2008). In other words, the qualitative phase builds directly on the results of the quantitative phase, resulting in a more detailed analysis. A case

study survey was used to distribute an online questionnaire to 200 Zimbabwean secondary school teachers in rural schools in the Masvingo Province. Of the 200 participants, 100 completed and returned the questionnaire to the researchers. Of those 100, cluster sampling was used to select ten informants who responded to semi-structured telephonic interviews. Cluster sampling was used because it applies to both qualitative and quantitative sampling approaches (Creswell & Creswell, 2017). The ten key informants were consulted and given anonymous names to protect their identities. The interview guide comprised the same themes as those expressed in the questionnaire, and the interviews were conducted after administering and receiving the online questionnaires. The qualitative method was also used to establish the problem from non-participant observation of the discourse of ICT in the classroom during the coronavirus Infectious Disease 2019 (COVID-19) and was case-studied for all other pandemics. The qualitative aspect was extremely limited in raising sufficient information to deal with the problem, given that Zimbabwe had a population of 14.98 million in January 2021. Zimbabwe's population increased by 223 thousand (+1.5%) between January 2020 and January 2021.52.3% of Zimbabwe's population is female, while 47.7% of its population is male [note: the United Nations does not publish data for genders other than 'female' and 'male'],32.3% of Zimbabwe's population lives in urban centres, while 67.7% lives in rural areas (Kemp, 2021).

This population calls for huge data management and quantum statistics, which can be easily interpreted using quantitative techniques and systems. This population faced challenges in providing education during the lockdowns and closure of schools due to outbreaks and the spread of pandemics, which would not allow face-to-face tuition. This population size was too large to generate a representative qualitative sample. The quantitative method was also employed through an online questionnaire to gather data from 100 teachers. Thus, the researchers used an explanatory mixed-method design in which quantitative data were collected first and followed up with interviews to help explain any outliers from the online questionnaire results. The online questionnaire was loaded through Google Docs. A series of questions were specifically structured to gather survey data on the impact of the pandemic on digital literacy skills for online teaching in Zimbabwean schools (Ngulube, 2019).

Qualitative data were analysed through thematic analysis, while quantitative data were analysed and presented, as shown in Figures 1, 2, and 3. The interview data were transcribed and coded. The researchers further coded the data into potential themes, reviewed the themes, and presented the findings in those themes. Both qualitative and quantitative findings were discussed and triangulated to enhance the validity of the results, as shown in the subsequent sections. In MMR, the data are analysed systematically. Usually, if data-gathering processes are performed properly, depending on the proportions of the mixture of methods, the data analysis will not miss anything crucial. The mixed methods allow these methods to complement each other. In the analysis process, the data either converged or diverged. If the data converge, researchers must determine the reason. If it diverges again, there is a need to provide reasons. MMR analysis allows researchers to develop comprehensive reports. Thick qualitative

descriptions clarify the issues, and precision is gained from the quantitative presentations, allowing decision-makers to make reasonable plans to resolve the problem. Among the other types of validity, this study used criterion validity to verify that the instruments aligned with an external criterion by testing them against one. Transferability was used to help readers understand how findings could apply to different contexts and provide thorough, detailed descriptions. Methodological triangulation was used to answer given research issues by employing qualitative and quantitative approaches to ensure that the results of one approach complement or make sense of the other.

FINDINGS

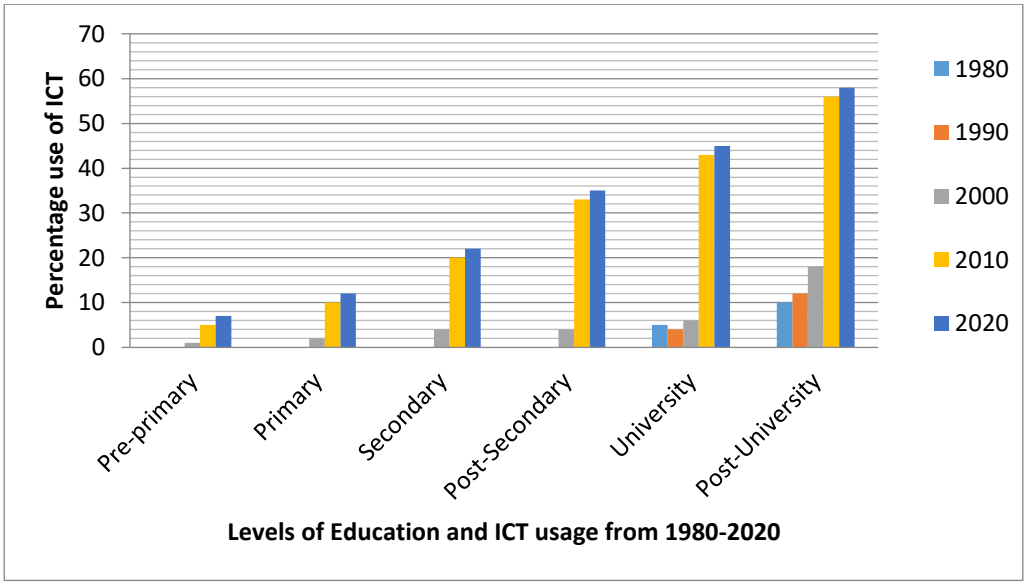
Zimbabwe has made significant strides in ICT development in education, but challenges like infrastructure, digital literacy, and affordability persist in rural areas, necessitating government investment and private sector involvement. The United Nations Millennium Development Goals emphasise the importance of ICT, with Goal 8 stating that new technologies should be accessible to all, emphasising the need for education to be literate in information technology processes. The findings are fully elaborated on in the preceding paragraphs.

