TEACHERS' USE OF INFORMATION AND COMMUNICATION TECHNOLOGY FOR CURRICULUM DELIVERY AT A MODEL SCHOOL DURING COVID-19

by

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DECLARATION

I, Shabbeer Wyngaard, hereby declare that "Teachers' use of Information and Communication Technology for curriculum delivery at a model school during COVID-19" is my own work and that it has not been submitted for any degree in any other university.

Signed: ……

Shabbeer Wyngaard (215018168)

Date: December 2024

ABSTRACT

During the COVID-19 pandemic, all schools in South Africa were required to use a variety of digital platforms and resources to sustain teaching and learning. This research study sought to answer the main research question: "How did the teachers use Information and Communication Technology (ICT) for curriculum delivery at a model school during COVID-19?". The research sub-questions in this study were: "What benefits did the teachers experience when using ICT for curriculum delivery at a model school during COVID-19?" and "What challenges did the teachers experience when using ICT for curriculum delivery at a model school during COVID-19?". The research was guided by literature about teaching and learning during the COVID-19 lockdowns, teachers' use of ICT, ICT training, the shift to blended learning approaches, and teachers' experiences of teaching during the pandemic. Studies by Parker et al. (2020) and Jansen and Farmer-Phillips (2021) about education during COVID-19 concluded that educational institutions as well as teachers experienced a variety of challenges but managed to make innovative use of ICTs to continue curriculum delivery during the pandemic.

This study is informed by Mishra and Koehler's (2006) Technological, Pedagogical and Content Knowledge (TPACK) framework in conjunction with Puentedura's (2006) Substitution, Augmentation, Modification and Redefinition (SAMR) model. This conceptual framework provided an understanding of the ICT knowledge (TPACK) that the teachers were required to possess, as well as the levels (SAMR) at which ICT was integrated into their curriculum delivery.

The researcher adopted an interpretive paradigm to conduct a qualitative case study. The research site was a Model School (MS) or technology-rich school. Seven primary school teachers were purposively selected as participants. The data collection instruments were seven semi-structured, one-on-one interviews and seven TPACK and SAMR questionnaires. These multiple methods of data collection ensured that the study was trustworthy. The resultant data was both deductively and inductively analysed. The researcher assumed the role of an insider researcher, having previously been a student-teacher at the school in this study. Ethical clearance to conduct research was obtained from the university where the student is registered and from the Western Cape Education Department (WCED). Six themes emerged from the data: the benefits of ICT training for curriculum delivery, the availability

of ICT resources and frequency of use, the benefits of shifting to Google Classroom and WhatsApp for curriculum delivery, the digital divide during COVID-19, ICT training challenges, and parent miscommunication challenges.

The study revealed that even though these teachers were at a technology-rich school, they experienced a variety of challenges as well as benefits during this uncertain educational limbo. Based on the findings of this research study, certain recommendations for practice, policy, and future research are presented. The most important recommendation for practice is that teachers engage in regular ICT training workshops and seminars to stay abreast of the latest ICT developments. For policy, it is recommended that the teaching and learning policies concerning ICT use in schools include social media and other digital platforms. For future research it is recommended that the WCED and DBE work together on developing large-scale research studies of how teachers are using ICT in the classroom, the effectiveness of ICT training, and the nature of ICT training for the new educational landscape.

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DEDICATION

I wish to dedicate this dissertation to the following pillars of strength in my life, and extend a special thank you for the infinite showers of love which you have bestowed upon me.

My wife Faseegah Wyngaard, who has undeniably been my main motivator throughout this arduous journey. Your patience, kind words, love and support were simply indispensable. I will never be able to repay you, but I wish to thank you from the bottom of my heart for being in my corner every step of the way.

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LIST OF ACRONYMS/ ABBREVIATIONS

ATPs	Annual Teaching Plans
CAPS	Curriculum and Assessment Policy Statement
CK	Content Knowledge
COVID-19	Coronavirus Disease of 2019
CTLI	Cape Teaching and Leadership Institute
DBE	Department of Basic Education
et al.	and others
FP	Foundation Phase
HEIs	Higher Education Institutions
ICT	Information and Communication Technology
ICTs	Information and Communication Technologies
IT	Information Technology
ITSI	Information Technology Service Intelligence
IP	Intermediate Phase
LAN	Local Area Network
MS	Model School
OHPs	Overhead Projectors
PCK	Pedagogical Content Knowledge
PK	Pedagogical Knowledge
SA	South Africa
SAMR	Substitution Augmentation Modification Redefinition
SP	Senior Phase
SSA	Statistics South Africa
TCK	Technological Content Knowledge
TK	Technological Knowledge
TPK	Technological Pedagogical Knowledge
TPACK	Technological Pedagogical Content Knowledge
TREPs	Temporary Revised Education Plans
UNESCO	United Nations Scientific and Cultural Organisation
WCED	Western Cape Education Department
WHO	World Health Organisation

WAN	Wide Area Network
Wi-Fi	Wireless Frequency Interface

CHAPTER 1

ORIENTATION OF THE STUDY

1.1. INTRODUCTION

The World Health Organisation (WHO) (2020) declared the coronavirus disease (COVID-19) a public health emergency on 30 January 2020 and a global pandemic on 11 March 2020. This required all countries around the world to institute strict measures to curb transmission of the disease. The WHO indicated that this disease attacks the respiratory system and spreads via close contact (surface-based or physical contact). Countries were guided by the WHO's introduction of COVID-19 health and safety protocols, consisting of national lockdowns (operation of essential services only), the regular washing or sanitising of hands, the mandatory wearing of a face mask in public places and the maintenance of a physical distance (social distance) between people of 1,5 metres.

These COVID-19 protocols affected all spheres of society, including education sectors around the world, forcing 1.6 billion learners in over 161 countries out of educational institutions (Saavedra, 2020). Educational institutions were compelled to make a shift towards Information and Communication Technology (ICT)-based teaching during this pandemic to continue their work (Dhawan, 2020). Most developed countries could adapt to the new educational landscape consequent on the pandemic by having recourse to e-learning platforms. Many of them were well prepared because they had been using online learning platforms long before the pandemic.

In contrast, the United Nations Educational, Scientific and Cultural Organisation (UNESCO) (2020) recorded that in Sub-Saharan African countries, 89% (216 million) of learners did not own a computer, 82% (199 million) did not have internet access, and 11% (26 million) were not served with mobile networks. During COVID-19, ICTs were used in most developed countries around the world to uphold teaching and learning, while in Sub-Saharan African countries most learners did not have access to the necessary technology and were therefore exposed to potential learning deficits (Mekonnen & Muluye, 2020).

Having taught during the COVID-19 pandemic, the researcher witnessed the challenges that teachers experienced with using ICTs for curriculum delivery. Many teachers in South Africa were faced with the prospect of switching from traditional teaching approaches (using chalkboards, whiteboards and greenboards) to ICT-based teaching approaches. There were a few schools, labelled technology-rich schools, which were equipped with ICT infrastructure and resources before COVID-19, and which were perceived to be ready for teaching and learning during COVID-19. This perception is challenged by Chisango and Marongwe (2021), who point out that the availability of technological resources does not automatically mean that the technology is being used effectively in teaching and learning. The rationale for the researcher's choice of a technology-rich school was thus to explore whether the school – and, more specifically, the teachers – were prepared to teach effectively with ICTs during COVID-19.

1.2. ORIGIN OF AND BACKGROUND TO THE STUDY

On 15 March 2020, President Cyril Ramaphosa announced the closure of all educational institutions in South Africa with effect from 18 March 2020 to curb the spread of COVID-19 (Ramrathan, 2020). Schools were opened and closed sporadically, according to the severity of infections, which increased rapidly before eventually declining. The Department of Basic Education (DBE) responded to this closure by instructing schools to make use of remote teaching and learning approaches to sustain teaching and learning engagement during the pandemic. These included educational radio and television programmes (made available by the DBE), e-learning portals, WhatsApp Messenger, Facebook, YouTube, Zoom, Microsoft Teams, Google Classroom, as well as printed resources (Parker et al., 2020).

As a result of the closing of schools and the move to remote teaching, the DBE decided to trim the Curriculum Assessment and Policy Statement (CAPS) – the national curriculum for Grades R-12 – to something labelled the Temporary Revised Education Plans (TREPs) (Van der Berg & Spaull, 2020). This trimming meant that subject content and the accompanying assessments would be reduced. The lockdown restrictions on social gatherings created numerous challenges for the South African education system, notably because traditional face-to-face teaching was prohibited (Parker et al., 2020). The potential consequences of this were devastating (Cruywagen & Potgieter, 2020; Motala & Menon, 2020).

Against the backdrop of many schools in South Africa not being equipped with ICT resources and infrastructure, certain schools were selected by the Western Cape Education Department (WCED) to be Model schools (MSs) (technology-rich schools) for ICT integration. The MS initiative started in 2017, when sixteen public schools in the province were selected to be MSs. These schools were provided with ICT resources, infrastructure and teacher training prior to the emergence of COVID-19.

1.3. IMPORTANCE OF THE STUDY

This study is concerned with the abrupt shift from traditional face-to-face classroom teaching to using remote methods, and with how teachers adapted to teaching via ICT. Many studies of teaching and learning during COVID-19 have focused on schools situated in rural contexts (Van der Berg & Spaull, 2020; Jansen, 2020; Munje & Jita, 2020; Chisango & Marongwe, 2021). Fewer studies (e.g., Jansen & Farmer-Phillips, 2021) have explored how technology-rich schools (in this context, MS), and the teachers at these schools adapted to teaching and learning during COVID-19.

Due to the rapid spread of COVID-19 and the very real possibility of severe learning deficits being created within the South African education system, the Department of Basic Education (DBE) (2020) distributed new policy guidelines to schools on the use of ICT-based or remote teaching and learning approaches. These approaches had to be diverse, comprising a mix of radio and television broadcasting, social media platforms and printed materials. The DBE aimed to reach as many learners as possible in the widely varying SA educational context.

Unfortunately, the DBE's vision of successfully continuing curriculum delivery was not effectively realised in many schools (public and private) in the country. Of particular concern is that ICT-equipped schools experienced challenges, even though they had access to ICT infrastructure and resources before the emergence of COVID-19. Between 2017 and 2019 the training provided by the WCED for MSs focused on face-to-face classroom teaching and was not in line with the new remote learning context of COVID-19. Many teachers therefore could not utilise the available ICT infrastructure and resources to continue curriculum delivery during COVID-19 (Van der Berg & Spaull, 2020). Teachers were required to make an abrupt shift from face-to-face classroom practices using ICT, to a more complex online or remote-based teaching approach which many were not prepared for or equipped to implement

effectively (Ramrathan, 2020). This study does an important job of exploring in detail how seven teachers at a MS used ICT for curriculum delivery during COVID-19. Its significance thus extends to future educational policy and practice.

1.4. CONTEXT OF THE STUDY

This study was conducted at one public primary school, situated in an urban area of the Western Cape Province of South Africa. Since the researcher is a full-time educator with limited spare time, he chose a MS which was close to his home and place of employment (McMillan & Schumacher, 2014). In 2017, this MS was one of the few former prefabricated schools renovated by the WCED into a brick structure. The school was equipped with Wireless Frequency Interface (Wi-Fi), Local Area Network (LAN), Wide Area Network (WAN), E-beams, Overhead Projectors (OHPs), visualisers, a computer laboratory, a well-resourced library, interactive whiteboards, laptops for each teacher and tablets for each learner (WCED, 2017). All the teachers at this MS were provided with ICT training by the WCED to use Google Classroom, ITSI, Smart Classroom training, Google Application and Microsoft Office 365.

The WCED classified the MS in this study as a quintile 5 school. Quintiles 1, 2 and 3 schools are no-fee paying schools, whereas quintiles 4 and 5 are fee-paying schools. Based on this ranking, the WCED allocates quintile 5 schools the lowest funding allocation of R204 per learner (Xala, 2018). Despite the high quintile ranking of this MS, many learners come from low socio-economic backgrounds. These learners attend the school nutritional programme or feeding scheme. Many of these learners' parents or guardians receive social grants and are exempted from paying school fees. Additionally, these learners lack the resources and infrastructure to support remote learning outside of the school environment.

1.5. APPROACH TO THE STUDY

This qualitative case study utilised three data collection methods: i) a general questionnaire to obtain biographical information and identify the information-rich teachers relevant to this study; ii) the TPACK and SAMR questionnaire to gain an understanding of teachers' ICT knowledge and level of use; and iii) semi-structured one-on-one interviews to obtain in-depth data relating to the research questions and corroborate information obtained from the TPACK

and SAMR questionnaire. It would have been ideal to have been able to observe how the teachers actually taught online (Kumar, 2005), but this was not possible because they were no longer using ICTs to deliver the curriculum remotely at the time of data collection.

The principal of the selected school was contacted both via email and telephonically, to obtain permission to collect data at his school. The researcher emailed the principal the ethical clearance number from the university where he is registered, the WCED consent letter, and his research proposal. He discussed the significance of the study and the contribution it sought to make towards educational research. He explained that the identities of the teachers taking part in this study would remain anonymous and that they could at any time withdraw from the study without repercussions or explanation. The ethical clearance from the WCED stipulated that data collection was prohibited in the fourth term, and this research was conducted at the respective school in February and March 2022.

After granting permission for the research, the principal introduced the researcher to all the teachers. The researcher described the procedures of data collection and explained what he planned to do with the collected data. He provided all the teachers with the general questionnaire (Appendix 1) to establish which teachers would be selected according to the pre-determined criteria for the study. Once all the teachers had completed the general questionnaire, seven were purposively selected, and they voluntarily signed consent forms agreeing to participate in the study.

The seven selected teachers then proceeded to complete the TPACK and SAMR questionnaire (Appendix 2) to reveal their understanding of TPACK and SAMR in relation to their use of ICT for curriculum delivery during COVID-19.

Once all the preparation work was completed, during the first term of the school year the researcher distributed hard copies of the questionnaire and emailed it as well. He explained each section of the questionnaire to the teachers, who were encouraged to ask questions about anything unclear. They were given a week to complete all the questions in the questionnaire, to enable them to provide thoughtful and in-depth responses. When the participants had completed the questionnaire, they emailed it back to the researcher. He scanned all the completed questionnaires and saved them in a folder secured with a password.

The researcher then conducted one-on-one interviews (Appendix 3) with the seven teachers to gain in-depth, face-to-face responses. The interviews offered an intimate and focused atmosphere conducive to collecting detailed accounts of the teachers' experience of using ICT for curriculum delivery. The interviews were conducted after school hours so as not to intrude on classroom teaching and learning time. The interviews were conducted in English as it is the medium of instruction at the school. All interviews were recorded on the researcher's mobile phone, with a digital voice recorder as backup. The data collected from the interviews was transcribed, analysed, and organised into themes.

1.6. PURPOSE AND GOALS OF THE RESEARCH

The purpose of this study was to help remedy the dearth of literature about teachers' use of ICT for curriculum delivery at an urban primary MS (technology-rich school) in SA during COVID-19. Although these MSs are provided with ICT infrastructure and resources, and teachers have been trained to use these resources for teaching and learning, this may not have translated into effective curriculum delivery via ICT.

The goal of the study is to provide a detailed account of how teachers used ICT and what benefits and challenges they experienced when employing ICT for curriculum delivery at a MS during COVID-19. A secondary goal was to suggest how teachers could more effectively exploit ICTs for curriculum delivery.

1.7. THE STUDY'S TITLE

Teachers' use of Information and Communication Technology for curriculum delivery at a Model School during COVID-19.

1.8. RESEARCH QUESTIONS

The research project will seek to answer the following main research question and sub-questions:

Main research question:

How did the teachers use ICT for curriculum delivery at a MS during COVID-19?

Sub-questions:

1. What benefits did the teachers experience when using ICT during curriculum delivery at a MS during COVID-19?

2. What challenges did the teachers experience when using ICT during curriculum delivery at a MS during COVID-19?

1.9. CLARIFICATION OF KEY TERMS

The following seven key terms used in the study are defined and explained here: COVID-19, curriculum delivery, digital divide, Information and Communication Technology (ICT), Model School (MS), remote learning, and blended learning.

1.9.1. COVID-19

The WHO defined COVID-19 as a disease caused by SARS-CoV-2. SARS-CoV-2 is one of seven types of highly transmissible coronavirus that caused a pandemic of respiratory illness, called COVID-19 (WHO, 2020). The Department of Health in South Africa referred to COVID-19 as an infectious disease caused by the coronavirus. To slow the spread of the disease, schools were closed in South Africa for two months from 18 March 2020, with a staggered return of learners by 1 June 2020 (DBE, 2020). To mitigate the pressure on teaching and learning, the DBE implemented a trimmed curriculum, which meant that certain subject content was removed or minimised. In addition, the DBE announced that schools should use remote teaching and learning platforms – such as social media platforms and physical printed worksheets – to maintain contact with learners (DBE, 2020). The DBE used educational radio and television programmes, as well as zero-rated (free) educational websites which learners and parents could access (Parker et al., 2020). With COVID-19 still prevalent, schools resumed fully in the academic year 2021-2022 while social distancing and the wearing of masks were encouraged (DBE, 2022).

1.9.2. Curriculum delivery

COVID-19 caused a shift in curriculum delivery methods and approaches in educational institutions in South Africa (Ramrathan, 2020). Instead of schools using the conventional face-to-face teaching and learning approach, all teachers were required to implement ICT-driven methods (Parker et al., 2020). Social media platforms such as WhatsApp and Facebook were used by schools to sustain curricular engagement with their learners during the pandemic (Dutta, 2020). Some schools were able to adapt to this shift in teaching approach as they were using ICT before COVID-19, but poorer schools experienced challenges in sustaining curriculum delivery via ICT-driven platforms (Van der Berg & Spaull, 2020).

1.9.3. Digital divide

The digital divide is broadly defined by Erickan et al. (2018:4) as "a social inequality between individuals regarding access to ICT, frequency of use of technology, and the ability to use ICT for different purposes". In an educational context, the digital divide privileges schools that have access to ICT for teaching and learning and marginalises those that do not (Jansen, 2020). The more well-resourced schools "were the ones that sailed seamlessly between face-to-face and online learning once the lockdown happened" (Jansen & Farmer-Phillips, 2021:149), while poorer schools without access to technological resources experienced substantial learning losses (Ramrathan, 2020).

1.9.4. ICT

ICT incorporates all the tools and technologies used for purposes such as recording information (e.g., computers, laptops, flash drives, hard drives, and e-portals), communication via sound or images (e.g., microphones, cameras, and mobile phones), and the broadcasting of information (e.g., radio and television) (Simelane-Mnisi & Dumas, 2018). In the context of this study, ICT refers to technological tools that can be used for curriculum delivery. While some SA schools have an abundance of technological resources, many schools did not have access to ICT resources before and during COVID-19.

1.9.5. MS

In 2017, the WCED started an initiative whereby sixteen public schools were selected in the Western Cape Province and provided with a variety of ICTs and training for the teaching staff, the learners, and the administrator (Walker, 2019). These schools were provided with ICT infrastructure such as:

i. Wide Area Network (WAN), which equipped the entire school with high-speed internet connectivity;
ii. Local Area Network (LAN), which was installed for the whole school and provided wireless internet access;
iii. a smart classroom environment, which allowed teachers to use ICT in the form of computing devices, protection of devices, interactive teacher devices, and visualiser devices;
iv. a "slim lab", which was equipped with appropriate ICTs, effective connectivity, digital resources, ICT suite atmosphere and teacher workspace;
v. Wireless Frequency Interface (WIFI), providing wireless internet access to connect each classroom; and
vi. interactive learner tablets to enable learners to access educational content, websites, and resources.

These schools were expected to serve as an example and inspiration to other schools. Furnished with ICT resources, infrastructure and teacher training prior to COVID-19, MSs (it was assumed) could continue with their curriculum delivery during the pandemic.

1.9.6. Remote learning

Remote learning includes "a combination of synchronous, which is live learning where learners learn with the teacher at the same time and asynchronous, where the learners learn independently at different times" (Netolicky, 2020:12). Teachers who opted for a synchronous approach relied on Microsoft Teams, Zoom and Google Meets, whereas teachers who opted for asynchronous methods utilised social media platforms such as WhatsApp messenger, Google Classroom, Facebook and TikTok (Jansen, 2020; Nel & Marais, 2020; Netolicky, 2020; Jansen & Farmer-Phillips, 2021). Most teachers used one or

more social media platforms as a means of sustaining contact with their learners during COVID-19 (Jansen & Farmer-Phillips, 2021). If factors such as learner or teacher connectivity, availability of digital devices and internet access could not always be relied upon, an asynchronous approach was used to continue teaching and learning (Nel & Marais, 2020; Netolicky, 2020; Van der Berg & Spaull, 2020). In contrast, where there were a majority of learners with access to devices and the internet, a synchronous approach was used to support learning (Jansen, 2020; Netolicky, 2020; Ramrathan, 2020).

1.9.7. Blended learning

Mulyanto et al. (2020) characterise blended learning as a mixture of various learning styles, teaching methods and delivery approaches. Blended learning is a combination of face-to-face learning and learning with the aid of technology (Salakhova et al., 2020). During COVID-19 many teachers explained the subject content to their learners during face-to-face lessons and would then send home video clips or voice notes on WhatsApp messenger to illustrate and expand on the concepts taught in the classroom (Jansen, 2020; Ramrathan, 2020; Jansen & Farmer-Phillips, 2021). In this study, blended learning refers specifically to a combination of face-to-face and ICT-based teaching methods to support curriculum delivery during COVID-19.

1.10. SIGNIFICANCE OF THE STUDY

The main significance of this study lies in its i) exploring how teachers used ICTs at a MS for teaching and learning, and ii) ascertaining the benefits and challenges that the teachers in this study experienced when using ICT for curriculum delivery at a MS during COVID-19. The study may be useful to the Western Cape Education Department (WCED) and the Department of Basic Education (DBE) in the context of Information and Communication Technology (ICT) training. It should also contribute to teacher training and whole school improvement for ICT use by supplying some empirical background.