ICT Development in Educational Institutions in Zimbabwe

The importance of ICT was captured and highlighted in the United Nations Millennium Development Goals of 2000 as a global agenda. Goal 8 articulates the need to ensure that the benefits of new technologies, such as ICTs, are accessible to all (Guvhu, 2018). Thus, the education sector plays a pivotal role in enhancing the production of knowledge and information and in sharing them with learners. Consequently, for teachers and learners not to be left behind, they need to be literate in information technological processes. According to this study, ICT development and the use of technology for educational purposes from 1980 to 2020 are shown in Figure 1.

Figure 1.

Usage of ICT in Zimbabwean schools



Since 1980, ICT has been used in pre-primary, primary, secondary, and post-secondary schools. ICT occurred in university and post-university from 1980 to 2020, although in very small percentages. Pre-primary, primary, secondary, and post-secondary began using ICT in 2000. The quantitative summary of ICT Usage and development in Figure 1 is further illuminated through qualitative descriptions of ICT development in Zimbabwe.

The development of information communication technologies (ICTs) in Zimbabwe's education system can be traced back to the beginning of the 21st century. The Zimbabwean government developed the National ICT in 2005. The Nziramasanga Education Commission Report of 1999, the National Science and Technology Policy of 2002 and the country's Vision 2020 (Isaacs, 2007) informed the policy development. Alongside Zimbabwe's Millennium Development Goals report of 2005, the National ICT policy of 2005 recognised the potential of ICTs to contribute to achieving Vision 2020 to transform the country into a knowledge-based economy. However, the literature confirms that many teachers in primary and secondary schools lack ICT skills, which could help them implement ICT-related curricula (Maphosa, 2021; Mhlanga & Moloi, 2020). Figure 1 shows that before 2020, ICT usage in the basic education sector was very low. In 2000, 2010, and 2020, pre-primary school ICT usage percentages were 2%, 4%, and 7%, respectively. ICT usage in the three decades was 5%, 10%, and 12% in 2000, 2010, and 2020, respectively. The usage of ICT in secondary education was 4%, 20%, and 22 in the same year. Quantitative data show that the use of ICT in basic education in Zimbabwe is very low. Qualitative descriptions provide richer historical and contextual details, complementing quantitative data. Indeed, from such evidence, this study contributes knowledge to the need to rethink teachers' digital literacy skills in the face of pandemics and the global demands of e-learning through a mixed-methods approach in developing countries where ICT usage in teaching and learning, especially in basic education, is still very low.

Upon adopting the National ICT policy, the president's office launched a campaign to provide most schooling institutions with computer-related equipment. In the 21st century, ICTs are prioritised as invaluable tools to empower teachers and learners with the skills needed to confront the challenges of a changing world. The presidential launch was a progressive move promoting the pedagogical use of ICT. However, the launch did not provide adequate computers for all schools and teacher colleges in the country. It should not be overlooked that before 2005, teacher training institutions did not offer courses in information communication technologies (Gomba, 2016). Consequently, many teachers who received training before 2005 did not have adequate digital literacy skills. Most of these teachers are currently employed in an era where digital literacy is a must-have.