1.11. LIMITATIONS OF THE STUDY

In this study, the researcher was aware of a few limitations. One was the small number of schools (sixteen) that had been classified as MSs. There was only one MS public primary,

quintile 5 school near the researcher's home, which limited the site selection. The sample used in the study was confined to seven teachers – two Foundation Phase (FP) teachers, two Intermediate Phase teachers (IP), two Senior Phase (SP) teachers, and one ICT champion. In 2017, these seven teachers – who willingly agreed to be part of the study – were trained in curriculum development using ICTs. Due to COVID-19 protocols, the study was limited to collecting data from only two questionnaires. Interviewing teachers was limited to the afternoons when the researcher was available, and teaching observation was prohibited.

1.12. ASSUMPTIONS OF THE STUDY

A reasonable assumption was made that the seven teachers at the MS, having been provided with ICT infrastructure, resources and training before COVID-19, would be able effectively to use ICT to continue curriculum delivery during COVID-19. It was also assumed that these teachers, who were information-rich, would be willing to participate in the study.

1.13. ORGANISATION OF THE DISSERTATION

This study consists of five chapters that are briefly outlined below.

Chapter 1: Orientation of the study

Chapter 1 offers an introduction to the study and provides some contextual orientation, including attention to the origin, background and importance of the study. It describes the research approach used, the purpose and goals of the research, the study's title and the research questions. Seven key terms were discussed and defined: COVID-19, curriculum delivery, digital divide, ICT, MS, remote learning and blended learning. The chapter concludes by discussing the significance, limitations and assumptions of the study.

Chapter 2: Conceptual framework and literature review

Chapter 2 outlines the conceptual framework of the study and offers a literature review. The study was informed by two frameworks: TPACK (Mishra & Koehler, 2006) and SAMR (Puentedura, 2006). The chapter also canvasses national and international literature regarding teachers' use of ICT for curriculum delivery during the COVID-19 pandemic.

Chapter 3: Research design and methodology

Chapter 3 outlines the research paradigm, the research approach and the research design utilised in this study. It describes the site and sample selection and outlines the data collection and data analysis methods. It also addresses the trustworthiness of the study, the researcher's position and relevant ethical considerations.

Chapter 4: Findings and discussion

This chapter analyses the data collected and presents and discusses the results obtained.

Chapter 5: Conclusions and recommendations

Chapter 5 draws conclusions from the research and provides recommendations for practice, policy and future research.

CHAPTER 2

CONCEPTUAL FRAMEWORK AND LITERATURE REVIEW

2.1. INTRODUCTION

This chapter presents the conceptual framework (comprising the TPACK framework and SAMR model) that informs the research study. The TPACK framework is concerned with the knowledge that teachers need to possess to teach effectively using technology. The SAMR model measures the level at which teachers are using ICT. These two theoretical frameworks were therefore merged to create a conceptual apparatus to investigate teachers' use of ICT for curriculum delivery during COVID-19. The literature review provides an overview of recent local and international research cognate to the field of the current research study. It also demonstrates that the researcher is not reproducing existing research.

2.2. CONCEPTUAL FRAMEWORK

Mishra and Koehler's (2006) Technological, Pedagogical, and Content Knowledge (TPACK) framework and Puentedura's (2006) Substitution, Augmentation, Modification, and Redefinition (SAMR) serve to structure this empirical research study. The focus is thus on the interface between teacher knowledge and the various levels of technology use. The theories will be used to interpret the results of the empirical research.

2.2.1. TPACK framework

The TPACK framework, developed by Mishra and Koehler (2006), encapsulates the manifold and complex strands of knowledge teachers are required to possess to effectively teach using ICT. The TPACK framework emphasises the relationship between seven integral knowledge bases, described by Mishra and Koehler (2006) as technological knowledge (TK), pedagogical knowledge (PK), content knowledge (CK), pedagogical content knowledge (PCK), technological content knowledge (TCK), technological pedagogical knowledge (TPK) and technological pedagogical content knowledge (TPACK). Koehler and Mishra

(2009) present TPACK as a framework that describes "Pedagogical content knowledge (PCK) to explain how teachers' understanding of educational technologies and PCK interact with one another to produce effective teaching with technology" (Shling et al., 2015:43). The rationale for using the TPACK framework, is to provide an understanding of the various forms of knowledge that teachers are expected to possess to use ICT effectively. The seven knowledge bases will be discussed in more detail.

Figure 2.1 outlines the various contexts previously discussed and provides a diagrammatic view of Misha and Koehler's TPACK framework:

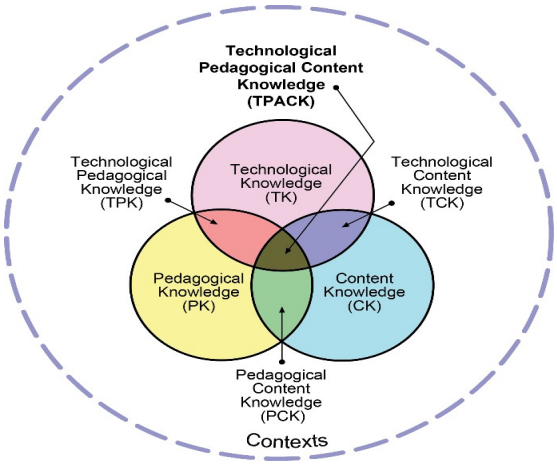

Figure 2.1: TPACK framework (Mishra & Koehler, 2006:1025)

2.2.1.1. Technological knowledge (TK)

TK is characterised by Cox and Graham (2009) and Pamuk (2012) as teachers' ability to integrate education and technology in the modern classroom. Moreno et al. (2019:2) offer a little more detail:

> [TK is] the teachers' knowledge regarding the different technologies in order to develop their teaching practice. It includes, for instance, knowledge of operating systems and hardware, how to install programs, and how to create documents. It is also important to learn and to adapt to upcoming new technologies.

TK is thus essentially knowledge about technological hardware and software, and it is constantly changing in nature, application, and organisation (Harris et al., 2009).

2.2.1.2. Pedagogical knowledge (PK)

PK is described by Moreno et al. (2019:1) as "the knowledge possessed by the teacher regarding pedagogical activities, processes, practices, teaching and learning methods used in the teaching-learning process, and how they relate to the educational goals". PK demands "an understanding of cognitive, social, and developmental theories of learning and how they apply to students in the classroom" (Koehler & Mishra, 2009:64). During the COVID-19 pandemic, teachers were required to adapt their pedagogical approaches in order to sustain curriculum delivery. To do this they had to have the appropriate PK.

2.2.1.3. Content knowledge (CK)

CK is knowledge of subject content and related concepts (Cox & Graham, 2009; Koehler et al., 2013), such as teachers' knowledge of topics in Mathematics or Science. Moreno et al. (2019:1) note that possession of CK is a core function of a teacher because "specific matters or areas must be taught to the students, including concepts, theories, facts and procedures in the area". In this study, these "specific matters or areas" include teachers' curriculum knowledge and confidence in teaching subject matter in the Foundation Phase (FP), Intermediate Phase (IP) and Senior Phase (SP).

2.2.1.4. Pedagogical Content Knowledge (PCK)

Mishra and Koehler (2006:1027) describe PCK as follows:

> the ability of a teacher to know what teaching approaches fit a content and also knowing how elements of the content can be arranged for better understanding of learners. PCK is concerned with the representation and formulation of concepts, pedagogical techniques, and knowledge of what makes concepts difficult or easy to learn, knowledge of students' prior knowledge, and theories of epistemology. It also involves knowledge of teaching strategies that incorporate appropriate conceptual representations in order to address learner difficulties and misconceptions and foster meaningful understanding.

PCK is also referred to as the "art of knowing something which entails integrating skills and understandings into teachers' practice: understanding of the learners' learning styles, the

curriculum, and teaching methods" (Solis, 2009:15). While PCK can be stimulated by using a variety of different instructional approaches, it must embrace certain fundamental factors: (i) knowledge that portrays the topic and content knowledge (CK); (ii) an understanding of learners' backgrounds in relation to the learning area and tasks that address a particular theme; and (iii) pedagogical facts (methodology) (Solis, 2009). This is what renders PCK a unique body of knowledge. This study sought to identify how teachers used various pedagogical strategies to teach a particular content.

2.2.1.5. Technological content knowledge (TCK)

TCK, according to Moreno et al. (2019:2) "includes the knowledge of how to represent specific concepts with technology, which means the way technology and the discipline are reciprocally linked". Mishra and Koehler (2006) add that teachers should possess TCK to understand which aspects of the subject matter can be effectively taught using ICT. The researcher focused on the ICT-based platforms that teachers used to deliver lessons, and how this use of ICT supported the learners' understanding.

2.2.1.6. Technological pedagogical knowledge (TPK)

According to Molotsi et al. (2018), TPK involves understanding how a teaching approach can be stimulated or reimagined through ICT tools. Koehler and Mishra (2009:65) claim that TPK involves "an understanding of how teaching and learning can change when particular technologies are used in particular ways", and "includes knowing the pedagogical affordances and constraints of a range of technological tools as they relate to disciplinarily and developmentally appropriate pedagogical designs and strategies". A particular interest in this study was the various pedagogical strategies and modes of ICT that the teachers used in curriculum delivery to sustain interaction with their learners during COVID-19.

2.2.1.7. Technological pedagogical content knowledge (TPACK)

Mishra and Koehler (2006) maintain that TPACK is the knowledge that is needed for effective teaching with technology. They define TPACK as follows:

> the basis of good teaching with technology [that] requires an understanding of the representation of concepts using technologies; pedagogical techniques that use technologies in constructive ways to teach content; knowledge of what makes concepts difficult or easy to learn and how technology can help redress some of the problems that students face; knowledge of students' prior knowledge and theories of epistemology; and knowledge of how technologies can be used to build on existing knowledge and to develop new epistemologies or strengthen old ones. (Mishra & Koehler, 2006:1029)

Similarly, Moreno et al. (2019:2) observe that TPACK "is a form of knowledge that goes beyond these three components (content, pedagogy, and technology). TPACK includes, for example, the knowledge of pedagogical strategies that allow the effective use of technologies to teach the content of the discipline, and knowledge of the aspects that make the content easy or difficult to learn, and how technology can help with some of the problems that students face". In this study, the researcher was interested in determining how teachers used ICTs to teach content using various pedagogical strategies.

In sum, the framework outlined above was deemed appropriate as it provides a lens through which to view the knowledge bases of teachers teaching with the help of ICT, excluding the actual integration and level of their ICT use. An additional theoretical lens is required for the latter. The SAMR Model was therefore selected, to address certain issues that the TPACK framework excludes.