When implementing the National ICT policy, the College Information Technology Enhancement programme was compulsory at all 15 teachers' colleges (Gomba, 2016). The college lecturers also received ICT training through workshops based on the trainers' concepts and peer-to-peer teaching. It became mandatory for a student teacher to be certified in any of the 15 colleges, and he/she should have passed the ICT course. Along the way, the Ministries of

ICT and Primary and Secondary Education started collaborative programmes which articulate ICTs as a key pillar for developing a digital economy in the country. Such strategic programmes are important in combating the negative impact of emergencies such as the COVID-19 pandemic. Furthermore, the Post and Telecommunications Regulatory Authority of Zimbabwe (POTRAZ) continues to provide gadgets for schools, especially those in rural areas (UNESCO, 2020).

POTRAZ and its Contribution to the Zimbabwean Education Sector

POTRAZ promotes technology integration into the curriculum of Zimbabwe's educational system (POTRAZ, 2016). Its annual report reveals that 1,300 schools in Zimbabwe benefited from a School Connectivity project which provided Internet connectivity, websites with e-learning content, email services, and video conferencing equipment. In another project (an e-learning project), POTRAZ procured and donated 3 224 computers to 221 schools around the country to enhance e-learning activities in the education sector. Several schools in all nine provinces have benefited from POTRAZ (MoPSE, 2016; POTRAZ, 2016).

The POTRAZ ICT intervention programme has been extended to include higher education. Currently, the authority is negotiating with the Zimbabwe Council for Higher Education to provide financial assistance and to establish a digital inclusion and information portal for Zimbabwean universities (POTRAZ, 2021). The portals' core objective was to host various information courses common to universities and community members. The centre will add to the 146 Community Information Centres commissioned in different parts of the country. POTRAZ has also announced its intention to set up four new base stations in the country's provinces: Matabeleland South, Midlands, Mashonaland Central, and Mashonaland West. Another project in the pipeline by POTRAZ, with the assistance of the Universal Service Fund, is to deploy a 120 km fibre link from Rutenga to Chikombedzi, two townships in Masvingo province. Another noticeable step in facilitating ICT in education is the offshoot of the UNESCO agenda in Africa. UNESCO has a long history of facilitating educational objectives in Zimbabwe, among other countries. Against this backdrop, the organisation has been working with the Zimbabwe MoPSE and has developed a professional development programme called Rapid Teacher Training on open, distance, and online learning programmes. The programme supports teachers in facilitating teaching and learning during the COVID-19 pandemic using ICTs (UNESCO, 2020). The programme offers a course that introduces teachers to basic digital skills, remote learning methods, and the integration of ICT in teaching and learning. The programme started in early 2021, and by the end of May 2021, 1,400 teachers had been trained in all nine provinces in Zimbabwe.

The 2015 Curriculum Review in Zimbabwe Integrating Open Distance Learning and E-learning

In September 2014, the Ministry of Primary and Secondary Education (MoPSE) consulted the public nationwide about the proposed curriculum review and phasing (MoPSE, 2016). The efforts put by the MoPSE to review the old curriculum resulted from several factors, including the agrarian reforms introduced in 2000, the implementation of the 2005 ICT national policy,

the new Constitution of 2013, and largely, the Nziramasanga Commission report of 1999 (Gomba, 2016; Kabanda, 2015). The Nziramasanga report was compiled by the Presidential Commission of Inquiry into Education and Training (Gomba, 2016). Among the issues raised in the report about the curriculum in use were the following:

- The old curriculum lacked national values to guide learners.
- It does not promote reliance or entrepreneurial skills.
- It did not promote the teaching of science, math, or technology (Mandoga et al., 2013; Musarurwa, 2011).

The MoPSE was also triggered to update the curriculum because of the expansion in the capabilities of ICTs in a global village-driven economy, which underpins the dire need to develop new skills to live and work competitively.

The Curriculum Review in Zimbabwe, which led to the adoption of the new curriculum in 2015, revealed that the education curriculum did not include ICT integration visions. Thus, the grassroots level of digital literacy remained low, which stimulated the uptake and usage of ICTs within public schools in the country (MoPSE, 2016). Thus, the integration and use of ICTs within schools is still limited in most parts of the country. There is a conspicuous contradiction to the reality of the country's National ICT policy, which aims to be equitable, valuable, inclusive, relevant, and competent-driven (Gomba, 2016; World Bank, 2015).

Difficulties are experienced apart from government attempts to provide ICT resources needed to promote ICT policy initiatives. Gomba (2016), Kabanda (2015), and Shadreck (2015) concur that ICT-related proposals in the Zimbabwean education context lack scholarly inquiries that could guide such initiatives. The dearth of enquiries focusing on the challenges faced by teaching staff in most schools in the country is part of the motivation behind this study.

In most developing countries, integrating ICTs into teaching and learning is difficult in Zimbabwe. The literature confirms that most teachers in rural areas have never used overhead projectors, video conferencing, or any other instructional software. Because of this lack of knowledge, it is common for teachers not to use ICTs. They always want to cling to traditional methodologies challenged by outbreaks of diseases such as COVID-19 worldwide and natural disasters such as cyclone Idai in Zimbabwe and Mozambique. Less digitally literate teachers are less confident in using ICT gadgets in their teaching because they lack technical knowledge. In Zimbabwe, teachers in both primary and secondary schools opened classes through WhatsApp groups with learners and their parents. While teachers prefer using WhatsApp groups as teaching-learning platforms, UNESCO (2020) COVID-19 Education Response recommends using Zoom and Google Classroom for teaching and learning.

Curriculum researchers assert that the success of any proposed curriculum can be measured by its implementation. In implementing the 2015 curriculum, the Zimbabwe education sector suffered from inadequate instructional materials and facilities and inadequate qualified teachers, among others. This drawback is especially experienced in schools in rural Zimbabwe. Although the reviewed curriculum of 2015 emphasises the integration of ICTs in

promoting teaching and learning, teachers' inability to apply ICT in most schools in the country militates against online teaching and eLearning. Therefore, there is a gap in the skill enhancement programmes for teachers to ensure and enable digital literacy. The gap also reveals inadequacies in accessing correct information using digital tools, developing a critical perspective of learners' diverse needs, organising educational activities in digital environments, and evaluating and controlling biased information (Gozum & Demir, 2021). Scholars also assert that COVID-19 pandemic experiences have revealed that teachers do not adequately possess the digital skills and competencies required for remote teaching and learning (Ali, 2020; Alipio, 2020; Maphosa, 2021). Thus, it should be noted that, in the age of COVID-19, teachers face many problems in executing their duties. It should also be highlighted that most of the literature reviewed is based on either qualitative or quantitative approaches. Thus, there is conspicuously a lack of research on ICT from the pragmatic or mixed-methods paradigm.

TPACK Model for Zimbabwean Education

This study used the theoretical framework model of technological pedagogical and content knowledge to underpin the discussions. The study was based on Mishra and Koehler's (2006) TPACK model. Their model is an extension of (Shulman, 1986) technological and pedagogical content, which represents blending content and pedagogy to understand how specific topics, problems, or issues are organised and adapted to learners' diverse interests and abilities (Shulman, 1986). The TPACK model is premised on seven dimensions divided into three main domains: technological, pedagogical, and content knowledge. The four sub-domains are discussed below.

The technological knowledge (TK) domain associates teaching and learning with the cooperation of traditional analogues and technologies (Mishra & Koehler, 2006). Thus, a teacher with a sound TK base understands three things. First, the teacher understands how to integrate information communication technologies to improve teaching methods and enhance learning (Koehler & Mishra, 2009). Second, technologically knowledgeable teachers can fit ICT tools into teaching, learning, and learners' daily lives (Mishra & Koehler, 2006). Finally, teachers with TK can use contemporary information communication technologies. The second domain is pedagogical knowledge. This domain relates to the knowledge of teaching strategies to support learning. The third domain, content knowledge, describes the specific discipline of subject knowledge a teacher delivers to learners (Koehler & Mishra, 2009).

The TPACK model further explicates four subdomains, illuminating the dynamic intersectionality between the three main domains. Interconnectedness is referred to as pedagogical content knowledge. It is the intersectionality of knowledge of teaching strategies, learners' prior knowledge, and specific content elements (Shulman, 1986). The second intersectionality is technological pedagogical knowledge. It elaborates on the reciprocal relationship between technology and teaching practice. It also outlines how technology enhances or hinders pedagogical processes. The third interconnectedness highlights the functional roles ICTs play in promoting or constraining the content of any subject a teacher can

deliver to learners. The central and last intersection is TPACK, which draws from all three primary knowledge domains. This centrality highlights the comprehensive intersectionality of technology, pedagogy and content. Mishra and Koehler (2006) emphasise that the TPACK perspective can effectively enhance teachers' technological pedagogical content knowledge. Every teacher could use the model to set the vision, direction, and goals of their teaching. The vision and goals help to promote effective instructional and evaluation practices by teachers who use ICTs. Thus, teachers' ICT knowledge and skills are dire under the TPACK perspective to ensure that ICT integration yields positivity. From the theoretical discussion that undergirds this study, it is evident that teachers should possess special technological and pedagogical content knowledge for effective online teaching and learning.

Reflections on the Mixed Methods Case Study Data

The data collected from the online questionnaire with the teachers were analysed, and the challenges teachers face in integrating ICT into their teaching are presented in Figure 2.