2.2.2. The SAMR Model

The SAMR model was developed by Puentedura (2006). It comprises two phases, as shown in Figure 2.2: Enhancement (the lower phase) and Transformation (the upper phase). These two levels can account for four levels of technology use by teachers, from substitution to redefinition. Tunjera and Chigona (2020:128) note that "the SAMR model describes the process of adopting technology from acquisition to a point when the art is incorporated into one's everyday practice, i.e., the art of appropriating digital technology into one's teaching practice for targeted outcomes". The SAMR model is diagrammatically represented in Figure 2.2 and is further explained below:

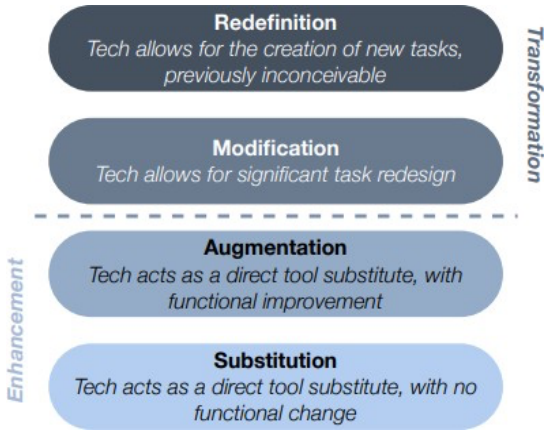

Figure 2.2: The SAMR Model (Puentedura, 2006)

Substitution (S) is the first stage in the Enhancement phase of the SAMR model, where technology is used in the same way as it was in the twentieth century (Drugova et al., 2021); that is, "no functional changes to pedagogy really occur here, but we can see the potential for supporting learning" (Hardman & Lilley, 2018:201). An example of this is provided by Hamilton et al. (2016:434): the teacher "chooses to substitute digital versions for a hard copy set of test review questions". At this level, then, the traditional teaching approach is continued, and learners' technological skills are not improved. For instance, a learner will compose an oral presentation on their favourite novel using a computer.

According to Drugova et al. (2021), **Augmentation (A)** is the second stage in the Enhancement phase, where specific and appropriate technologies are used to stimulate teaching and learning, thereby providing more functionality. At this level, technology enhances the task by providing some functional improvements or efficiencies in comparison to the non-digital version (Puentedura, 2006). An example would be when learners use a computer to compose an oral presentation on their favourite novel, using an online language checker.

Modification (M) is the third stage, now in the Transformation phase, where aspects of academic tasks are redesigned to enable the use of enhanced functionalities that will transform the teaching and learning process through technology (Hamilton et al., 2016). Learners compose oral presentations on their favourite novel, using a language-checker, which they record themselves and include visuals (photographs). These are made available to

other learners for comment. This encourages collaboration as learners receive feedback from their peers.

Redefinition (R) refers to the highest level of the Transformation phase of the model, in which learners use previously unconventional means of performing tasks (Drugova et al., 2021). This is when ICT "truly transforms pedagogy and learning, allowing for tasks that cannot be done without technology" (Hardman & Lilley, 2018:202). At this level, learners create a documentary video on their favourite novel and present it in groups through an online learning management system.

According to Kamalruzzamon et al. (2016:43), "The SAMR Model is an instructional model which guides educators to infuse technology with teaching and learning [and] enables teachers to design digital flipped class learning experiences that utilise technology in class time". Hence it was appropriate to use the SAMR model in this study as an analytical tool to understand how teachers used ICT in their curriculum delivery.

2.2.3. The interaction between the TPACK framework and the SAMR model

Figure 2.3 below outlines the correlation between the TPACK and SAMR models.

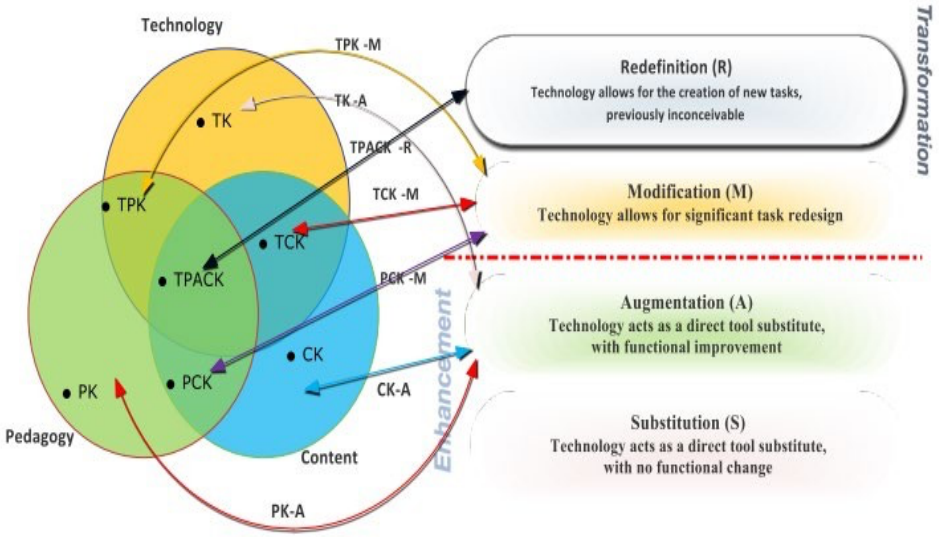

Figure 2.3: TPACK and SAMR models correlation (Kihoza et al., 2016:112)

Tondeur et al. (2007) note that both the TPACK and SAMR models focus on ICT integration in the classroom. They identify three major characteristics for ICT frameworks: (1) promoting ICT use based on learning enhancement capabilities, (2) ICT use and ICT know-how, such as general knowledge of how to use hardware and software and, (3) infrastructure and institutional capacity building for instance availability of computers, software, and internet access devices (Tondeur et al., 2007). The first characteristic is relevant to this study because teachers' use of ICT to sustain learning engagements was the object of investigation. Secondly, teachers' knowledge (TPACK) and level (SAMR) of ICT use for teaching and learning during the pandemic were also explored. Lastly (and corresponding to characteristic 3, above), the school in this study was classified as technology-rich, with each teacher afforded appropriate ICT infrastructure and resources.

The SAMR model withholds the notion that classroom ICT integration is premised on the transformation or enhancement of traditional pedagogies through the use of efficient new technologies, through the substitution, augmentation, modification or redefinition of educational tasks (Kihoza et al., 2016; Hockly, 2012). The use of TPACK in isolation, on the other hand, might be inadequate. Its limited constructs require additional clarification to guide future educational ICT use (Brantley-Dias & Ertmer, 2013). The TPACK framework addresses ICT as part of a contextualised set of constructs such as TK, TPK and TCK, whereas the SAMR model focuses not on the contents and pedagogy but rather on how ICT can sustain the constructs of enhancement and transformation.

The similarities between the concepts informing the two models – TPK-M, TK-Augmentation, TCK-Modification, PCK-Modification, CK-Augmentation, PK-Augmentation, and TPACK-Redefinition – suggests that they can be utilised to achieve common objectives using alternative methods (Puentedura, 2006, 2014; Tucker, 2013). Having said this, it must be pointed out that either of these two models alone is entirely adequate for encouraging ICT use in education.

Combined, the TPACK framework and SAMR model constitute a conceptual lens for exploring teachers' use of ICT for curriculum delivery at a model school during COVID-19. Valtonen et al. (2020) describe TPACK as a framework that characterises teachers' knowledge bases regarding the use of ICTs to teach effectively. Molotsi et al. (2018) claim that the SAMR model assists teachers in preparing learners for an unpredictable future, which

is undoubtedly a way of construing the advent of COVID-19. A key similarity between the two theories is the use of technology (see Figure 2.4, below).

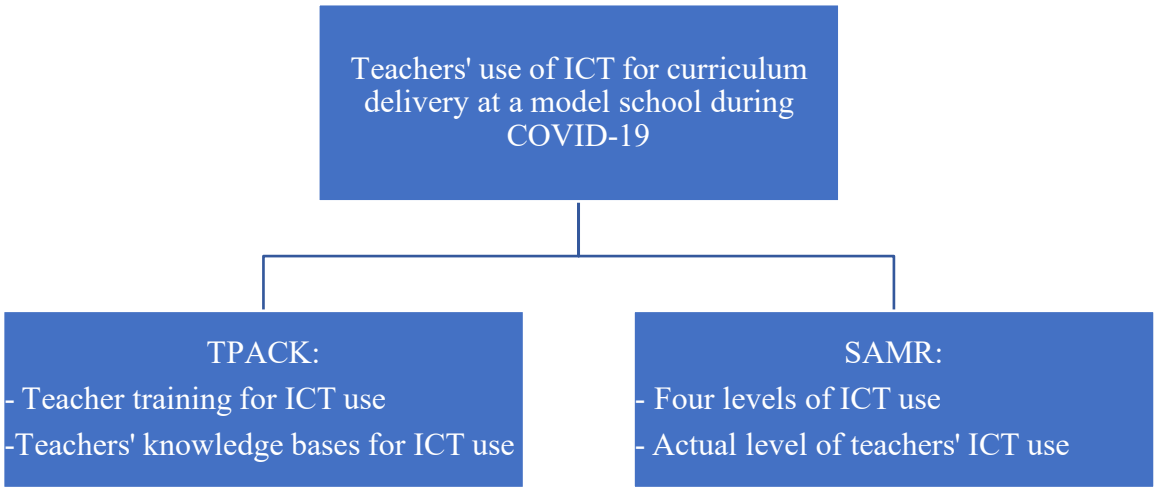

Figure 2.4: Conceptual framework

2.3. LITERATURE REVIEW

The literature review explores previous national and international studies of teachers' use of ICT for curriculum delivery during COVID-19. There have been many empirical studies conducted since the emergence of COVID-19 regarding the impact of the pandemic on education systems around the world (Almaiah et al., 2020; Lee et al., 2021) and in South Africa, where the emphasis has been on the fate of the school's curriculum (Jansen, 2020; Ramrathan, 2020; Van der Berg & Spaull, 2020; Patrick et al., 2021), and on teaching and learning in rural schools (Chisango & Marongwe, 2021). There is a dearth of studies on how teachers at technology-rich schools navigated teaching and learning during COVID-19, given that, with the switch to online teaching, the teachers had to adapt and implement the new technologies they had recently been introduced to. This study addresses this absence by assessing teachers' use of ICT for curriculum delivery at a MS during COVID-19. The literature surveyed in this section will focus on the following issues:

2.3.1 The "new normal" educational landscape during COVID-19;
2.3.2 The digital divide during COVID-19 in South African schools;
2.3.3 ICT use during COVID-19: remote and blended teaching;
2.3.4 Teachers' experiences of teaching during COVID-19: benefits and challenges;
2.3.5 ICT Training;

2.3.6 Digital platforms used during COVID-19; and

2.3.7 Benefits and challenges of ICT use.

2.3.1. The "new normal" educational landscape during COVID-19

Table 2.1 outlines the academic school calendar for the year 2020. Towards the end of the first term, the presidential directive closed all schools (DBE, 2020). At the start of the second term, the initial announcement would be that Grades 7 and 12 would return followed by the rest of the grades at staggered intervals. The subsequent term dates were announced, yet the national and provincial education departments could not follow through on this timetable due to the instability of the educational landscape brought about by COVID-19 (Spaull, 2020).