Figure 2.

Challenges affecting the adoption of ICT

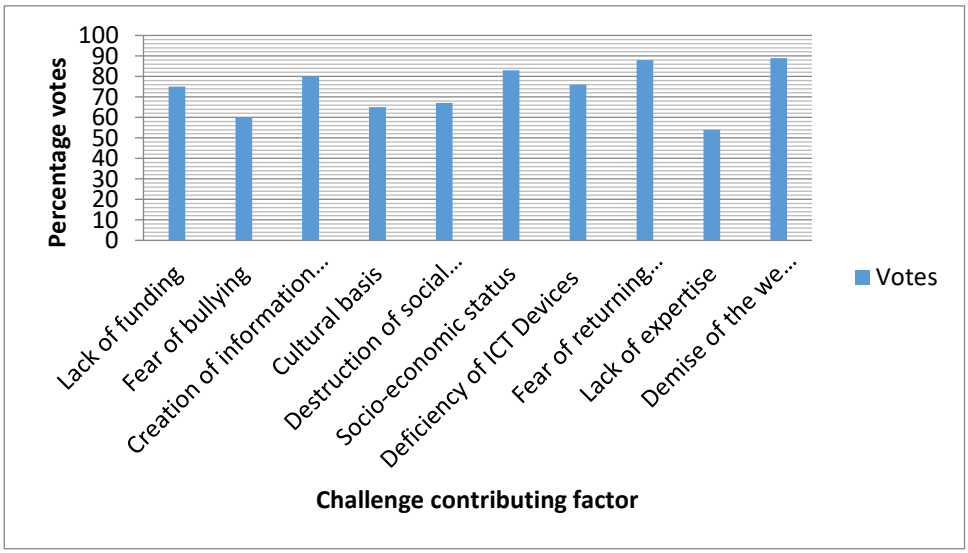


Figure 2 summarises the factors contributing to teachers' use of digital technologies in Zimbabwe during the pandemic. According to the data presented, people are worried about the demise of face-to-face teaching and learning. The teachers feared that the education system would return to a bottleneck. Other drawbacks to the effective integration of ICTs, teaching, and learning are the current pathetic socioeconomic status of most people in Zimbabwe, the creation of an information gap and lack of funding, and the least worry was the lack of expertise. All the challenging contributing factors were discussed using a quantitative approach, and all other missing details from the processes were selected in the qualitative data analysis. This is one of the major strengths of mixed-method research, especially if conducted sequentially, as in this study. For example, the data shown in Figure 2 are silent on the experiential voices of the teachers who participated in the study. Thus, the quantitative data in Figure 2 fall short of context-specific information, which may add value to understanding the challenge contributing

factors represented in Figure 2. The role of context was revealed through an interpretive presentation and discussion of the data from the teachers who participated in the study. This feature is presented in the following sections, in which qualitative data are presented and discussed in detail. This is one of the advantages of using MMR in a single study.

Lack of ICT Training in Teacher Professional Development

It emerged from the findings that some schoolteachers did not receive ICT training at colleges or universities to engage with ICT integration in teaching and learning. Thus, despite attending some ICT workshops facilitated by MoPSE, POTRAZ, and sometimes UNISECO, the participants expressed that those workshops were very few, and sometimes, UNISECO, the participants expressed that those workshops were very few and were conducted as crush programmes. In other words, workshop sessions were not thorough enough to equip attendees with lifelong digital literacy knowledge and skills. The following excerpts confirm this finding.

> *I completed my teaching qualifications before the colleges began teaching computers. Most teachers trained before 2004 shared their experiences. We feel comfortable teaching in a physical classroom using textbooks and a chalkboard; that is, how we were trained. I do not have confidence in using laptops and advanced information technology gadgets.*
>
> Similarly, another teacher stated the following:
>
> *We do not benefit much from ICT because the facilitators have loads of other workshops to conduct, so they rush through their presentations, assuming that we possess basic ICT knowledge.*

These findings highlight the fact that teachers have insufficient acute digital literacy skills. Teachers lacked sufficient knowledge about the use of technologies in teaching, largely because training in that regard was not conducted. In the context where training is offered, it is not sufficient to equip teachers with adequate technological knowledge that they can confidently infuse with the pedagogical and content knowledge they possess. From the TPACK vintage, the findings show that in-service teachers possess traditional teaching strategies with confidence in subject-specific content (Shulman, 1986), but the missing link is that such teachers lack TCK. Without this resource, using ICTs scares them, and they lack the enthusiasm to integrate digital technologies and teaching (Silverman & Patterson, 2021).

It was also expressed that not much was covered by those teachers who took up a course in ICT since they only attended two lessons on ICT. One teacher said:

> *Of course, I have some knowledge about ICT. We conducted an ICT course at a college, but there were only two weekly lessons, mass lectures for students in the whole stream, conducted in the hall. It was more of a theory because it was not easy to have hands-on learning, as the computer labs were always occupied.*

It was also revealed that

I know little about anything like Google Classroom, teaching Zoom, video conferencing, or even using overhead projectors. I am 45 years old but have never used these resources. We do not know how to use them in rural schools.

The excerpts above reveal a lack of TK. These findings echo those of Maphosa (2021) and Mhlanga and Moloi (2020), who stated that most teachers teaching in remote rural schools in developing countries do not have experience using ICT technologies. Lack of skills to fit in ICT resources, such as overhead projectors, is a barrier to implementing the ICT policy in education, as promulgated in the Zimbabwean updated 2015 school curriculum. It is lamentable that in critical times like the COVID-19 pandemic, participants do not know how to use Zoom or Google Classroom as virtual tools to facilitate the continuity of teaching and learning.

The case study revealed that most teachers who lack digital literacy skills are technophobic because they fear integrating ICTs into their teaching. Most of these teachers were long-serving members who had entered the teaching profession before developing and implementing the ICT National Policy in Zimbabwe. Apart from technophobia as a drawback, the country's constrained economy is one thing the Ministry of Primary and Secondary Education should pay attention to if it seeks to see effective integration of ICT, teaching, and learning. Otherwise, rural schools in most developing countries may take a long time to effectively shift to online teaching and learning because of socioeconomic hurdles.

The detailed verbatim statements captured from teachers who participated validate some quantified data in Figure 2, in which 54% of the sample showed that lack of expertise in the use of ICT is a challenge for teachers when they are expected to teach online due to pandemic restrictions, such as national lockdowns which have seen schools closed for prolonged periods. Voices provide the truth of the matter to those experiencing the challenge. The respondents' experiences provided context, which helped them understand more than just looking at quantitative figures. More information was obtained by mixing quantitative and qualitative methods in a single study.

Constrained Socioeconomic Conditions

The participants revealed that because of the economic hardships currently faced in Zimbabwe, the Ministry of Primary and Secondary Education struggled to provide enough resources to enhance the use of ICT in teaching and learning in schools.

I am computer literate, but I teach at a school that struggles to get ICT resources such as desktops, computers, and other ICT hardware. Therefore, socioeconomic factors are important. Economic meltdown affects the education sector. Therefore, we were forced to use WhatsApp for teaching (Teacher 9).

The participants revealed that most electrified rural schools relied on donations, which, when received, would not be sufficient to accommodate all the classes in each of those schools. There is a very low digital technology-to-learner ratio when school infrastructure is absent.

At my school, we received ten laptops from the former student association. Of these ten, one is used by the headmaster, one by the school bursar, and the other by the

receptionist. The remaining seven were inadequate for accommodating all teachers and learners in the school.

Another teacher revealed the following:

Our school uses only three computers owned by the headmaster and the administrative staff. The School Development Committee cannot afford to buy extra computers because the school coffers are always dry because of several factors: the fees paid by learners are very low due to inflation.

The above findings show that such low ratios hinder effective ICT-integrated teaching and learning, even in cases where some teachers may be knowledgeable about using digital technologies in classrooms. These findings corroborate MoPSE's (2016) affirmation that schools in Zimbabwe experience an acute shortage of ICT devices, resulting in many learners or teachers using one gadget. This situation hinders the effective integration of information technology into teaching and learning in these schools.

The findings also revealed that where teachers may have some knowledge of how to use basic digital technologies, such as smartphones, to teach through WhatsApp, most learners did not have access to the Internet. One teacher stated the following:

Most learners do not have smartphones; thus, it is difficult for teachers to use WhatsApp as a teaching tool. Remember that COVID-19 outbreaks occurred in the middle of economic hardship in Zimbabwe, so parents could not suddenly afford smartphones while they struggled to put food on the tables.

Other teachers revealed that, in Zimbabwe, most parents were poor and could not afford to buy smartphones for their children.

Our learners' parents were mostly peasants who could not afford to buy smartphones for themselves, let alone their children. Most of the parents did not work. There were no jobs in the country. A few smartphones cannot afford Internet data for online learning.