Table 2.1: The original 2020 academic timeline for public schools (DBE, 2020)

Term 1: 15 January–18 March 2020	
15 January 2020	All learners at school as per normal pre-COVID
18 March 2020	School closed by presidential announcement
18 March 2020	Initial end-of-term date
Term 2: 11 June–24 July 2020	
1 June 2020	Grades 7 and 12 all return to school
6 July 2020	ECD, Grades R, 1, 2, 3 and 6 learners return to school
24 July 2020	School closes
Term 3: 3 August–23 October 2020	
3 August 2020	Grade 12 learners return to school
11 August 2020	Grade 7 learners return to school
24 August 2020	Grades R, 1, 2, 3, 4 and 6 learners return to Primary School Grades 9, 10 and 11 return to High School
31 August 2020	Grades 5 and 8 learners return to school
23 October 2020	School closes
Term 4: 2 November – 2 December 2020	
2 November 2020	Grades R-12 learners return to school
2 December 2020	School closes

On 23 May 2020, the DBE circulated a document revising the annual teaching plans (ATPs) for Grade 7 and 12 learners to "assist schools, teachers and all other key stakeholders in

education involved in the curriculum implementation process, with meeting the key requirements of the curriculum in the remaining part of the academic year" (DBE, 2020:9). This adjustment to the curriculum received mixed responses from education stakeholders during COVID-19. Sensoi (2021:39), a South African teacher, remarked as follows:

> The requirements put forward by the department [DBE] with respect to amending the curriculum and teaching seemed tedious at first. Still, as teachers, we are always expected to adapt to our surroundings and circumstances, and this time was no different.

This teacher thus greeted the trimming of the curriculum with optimism, citing teachers' versatility and ability to adapt to varying situations. However, Koopman (2021:45), another South African teacher, shared the following sentiments:

> A few adjustments were made to the curriculum in the foundation phase. One of the major changes was the instruction to integrate the Life Skills themes into Home Language… certain skills from Mathematics were left out and did not need to be covered for the year. As a grade, we structured our planning in a way where learners received take-home packages to complete on those alternate days when they were at home. However, not all learners complete their work or parents are not there to assist.

Mafoko (2021) mentioned that the trimmed curriculum enabled teachers to manage teaching and learning engagements in a more "placid" manner, because of the decreased number of themes and concepts in the 'COVID-19 curriculum'. A teacher in the study conducted by Mafoko (2021:71) added:

> I took every day in my stride. We had time to cover most of the required topics in the trimmed curriculum. It was not necessary to repeat lessons to different class groups because they could fit into the school hall.

Many schools used the strategy of combining learners into the school hall to adhere to the physical distancing measures attendant on COVID-19 (Jansen & Farmer-Phillips, 2021). The DBE issued strict guidelines for these measures, which all schools in the country were required to adhere to at all times during the pandemic (Patrick et al., 2021; Maree, 2022).

Table 2.2 displays the number of school days lost as a result of the pandemic. The Table indicates the Grade cohorts that returned to school as well as the percentage that each grade lost during COVID-19 (Spaull & Van der Berg, 2020).

Table 2.2: The school days lost in 2020 because of COVID-19
(Spaull & Van der Berg, 2020:5)

School days lost up to 7 August 2020 by Grade				
	(New calendar) Current school days up to 7 August 2020	**(Old calendar) pre-COVID scheduled school days up to 7 August 2020**	**Days lost up to 7 August 2020**	**School days lost as a percentage of pre-COVID scheduled school days up to 7 Aug 2020**
ECD + Grades 1, 2, 3, 6, 10, 11	72	122	50	41%
Grades 4, 5, 8, 9	53	122	69	57%
Grades 7 & 12	92	122	30	25%
School days lost up to 7 August 2020 by Grade (assuming no further closures)				
	(New calendar) School days lost in proposed 2020 calendar	**(Old calendar) pre-COVID scheduled school days in 2020**	**Days lost in 2020 (assuming no further school closures)**	**School days lost in 2020 compared to pre-COVID scheduled school days in 2020**
ECD + Grades 1,2,3,6,10,11	155	204	49	24%
Grades 4,5,8,9	136	204	68	33%
Grades 7 & 12	175	204	29	14%

According to Table 2.2, the South African education system experienced a substantial loss in teaching and learning time across the country. Jansen (2020:2) advocated that the 2020 academic year be scrapped, and had this to say:

> Scrap the academic school year; even a "trimmed down" curriculum will soon be meaningless for the school system as a whole.
>
> Our biggest mistake would be to treat children as cognitive machines that can simply be switched on again after the trauma of COVID-19.

This drastic loss of teaching and learning time resulted in many learning deficits across all grade levels in South African schools (Spaull, 2020). But many, like Jansen (2020), maintained that the well-being and safety of learners and all educational stakeholders should take preference over the pressure to return to school.

According to a report by UNICEF (2021), South African school children are approximately between 75% and 100% of an academic year behind their expected grade levels. Moreover, about 400,000 to 500,000 learners reportedly dropped out of school between March 2020 and July 2021. Gustafsson (2022) found that throughout schools, grades and subjects, South African learners experienced 57% to 130% of one year's learning loss as a result of COVID-19. He noted that they had lost out on valuable skills that they could have acquired in at least half a year of schooling. Table 2.3 indicates the 2021 term dates for all public schools in South Africa. The 2021 academic calendar was more organised and systematic than the 2020 version. The amendments were closely monitored by the DBE and provincial education departments.

Table 2.3: The amended 2021 academic timeline for public schools (DBE, 2021)

Term duration	No. of weeks	No. of days	No. of public holidays	Actual no. of school days
Term 1: 25 February – 23 April 2021	12 weeks for teachers and 10 weeks for learners	60 days for teachers and 48 days for learners	3	57 actual days for teachers and 47 actual days for learners
Term 2: 03 May – 09 July 2021	10	50	1	49
Term 3: 26 July – 01 October 2021	10	50	2	48
Term 4: 11 October – 15 December 2021	10	48 days teachers 48 days for learners	0	48 actual days for teachers and learners
Total	42 weeks for teachers and 40 weeks for learners	208 days for teachers and 198 days for learners	6 days public holidays for teachers and learners	202 actual days for teachers and 192 actual days for learners

2.3.2. The digital divide during COVID-19 in South African schools

Jansen and Farmer-Phillips (2021:150) remark that: "closing the digital divide is probably the single most compelling policy and planning question to come out of this pandemic". They explain the situation as follows:

> Once upon a time, the world was divided between those with money, knowledge, and connections – and those without these properties. For schools, the big divide will be between 'technological haves' and 'technological have nots. Teachers in poor and working-class schools saw this and, as the stories tell, they were emotional – sometimes angry – about the persistent divide. These teachers felt helpless, for they could see the consequences of a growing, yawning gap between the education of the privileged and the poor.

In South Africa, The General Household Survey of 2018 revealed that 22% of households have a computer, with 10% having home internet access; while 90% have access to a mobile phone, with 60% having internet access (Statistics South Africa, 2019). As far as public schools are concerned, 80% are ill-equipped and under-resourced to administer online teaching and learning. Despite these statistics, directives attendant on the COVID-19 pandemic required all schools in South Africa to make a shift from conventional teaching approaches to ICT-based teaching approaches to sustain learning engagement (Ramrathan, 2020).

This change in teaching approach served to reinforce inequalities within the South African education system and created what Munje and Jita (2020:7) refer to as a "digital divide". Erickan et al. (2018:4) characterise this divide as "a social inequality between individuals regarding access to ICT, frequency of use of technology, and the ability to use ICT for different purposes". Many teachers and learners from disadvantaged schools and communities did not have access to basic ICT resources and were therefore unable to engage in teaching and learning during COVID-19 (Van der Berg & Spaull, 2020). The pandemic thus showed up how the socio-economic status of many South African families has retarded the technological shift of the SA education system, globally speaking, into the 21st century (Parker et al., 2020).

The shift from face-to-face to online-based teaching and learning created a divided learning experience for learners, in terms of which many were not able to access online materials or lessons. Many teachers received ICT training for face-to-face teaching, and not online-based teaching, which also contributed to the digital divide (Monareng et al., 2020). Gustafsson and Deliwe (2020:13) predicted that COVID-19 could "erode the learning gains made in schools over the last two decades. As the poor will be most affected, inequality in education could widen with social and economic implications in the long term". It seems incontestable that the pandemic exposed the digital divide, condemning learners who were unable to access ICT platforms during COVID-19 to suffer learning deficits and knowledge gaps.

There have been several studies on how learners in disadvantaged communities would suffer from this inequality of technological access, exacerbated by the pandemic (Jansen, 2020; Monareng et al., 2020; Van der Berg & Spaull, 2020; Mhlanga, 2021). This concern about digital inequity was voiced by Njilo (2020:4), who protested that learners "who have no study gadgets or internet connectivity should not be treated as though they were the cause of Covid-19". In agreement, Chisango and Marongwe (2021) concluded that the spread of the pandemic amplified the existing challenges in education and starkly exposed inequalities that had existed and continued to exist in schools.

2.3.3. ICT use during COVID-19: remote and blended teaching

According to the World Bank (2020:12), education systems around the world were forced to implement "remote teaching and learning platforms" as a means of sustaining learning engagements during COVID-19. Remote teaching and learning is of two basic kinds: synchronous and asynchronous. Netolicky (2020) refers to synchronous remote teaching as 'live' learning where learners learn in tandem with the teacher. Asynchronous learning involves learning independently and at different times. In SA, many ICT-equipped schools could (in theory, at least) seamlessly continue their teaching and learning while under-resourced schools were left befuddled by the prospect of remote teaching (Monareng et al., 2020).

Ramrathan (2020) indicates that the most common remote teaching and learning platforms used during COVID-19 were departmental e-portals, WhatsApp messenger, Zoom, Microsoft Teams, Google Meets, Skype, Google Classroom, YouTube, Facebook, TikTok, Snap Chat

and, in many instances, physical printed resources (worksheets/booklets). Monareng et al. (2020) concluded that remote teaching and learning yielded many benefits, such as flexibility in teaching and learning and the potential to develop learners' 21st-century skills. In contrast, Van der Berg and Spaull (2020) conclude that rural schools in SA did not benefit from ICT-based remote teaching and learning during COVID-19. Table 2.4, below, summarises some of the benefits and limitations of asynchronous and synchronous learning.

Table 2.4: The benefits and limitations of asynchronous and synchronous learning (Solomon & Verrilli, 2020:25).

	Asynchronous learning	**Synchronous learning**
Benefits	• More polished product • Teachers and learners were in control of their work pace • More complex and sustained tasks	• Maintaining connections between teacher and learner • Real-time response/ rapport/ feedback • Makes provision for greater engagement
Limitations	• Real-time engagement and understanding is absent • Less connection and accountability • Insufficient connection with learners who are experiencing challenges • Screen fatigue • Attention decrease	• Coordinating schedules • Technology issues/ access disrupt learning • Screen fatigue • Attention decrease

Blended learning was another prominent method of delivering the curriculum during the COVID-19 pandemic. Blended learning is defined by Salakhova et al. (2020:1413) as follows:

- an educational process structured on the foundation of integration and mutual complementarity of traditional and e-learning technologies;
- an educational methodology combining traditional methods with computer-mediated activities for teaching and learning;

- active use of e-learning in conjunction with traditional forms of learning; and
- a systematic approach to the organisation of the educational process, embedded in a combination of full-time lesson delivery and e-learning.

Salakhova et al. (2020:1413) claim that "the convenience and flexibility of e-learning is complemented by a teacher's direct contact with the group in the classroom via internet technology". The COVID-19 pandemic encouraged approaches such as blended learning to mitigate and manage the challenges it presented (Rachmadtullah et al., 2020). Banitt et al (2013:3) state that the new educational landscape requires a shift in pedagogical strategies:

> To teachers, it seems that today's learners demand new, innovative learning methods that bridge the digital divide between their in-school and out-of-school lives. For educators, this means fusing proven pedagogy and curriculum with technology integration in creative, meaningful, and engaging ways.

The rapid spread of COVID-19 applied pedagogical pressures on teachers and required them to quickly adjust or completely rethink their teaching approaches (Patrick et al., 2021).

2.3.4. Benefits and challenges of using ICT during COVID-19

Benefits of using ICT for curriculum delivery during COVID-19

Optimism

In a study on the benefits and challenges of using ICTs, Dias and Victor (2022:26) concluded that teachers and learners became "optimistic about the use and influence of these devices on students' motivation, communication, collaboration and ability to research". Teachers were urged to tap into a sense of optimism as they maintained contact with their learners during the pandemic, and their attitude towards the use of ICT was an important factor in the successful use of technological tools during COVID-19 (Parker et al., 2020). In sum, the positive approach of teachers towards technological resources and platforms significantly contributed to the effective learning experiences created during the pandemic.

Learners could learn at their own pace

Bailey and Lee (2020) declare that using ICT in an online environment affords learners the opportunity to learn at their own pace and anywhere where there is connectivity. Particularly during the days of the pandemic, it was important for learners to be able to have an accommodating schedule and space for work to be completed. The innovative use of ICT enabled learners to complete tasks at a self-regulated pace (Chua et al., 2021). Teachers could assign work for learners to complete and submit within a reasonable timeframe by using the ubiquitous features of the various digital platforms. ICT use during COVID-19 enabled teachers and learners to engage with educational content in a more flexible manner, whereby tasks, deadlines and submissions could be made anywhere and at any time (Bailey & Lee, 2020).

Resilient teachers

Through the innovative use of ICT platforms and resources, teachers became resilient practitioners who offered various levels of support to learners and parents during the treacherous regime of COVID-19 (Jansen & Farmer-Phillips, 2021). The pandemic brought with it many uncertainties and confusions, and teachers were in some ways situated in the middle of it all. Teachers were required to resiliently approach the new educational landscape and practices. Sampson (2021:34), a teacher in the Western Cape, shared her experience of having to become resilient and adapt her practice during the pandemic as follows:

> I had to adjust that lesson very quickly, making use of text, photos, and voice notes. I discovered later that I could download short videos from Vidmate in order to enhance their lessons.

This is but one example of how teachers did not allow the compromised circumstances of COVID-19 to deter them from delivering lesson content to their learners (Dias & Victor, 2022). Even though new demands were constantly made of teachers, their innovative efforts ensured that learning continued during the harsh educational climate of COVID-19.

Supporting learners and parents

One of the highlights of teaching during the pandemic was the way teachers tirelessly ensured that learners and parents were supported, making use of various digital platforms (Jansen & Farmer-Phillips, 2021). Though many learners could not access support in completing

assigned tasks, teachers did their best by using communication channels accessible to the majority of households such as WhatsApp Messenger (Munir et al., 2021). Parents relied on teachers' help with challenging content, who responded with pictures, texts, voice note messages and video demonstrations to provide the necessary support (Chua et al., 2021).

Using different ICT tools

Teachers used an abundance of ICT-based platforms, resources and tools during the pandemic. Ungerer (2021:47) was a teacher who used the pandemic to pioneer digital-based teaching strategies:

> I used different ways to reach my learners, such as Zoom, Microsoft Teams, WhatsApp messages and pictures. I made lots of videos using an application, Inshot, to support my learners online. I arranged with the parents to call my learners at least once a week just to hear their voices and to ask them how they were doing.
>
> Within the first six months of lockdown, my YouTube channel had gained more than 1000 subscribers. The lessons had more than 50,000 views.

This teacher innovatively adapted her practice during the pandemic. By using different technological platforms, teachers ultimately enhanced their delivery of lesson content (Chua et al., 2021). As confidence was gained in the use of a wider variety of ICT-based resources, teachers not only effectively engaged learners in constructive learning, but also became innovators of successful ICT integration (Bailey & Lee, 2020; Christopoulos & Sprangers, 2021; Jansen & Farmer-Phillips, 2021).

Recent local and international literature on the use of ICT during COVID-19 makes it clear that there were many benefits experienced by teachers who engaged with ICT-based platforms to deliver their curricula. Their innovative practices and approaches should be tailored for continued future use.

Challenges of using ICT for curriculum delivery during COVID-19

COVID-19 contributed to the disruption of traditional teaching methods and created challenges for teachers and teaching, which Reich et al. (2020:2) have characterised as "professional loss and burnout, and exacerbated inequities". The teachers who were 'at the

coalface' during the pandemic were expected to meet these challenges and adapt to a 'new normal' way of teaching and learning. Maree (2020) mentions that many teachers experienced challenges with transitioning to delivering instruction using ICTs, particularly under pressured conditions or where minimal guidance was provided.

Pressure and comfort zone issues

There have been several studies of the challenges experienced by teachers with ICT use during COVID-19 (Jansen, 2020; Chisango & Marongwe, 2021; Mhlanga, 2021). A South African teacher by the name of Sampson shared her experiences of being taken out of her familiar teaching environment:

> I was certainly taken out of my comfort zone when presenting these classes. I had high hopes for making videos and sending it to my learners. I spent a lot of time and effort making my first – and last – video, demonstrating how to make a sandwich for the lesson on recipes. In the end, WhatsApp rejected the video because the format was incorrect. I still do not know what went wrong. (2021:34)

The shift from face-to-face classroom teaching placed this teacher under considerable strain and exposed her to the unfamiliar terrain of ICT-based teaching (Ramrathan, 2020). She explicitly mentions being "taken out of [her] comfort zone", evoking the additional pressure of the demands made on her by the remote mode of teaching. Many teachers experienced considerable anxiety upon entering the new educational landscape of using technology to deliver the curriculum (Chisango & Marongwe, 2021).

Lack of resources

A common problem for teaching and learning during the pandemic was that of a lack of resources. Mhlanga (2021) found that many learners from disadvantaged communities did not have access to the required devices to sustain their learning. Those who had access were often required to share devices with siblings or other family members. Many learners who lacked resources were not supported at various levels and times during the pandemic. This created further inequality and amplified the challenges that learners from impoverished communities faced (Mkhize & Davids, 2023).

Parental challenges

During COVID-19, many teachers were required to collaborate with parents using digital platforms. Garbe et al. (2020) found that parents experienced real difficulties with having to adopt the role of co-educator through the medium of ICT-based platforms. Parents were not only required to support learning but in many instances were expected to explain concepts to their children. This resulted from another challenge, this time in the form of communication. Balkar et al. (2022) report that communication between teachers and parents was a challenge, as many technical issues, such as poor video quality and insufficient storage to download content, arose in the course of attempts to establish interaction. Because many parents had neither the knowledge nor the technological skills to administer support to their children, teachers struggled to inform them how concepts should be reinforced and explained (Clausen et al., 2020).

Google Classroom and WhatsApp

Many digital platforms were utilised by teachers during COVID-19, including, most prominently, Google Classroom and WhatsApp Messenger (Munir et al., 2021). These digital platforms were commonly used during the pandemic among teachers, learners, and parents. A description of each platform accompanied by a brief account of the benefits and challenges of each will be presented.

Google Classroom

Okmawati (2020:439) describes Google Classroom as follows:

> Google Classroom is a free web service developed by Google for schools that aims to simplify creating, distributing, and grading assignments. The primary purpose of Google Classroom is to streamline the process of sharing files between teachers and students. Google Classroom enables teachers to create an online classroom area in which they can manage all the documents that their students need. Documents are stored on Google Drive and can be edited in Drive's apps, such as Google Docs, Sheets.

Shaaban (2022) adds that Google Classroom accounts can easily be established and that the platform boasts useful characteristics such as flexibility, security and saving time. It also provides opportunities for collaboration among learners. She adds that the teacher can create classes, distribute assignments, send feedback, and see everything in one place. Oktaria and

Rohmayadevi (2021) observe that Google Classroom makes teaching more productive and meaningful by streamlining assignments, boosting collaboration and fostering communication.

Shaaban (2022) maintains that the common challenges of using Google Classroom were a lack of actual social interaction between teachers and learners and a lack of support from officials during the COVID-19 pandemic. An important aspect to be noted would be that teachers did not explore all the features of Google Classroom, which meant that it was not as useful as it might have been. According to Oktaria and Rohmayadevi (2022), common challenges associated with integrating Google Classroom into teaching during COVID-19 included a lack of teacher ICT knowledge and skills, insufficient technological resources, and a lack of learner participation.

WhatsApp

Nihayati and Indriani (2021) describe WhatsApp as a smartphone application and online-based social network, operated from many technological devices with different features and enabling easy communication. Waluyo and Purwait (2020:140) note that WhatsApp includes:

> sending text messages, sending photos from the gallery or the camera, sending videos, sending files, voice calls and messages, sharing location using GPS, and the sending of contact cards. WhatsApp also supports several emojis, and users can set up their profile panel, consisting of name, photo, status, some privacy setting tools to protect profiles, a tool to cover messages, change account numbers and make payments online.

This free platform was used by teachers, parents and learners to sustain educational engagement and communication during COVID-19.

The benefits of using WhatsApp as a teaching tool include that it "allows users to provide instructions, deliver course materials, announcements, and comments in the form of live text, documents, images, audios, videos, links, and even installable application programs" (Munir et al., 2021:169). The WhatsApp application is able to engage with a large number of learners at the same time (Munir et al., 2021). Darman (2020) adds that WhatsApp was able to combine media, including the availability of facilitators and constant learning anytime and anywhere, making it convenient for teaching and learning activities. In short, WhatsApp was

used to support learning engagements as a result of its interactive and easily accessible nature.

The challenges of using WhatsApp include the fact that some learners did not have mobile devices, that teachers struggled to contact parents, and that some learners put minimal effort into online learning (Munir et al., 2021). Teachers who had not used WhatsApp as a teaching tool before the advent of COVID-19 found it difficult to explain task expectations through the medium (Nel & Marais, 2020). What is more, teachers were often inundated with messages and requests for support on this messaging platform, which added to the challenges that they experienced (Nel & Marais, 2020).

A study conducted by Suparman et al. (2022) concluded that the use of Google Classroom and WhatsApp as digital platforms had an overall positive impact on teaching, learning and curriculum delivery during COVID-19. The literature relating to Google Classroom in particular, as the dominant ICT-based platform used during the pandemic, highlights the key benefits and challenges experienced and how technology influenced the new educational landscape.

2.4. CHAPTER SUMMARY

This chapter has described the conceptual apparatus informing the study, the TPACK framework and the SAMR model. Also presented were the most recent literature on the 'new normal' educational landscape during COVID-19, the digital divide during COVID-19 in South African schools, ICT use during COVID-19 in remote and blended teaching, and the benefits and challenges of using ICT during the pandemic.

Chapter 3 discusses the research design of the study and describes the research methodology employed.

CHAPTER 3

RESEARCH DESIGN AND METHODOLOGY

3.1. INTRODUCTION

This chapter outlines the research paradigm, research approach, research design, site selection, sampling and data collection methods, data analysis, trustworthiness, the researcher's position, and relevant ethical considerations. The chapter concludes with a summary.

The research methodology was largely determined by the nature of the research questions, which were introduced in Chapter 1, as follows:

The main research question is:

- How did the teachers use ICT for curriculum delivery at a model school duringCOVID-19?