In the above findings, the teachers highlighted how parents' financial situations impact teachers' online teaching. Although teachers can teach learners remotely via simple WhatsApp group platforms, they may not have smartphone access. The scenarios highlighted in the above findings cause serious problems in the education sector in developing countries. Poverty militates against effective teaching and learning as teachers, schools, and parents can barely afford to buy the electronic devices required for effective remote-based teaching and learning. Consequently, the gap between people with low incomes and the reach is widened, causing social injustices that impede learners from poor communities from having equality and equity in access to education. The challenge of poor socioeconomic status of teachers, parents, and learners is echoed in the quantitative data in Figure 2.

Cyber Bullying as an Obstacle to Effective Teaching and Learning

Cyberbullying has been revealed to be one of the most catastrophic hindrances to digital literacy skills for effective online teaching and learning in schools. The questionnaire data indicated that eighty per cent of the respondents feared using online teaching tools because they feared

cyberbullying. Similarly, from the interview data, seven of the ten key participants raised that some of the learners they taught were scared to participate in WhatsApp online classes because they constantly received nasty comments from anonymous WhatsApp numbers. Cyberbullying is not unique to the Zimbabwean situation. Research has shown that this is common among learners in educational institutions around the continent and beyond. Thus, Africa is becoming a network society constructed around personal networks powered by digital networks communicating via the Internet. However, there is a high chance that networks will become operational personas that replace human interfaces, leading to perilous outcomes that people will fail to control.

Moreover, because networks are global and have no boundaries, a network society is a global network society. Issues such as the Protection of Personal Information (POPI) Act, 2013 of South Africa (Nicole, 2022) and the Access to Information and Protection of Privacy Act (AIPPA), which was enforced in 2002 by the Zimbabwean Parliament, will be difficult to observe. Thus, the education sector is responsible for helping learners learn about the Act and the effects of breaching what is promulgated in policy documents.

Cyberbullying is a crime which breaches security in an IS. The shift to remote-based teaching through online conduct between teachers and learners and learners among themselves is a serious threat that the Ministry of Primary and Secondary Education has to work on. The authors advocate a cyber security curriculum which accommodates teaching online ethics to learners. Learners should always ask themselves questions such as: Is the information I share ethical? Am I not offending my classmates and teachers if I respond this way online? How best can I participate in an online lesson without infringing upon the rights of other participants on the platform? Individuals have complicated introspective conversions, such as those promoting online ethics.

Developing countries are slowly becoming network societies constructed around personal and organisational networking systems powered by digital networks communicating through the Internet. Some information-sharing networks promoting cybercrimes influence people to become operational personas that replace human interfaces, leading to perilous outcomes. Cyberbullied learners experience anxiety and depression, which may cause them to stop submitting their tasks online (Chiome & Chindanya, 2015). Unfortunately, the effects of cyberbullying were not observed by the bully. Thus, the effects were significant. The point is that when learners post negative information about a classmate on a learning platform such as WhatsApp, they do not bother about how the victim will feel after receiving the information. Technology removes the bully from seeing the physical impact of their actions on the victim.

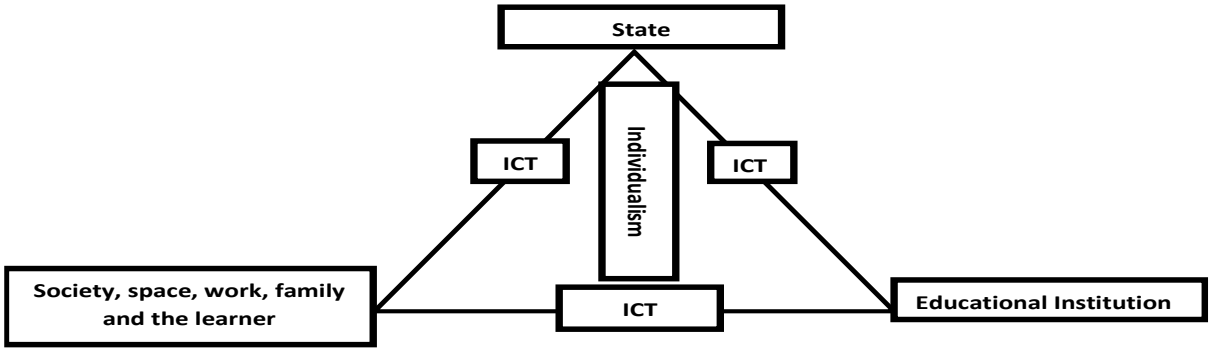
The issue of cybercrime emanates from the creation of individualised spaces afforded to children and everyone in the world of technology. It is based on the transformation of space work and economic activity (rise of networked enterprise and networked work processes), culture, and communication (shift from mass communication based on mass media to mass self-communication based on the Internet), the crisis of the patriarchal family, with increasing

autonomy of its members, the substitution of media politics for mass party politics, and globalisation as the selective networking of places and processes throughout the world. These changes can describe creating individual spaces as the rise of "me" centred society as conceptualised by Twenge (2013). The idea of a me-centred society can be linked to cyberbullying in that learners of the 21st century are concerned about using ICTs for their individual needs, so they do not mind if what they post about other learners is emotionally harmful.