The two sub-questions are:

- What benefits did the teachers experience when using ICT during their curriculumdelivery at a model school during COVID-19?
- What challenges did the teachers experience when using ICT during their curriculumdelivery at a model school during COVID-19?

3.2. RESEARCH PARADIGM

This study sought to explore and understand teachers' experiences of using ICT during the pandemic. The researcher therefore employed an interpretive paradigm, described by Hovorka and Lee (2010) as seeking – through an understanding of how the participants make sense of their everyday encounters and experiences – to identify their interpretation of a

phenomenon within their social setting. An interpretive lens thus enabled the researcher to "describe the phenomenon [under study] as [it appears] to the person experiencing the phenomenon" (Tuohy et al., 2013:17).

3.3. RESEARCH APPROACH

A qualitative approach was employed in this study. According to Keyton (2011:58), "in direct opposition to quantitative research, qualitative researchers do not convert their observations or participants' observations into numerical form". Instead, a qualitative approach aims to "explore, understand and describe" the verbal responses or observations of participants (Strydom & Bezuidenhout, 2014:173). The researcher was interested in "exploring, understanding and describing" the verbal responses of teacher participants, via interviews and a TPACK and SAMR questionnaire, to establish how they made sense of having to use ICT to sustain curriculum delivery.

3.3.1. Research design

This study took the form of a case study, which is defined by Yin (2002) as an investigation of a real-life phenomenon within a social setting, especially when the barriers between phenomenon and context are not clear. The justification for using a case study design was to provide a thorough and detailed description of the experiences of individuals within their context. The teachers, situated in the immediate context of the COVID-19 lockdown, were interviewed to find out how they used ICTs in their teaching. Merriam and Tisdell (2015) describe a case study as aiming to provide in-depth explanations or knowledge of a particular social group or individual (case) such as a person, a classroom or a school. In this study, "the particular social group or individual" refers to the teachers at the selected primary school.

Swart and Meda (2017:657) note that "a case study is usually used to increase the understanding of certain complex phenomena." An advantage of using a case study was therefore that it highlighted the complex nature of teachers' experience of delivering the curriculum during COVID-19. Case studies typically combine data collection instruments such as questionnaires, interviews and observations (Huberman & Miles, 2002). In this study, the researcher used questionnaires and interviews to investigate the complex phenomenon in question.

A disadvantage of using a case study design was that the data obtained was challenging to structure and organise. The researcher was required to identify the most suitable structure and use it to present the data collected from the questionnaires and verbatim responses. Another challenging aspect was that the researcher had to remain unbiased, objective and focused throughout data collection. These challenges were managed by using structured data collection instruments.

3.4. SITE SELECTION

This study was conducted at a primary Model School (MS) situated in the Western Cape Province, South Africa. A MS is provided with ICT infrastructure and resources as well as teacher training workshops by the Western Cape Education Department (WCED). The research site selected for this study was situated in a middle-class community, which according to Visagie (2013), is associated with an average level of income and a degree of affluence. According to the national ranking system, the school is classified as a quintile 5 school based on the "level of income, unemployment rate, and level of education in the school's community" (Murray, 2016:13).

The school was provided with educational technologies such as Wireless Frequency Interface (Wi-Fi), Wide Area Network (WAN), Local Area Network (LAN), and classrooms were equipped with data projectors (a data projector for each teacher), e-beams (a magnetic device that enables a flat surface to be interactive), visualisers (a device that enables the projection of images in a mobile fashion), whiteboards (an ordinary board that uses an e-beam to make the surface interactive). The school was also given a fully fitted computer laboratory with 40 operational computers, a tablet per learner (840 learners) and a laptop per teacher (22 teachers). The administration section of the school was also furnished with computers.

The teacher-to-learner ratio at the school is 1:35. The language of learning and teaching (LoLT) is English, with Afrikaans being the first additional language (FAL). The school starts at 7:45 am for teachers, and classes commence at 8:00 am.

Table 3.1: School used in this research

Site	Description
Type of school	Model School (provided with technology infrastructure, resources and training for teachers by the WCED)
Data collection method	TPACK and SAMR questionnaire and semi-structured one-on-one interviews
Location of the school	Urban

3.5. SAMPLE

The sample for the study consisted of two teachers from each of the Phases – Foundation Phase (FP), Intermediate Phase (IP) and Senior Phase (SP) – and one ICT champion (seven in total). A small sample is ideal for qualitative research in which the researcher engages with the participants intensively when collecting the data (Creswell, 2009).

Purposive sampling was used to identify the seven research participants to ensure that they were equipped to answer the research questions and provide unique, rich and current data (Etikan et al., 2016). The researcher met and worked with each of the research participants face-to-face, to build sound relations and discuss the purpose of the research (Hammett et al., 2014).

The teachers were purposively selected in accordance with the following criteria:

- Teachers must have received MS training in the use of ICT resources in classroom teaching;
- They must have taught at the school from the beginning of the MS project; and
- They are currently teaching at the MS.

The biographical information provided in Table 3.2 includes the participants' years in education, the phase in which they taught, the number of years they had worked at the school, and their gender. This information is displayed to authenticate the selection of the research participants (Pascoe, 2014).

Table 3.2: Biographical information about the research participants

Sample	Teacher 1	Teacher 2	Teacher 3	Teacher 4	Teacher 5	Teacher 6	Teacher 7
Gender	Female	Female	Female	Female	Male	Female	Female
Age group	20-29	30-39	20-29	40-49	50-59	30-39	30-39
Years of teaching experience	7	6	5	26	32	15	12
Phase(s) taught	IP	SP	FP	FP	SP	IP	IP
Years working at Model School	7	6	5	18	32	15	12

3.6. DATA COLLECTION METHODS

An interpretive case study typically involves data collection instruments such as "interviews, focus-groups, past records and observations" (Leedy & Ormrod, 2010:137). Although not commonly associated with qualitative research, questionnaires can be used and are capable of gathering rich and credible data (McGuirk & O'Neill, 2016). In this study, the researcher collected data from two sources: questionnaires and semi-structured, one-on-one interviews. Due to COVID-19 and the restrictions of going into schools, we relied on these two data collection tools. Table 3.3 displays the dates and data collection methods used for each research participant within this research.

Table 3.3: Data collection schedule

Participants	Initial meeting and introduction Questionnaire 1	Questionnaire 2	Interview
Teacher 1	01/03/2022	02/03/2022	03/03/2022
Teacher 2	01/03/2022	02/03/2022	03/03/2022
Teacher 3	01/03/2022	02/03/2022	05/03/2022
Teacher 4	01/03/2022	02/03/2022	03/03/2022
Teacher 5	01/03/2022	02/03/2022	03/03/2022
Teacher 6	01/03/2022	02/03/2022	03/03/2022
Teacher 7	01/03/2022	02/03/2022	04/04/2022

3.6.1. Questionnaires

The process involved in the two questionnaires (1 and 2) is visually depicted in Figure 3.1.

Questionnaire 1

The first questionnaire was an invitation questionnaire. It was handed out to all 22 teachers at this school, to retrieve general information about their use of ICT for curriculum delivery at this MS during COVID-19 (Appendix 1). This questionnaire established which teachers would be suitable to answer Questionnaire 2.

After analysing Questionnaire 1, the researcher purposively selected seven teachers to whom to administer Questionnaire 2 (Cohen et al., 2002). These teachers had to be available and willing to be a part of the research and were required to have been teaching at the school since the inception of its MS role. This eliminated many teachers who were not working at the school before it became a MS. The final seven teachers selected were invited to answer Questionnaire 2 (see Figure 3.1), in which they completed a self-assessment questionnaire on their knowledge and use of technology in terms of TPACK and SAMR (Appendix 2). Questionnaires 1 and 2 were completed in person. Each questionnaire was briefly introduced to the participants, and a justification for their use was provided.

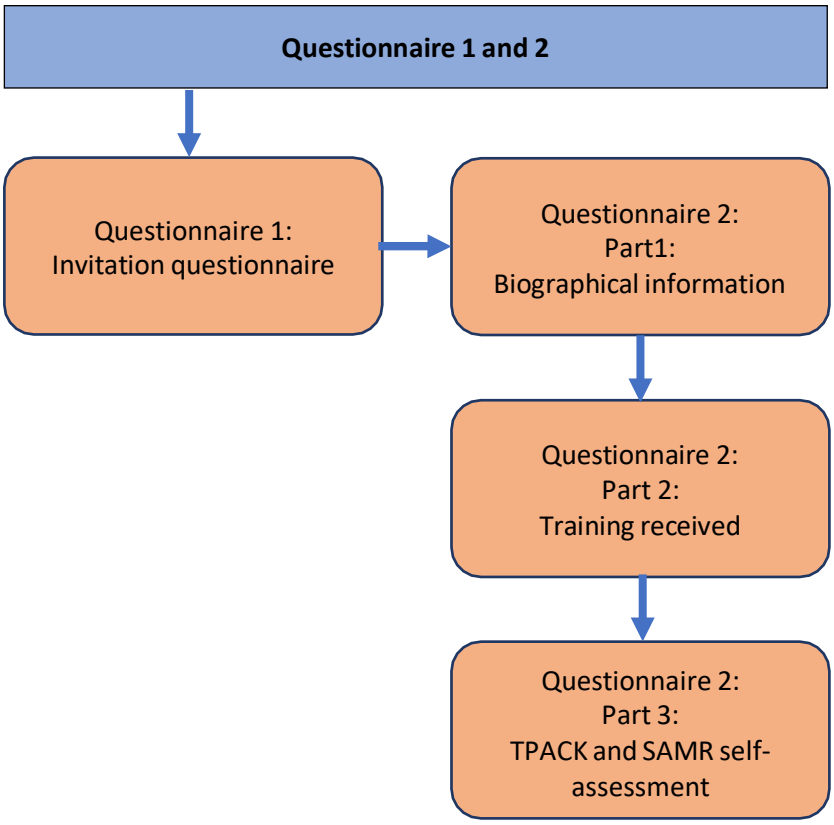

Figure 3.1: A visual representation of Questionnaires 1 and 2

Questionnaire 2

This questionnaire consisted of three parts, as described below.

Part 1: Sought biographical details through straightforward closed-ended questions. This yielded valuable information that the researcher used to gain an overview of the participants (Denscombe, 2017).

Part 2: Required participants to complete a self-assessment on the ICT training they had received as well as their level of ICT skills. The researcher used open-ended questions to allow respondents to explain their responses (Shenton, 2004).

Part 3: Consisted of closed-ended questions based on the TPACK and SAMR frameworks. These closed-ended questions were the same for all seven participants, which ensured consistency (McMillan & Schumacher, 2014). The responses to the TPACK questions outlined the teachers' understanding of the appropriate knowledge bases needed to use ICT in

their teaching practice. Their responses to the SAMR questions provided an understanding of how they used ICT for curriculum delivery.

Mathevula and Uwizeyimana (2014:1092) claim that "hand-delivering the questionnaires" is preferable as it "[prevents] possible delays resulting from posting questionnaires and also [helps] to establish a good relationship between the researcher and the respondents". The researcher decided to take this advice and physically deliver the questionnaires to the seven participants. The researcher was thus able to engage with the participants and begin to develop a positive relationship. A benefit of using questionnaires was that they were cost-effective: the researcher had access to the school facilities to make printed copies free of charge. The participants were allowed to complete the questionnaire at their own pace, which they did during their free periods.