Figure 3 summarises how technology has contributed to dismantling relationships among family members, learners, and citizens.

Figure 3.

State, society, space, work, family, student, and institution dismantled.



There is a general misconception about using ICT in the classroom: Teaching with ICT is not merely using Microsoft PowerPoint, nor is it teaching and learning computers. ICT does not understand that educational relationships are multilayered and change occasionally. These changes are controlled by the stakeholders' nature, style, and form (Lesame et al., 2011). ICT-based education requires a complete mindset change among stakeholders who either support or reject the emergence of an ICT culture. The new digital literacy skills for effective online teaching in Zimbabwean schools during pandemics and the advocacy of e-learning as a new approach are based on a new paradigm of change in education reform. There is consistency in the challenge of cyberbullying, as shown in the quantitative data, the critical analysis of literature on cyberbullying, and the qualitative data findings from the telephonic interviews were used to gather data from the respondents. The validity of the findings was enhanced using the MMR in this study.

Deficiency of ICT Devices in Schools and the Country

As the respondents revealed, another serious online teaching barrier was the unavailability of digital devices in electrified rural schools. The findings revealed that the rural electrification programme only installed and commissioned electricity. Schools should look for donations or buy the needed resources, such as overhead projectors, desktops, monitors, and related devices, to effectively use ICTs in teaching and learning. Some schools are electrified but too poor to purchase electric gadgets, such as overhead projectors and computers. In turn, this is a hiccup of the principles of democracy and social justice. Most countries always pay lip service

to equality, equity, and gender sensitivity, yet they keep widening gaps in all domains of life, leading to paralysis of socioeconomic cohesion.

The effect of not having enough ICT devices to use for teaching and learning kills the zeal to integrate ICT with teaching and learning. The teachers knew their schools were poor, so they could not afford the ICT gadgets. Consequently, they have lost interest in using ICT for teaching purposes. It is unfortunate for such teachers when the world is hit by pandemics such as COVID-19 and natural disasters such as cyclones. They are caught unaware, and their ignorance contributes, in a way, to the widening gap in access to education between urban schools and rural, poor schools. One can see from the above findings that there is a lack of relevant resources in Zimbabwean rural schools, and teachers need to integrate TPACK into rural secondary schools in the country. The lack of critical resources, such as computers and Internet access, is detrimental to the meaningful integration of TPACK (Alhababi, 2017; Shilenge & Ramaila, 2020).

CONCLUSIONS AND FUTURE RESEARCH DIRECTIONS

This research focuses on how MMR was used in a case study to investigate how teachers in Zimbabwean schools relate to digital technologies and how their digital literacy skills impact their online teaching during the pandemic. Through a sequential MMR approach, data from an online questionnaire and interviews provided rich insights into the challenges teachers in developing countries face in implementing ICT in their work execution, especially during pandemics. While developing countries are tasked with exploring innovative ways to promote digital literacy among all teachers and learners (Alipio, 2020), the million-dollar question is whether an abrupt approach to discard traditional teaching approaches will not cause more harm than good in contexts where those who teach lack the technological knowledge of how to integrate ICTs in teaching and learning. Interdisciplinary mixed-methods research by information science and educational researchers could help map a way forward to promote quality teaching and learning during the challenges of pandemics in the technological age of the Fourth Industrial Revolution.

Since mixed-methods research provides more detailed data from different research paradigms, researchers in the social sciences, behavioural sciences, and other disciplines that accommodate MMR should continue conducting MMR research. MMR plays a pivotal role in closing the binaries between positivist and constructivist wars in which researchers from each paradigm critique one another. Integrating ICTs into teaching and learning, especially in remote, poverty-stricken rural areas in developing countries, is still an ideal that can be fully achieved. Further studies are recommended to promote access to information, creation, evaluation, and sharing to enhance online teaching and learning. There is a dire need to explore how long-serving teachers can improve their digital literacy skills in an era in which remote-based teaching and open-distance learning are becoming the order of the day. Many teachers who participated in this research rarely used computers for preparation, administrative work, or classroom

instruction because schools do not have these resources. There is a need for research on professional development opportunities centred on integrating ICT into teaching and learning.

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