There were two disadvantages to using questionnaires that the researcher experienced. The first was the lack of detail in certain responses from the participants (Denscombe, 2017). Some did not provide justifications for their responses, which the researcher tried to counter by reminding them to substantiate their answers. A second disadvantage was having to explain the questionnaire sections numerous times, as each participant completed the questionnaire independently at a different time. This was even though the instructions in the questionnaire were formulated in simple English and made as easy to understand as possible.

3.6.2. Semi-structured one-on-one interviews

Once the researcher had analysed the responses to Questionnaire 2, he interviewed the participants. Having identified the level of responses produced by the participants, the researcher could prepare probing questions to be posed during the semi-structured interviews to explore the participants' attitudes, opinions and feelings. According to Harvey-Jordan and Long (2001:219), semi-structured interviews are used to "understand the reasons why people act in particular ways, by exploring participants' perceptions, experiences and attitudes". Efron and Ravid (2013:98) note that "open-ended questions … allow the researcher to ask additional questions not specifically planned in advance".

Some of the interviews were conducted in the staffroom during the school week and some at teachers' homes during the weekend. The interviews each lasted between forty-five minutes

and one hour and were conducted in the participants' home language of English. The detailed interview schedule with probing questions is attached as Appendix 3.

Strydom and Bezuidenhout (2014:188) indicate that an advantage of semi-structured interviews is that they secure "detailed explanations" from participants by asking "probing questions" to gain more understanding. All seven participants were asked the same questions, though their responses came from different perspectives and reflected their personal viewpoints. The open-ended questions were useful, partly because they enabled the researcher to pose follow-up questions. Participants who were interviewed in their homes seemed more confident about describing their experiences.

Saidin and Yaacob (2016) suggest that elements of personal bias and subjectivity, encompassing personal experiences, beliefs, perceptions, feelings and values, may have an influence on the interview process. The researcher mitigated this tendency by remaining professional throughout the interview process and avoiding the imposition of personal views that could have influenced participants' responses. The interview scheduling times posed a challenge as the availability of the researcher and the participants had to be taken into consideration. Because some of the interviews were conducted in the staffroom during school hours, certain interruptions occurred – such as the bell to mark the change of period, which required the interview to be paused until it had ceased ringing. The interviews conducted in the homes of participants were met with the occasional interruption by a family member. The researcher and the teachers remained flexible and patient through these occurrences and promptly resumed the interview process.

3.7. DATA ANALYSIS

Qualitative data focuses on phenomena through the media of words, statements and visuals (Denzin & Lincoln, 2011), which require the application of "textual or thematic data analysis" (Nishishiba et al., 2017:4). Thematic data analysis enables the organisation, interpretation and understanding of the data collected. The researcher first produced verbatim transcriptions of participants' responses – the exact words that participants used during the interviews – which was followed by repeated readings of the transcripts (Braun & Clarke, 2006; Denzin & Lincoln, 2006). This rereading acquaints the researcher with the information

obtained during the data collection process to the extent that s/he can begin inductively to identify patterns in the data.

The next step involved coding the data, that is, identifying and categorising excerpts from the transcriptions that appeared to respond to the research questions (Braun & Clarke, 2006). According to Vogt et al. (2014:13), symbol-coding is the "translation of data into symbols". The researcher used a symbol coding system to organise the verbatim transcriptions, assigning symbols such as "TF" (Teacher Factors) to distinguish passages associated with specific aspects of the research questions. Codes are then merged to form overarching themes (Bostrom, 2019), the "recurrent and distinctive features of participants' accounts, characterising particular perceptions and/or experiences, which the researcher sees as relevant to the research questions" (King & Brooks, 2019:150). The researcher also deductively identified themes linked to the conceptual framework of TPACK and SAMR.

Table 3.4: A representation of the five stages of qualitative data analysis used in this study (Denscombe, 2007).

Stage 1 (Preparation of the data)	The researcher prepared all the data collected (Questionnaire 2 and the semi-structured one-on-one interviews) by transcribing the information verbatim. The teachers were handed the transcriptions to check them for accuracy.
Stage 2 (Familiarity with the data)	The researcher then proceeded to reread the data collected from Questionnaire 2 and the semi-structured one-on-one interviews to begin to organise the data by breaking it down into smaller and more meaningful units (Flick, 2017).
Stage 3 (Interpretation of the data)	The researcher coded the various categories that emerged from the data collected as follows: 3.1 TS (Teaching strategies) 3.2 TB (Teaching benefits) 3.3 TC (Teaching challenges)
Stage 4 (Verification of the data)	Once the codes were established, the researcher proceeded to identify patterns and similarities within the data, which allowed him to organise the data into smaller units of meaning, developing themes and sub-themes for each of the research questions (Henning et al., 2007): 1. Main research question: the themes and sub-themes emerging from the data collected: 1.1 The benefits of ICT training for curriculum delivery; 1.2 The availability of ICT resources and frequency of use; and 1.3 The benefits of shifting to Google Classroom and WhatsApp for curriculum delivery. 2. Research sub-questions: The following themes and sub-themes emerged from the data collected: 2.1 The digital divide during COVID-19;

	2.2 ICT training challenges; and 2.3 Parent communication challenges. The themes and sub-themes that emerged were used to identify explicit links to and relationships with the conceptual framework and literature review (provided in Chapter 2)
Stage 5 (Representation of the data)	The findings resulting from the analysis of data from Questionnaire 2 and the semi-structured one-on-one interviews were presented using figures and tables, with consistent reference to theory and literature (Cohen et al., 2018). The researcher discarded initial themes such as TS, TB, TC as they did not afford sufficient data to answer the research questions.

3.8. TRUSTWORTHINESS

According to Reiley (2013:1), trustworthiness is a benchmark for ensuring "truthfulness" and "authenticity" in qualitative research. In order to achieve trustworthiness, Lincoln and Guba (1985) believe that the researcher needs to remain cognisant of four indispensable criteria: validity, reliability, transferability and conformability. To ensure a trustworthy study, the researcher used multiple methods of data collection such as the two questionnaires and semi-structured one-on-one interviews (Maree, 2022), supported by member checking (Reiley, 2013). A discussion of the four criteria for trustworthiness and their implementation in this study ensues.

3.8.1. Validity

Validity is "the accuracy with which the researcher interpreted the data that was presented by the participants" (Du Plooy-Cilliers et al., 2014:258). The researcher encouraged validity by collecting the data in the 'natural' contexts of the seven selected teachers, their classrooms or their homes. Cohen et al. (2018) claim that credible and authentic in-depth responses will be collected if the participants are comfortable within their contexts.

There are two forms of validity, internal and external (Du Plooy-Cilliers et al., 2014). In this study, internal validity was checked by the researcher. Internal validity focusses on the extent to which the results of the study are credible, sensible, authentic, and correspond to reality (Cohen et al., 2018). To achieve this kind of validity, the responses of the participants were carefully scrutinised and analysed by the researcher. That the participants in this study were knowledgeable about using ICT for curriculum delivery helped ensure the validity of the

findings. Probing questions constituted a deliberate strategy to obtain reliable and valid information from the participants.

The researcher used more than one data collection instrument – two questionnaires and semi-structured one-on-one interviews – which is termed triangulation, a strategy that contributes to validity (Fleming, 2018). Member-checking was another measure utilised: the researcher presented the participants with transcriptions of the semi-structured one-on-one interviews for them to check if their responses had been accurately recorded (Creswell, 2009). All seven participants confirmed that their responses were faithfully recorded, which helped to avoid bias and confirm validity.

3.8.2. Reliability

Reliability highlights the juxtaposition of the data collected with "what actually occurs in the natural setting" of these teachers' use of ICT for curriculum delivery during COVID-19 (Cohen et al., 2018:270). Reliability in qualitative research strives to "employ techniques to show that, if the work were repeated in the same context, with the same methods, and with the same participants, similar results would be obtained" (Shenton, 2004:63). The similarities and differences in teaching strategies as well as benefits and challenges experienced by teachers while delivering the curriculum during the pandemic were monitored and recorded throughout the process of data collection and could easily be repeated in a similar context.

Different teachers used different pedagogical strategies and experienced various benefits and challenges when using ICT to teach during COVID-19. The researcher was thus required to increase reliability in the study by using two pre-determined questionnaires and a semi-structured interview schedule "with the same format and sequence of words and questions for each" of the participants (Cohen et al., 2018:273). To ensure reliability, the researcher presented all seven participants with the same two questionnaires which consisted of closed-ended questions, requiring in addition only brief justifications. Open-ended interview questions were posed to allow participants to describe their unique use of ICT for curriculum delivery during COVID-19. As far as possible, the researcher ensured that the "findings are the result of the experiences and ideas of the informants, rather than the characteristics and preferences of the researcher" (Shenton, 2004:72). The process produced substantially reliable findings.

3.8.3. Transferability

A fundamental function of transferability is "the ability of the findings to be applied to a similar situation and deliver similar results" (Koonin, 2014:258). The researcher, aware of his positionality, was also aware of his understanding of the school and participants, therefore made extensive notes during the process of data collection to report on what the participants indicated (Koonin, 2014). He provided contextual information regarding the participants, which assists in transferability to similar settings.

This small case study only included seven primary school teachers using ICT for curriculum delivery at a MS during the pandemic lockdown. The research findings should be transferable to other contexts, such as other provinces and teachers in different phases that seek to enhance their use of technology at Model Schools.

3.8.4. Confirmability

Confirmability "is concerned with establishing that the data and interpretations of the findings are not figments of the inquirer's imagination, but clearly derived from the data" (Korstjens & Moser, 2018:67). The following categories can be employed by the researcher to develop an audit trail and increase confirmability: data reduction and analysis products, data reconstruction and synthesis products, process notes, materials relating to intentions and dispositions, instrument-development information (Lincoln & Guba, 1985). The researcher collected the raw data and then structured and categorised it into themes. The quality of confirmability can be enhanced through triangulation (Anney, 2014).

3.8.5. Triangulation

Denzin and Lincoln (2006) note that the term triangulation refers to the use of various methods to analyse the same phenomenon. Triangulation can be achieved when multiple strategies are used to collect data, such as interviews, questionnaires, observation and document analysis (Maree, 2010). In this study, two questionnaires and semi-structured one-on-one interviews were used to achieve triangulation.

The researcher derived his findings from different sources of information and individuals to ensure a credible and accurate study (Maree, 2010). The responses to the two questionnaires aligned with those from the semi-structured one-on-one interviews. Theoretical triangulation was achieved by drawing from two theorists to analyse the data; Mishra and Koehler's (2006) TPACK framework and Puentedura's (2006) SAMR model. Triangulation of time and instruments was attained by the researcher's being consistent in his data collection, using the same questionnaires and interview schedule for all seven participants.

3.9. THE RESEARCHER'S POSITION

Since the researcher was a former student teacher at this school, he can be identified as an insider-researcher. Trowler (2011) describes an insider-researcher as a researcher who researches within an organisation, group, or community of which s/he is a member. The advantage of an 'insider role' boils down to the relationships already established between the researcher and participants. Also, the researcher's understanding of the context may assist with the process of data collection and analysis (Fleming, 2018). At the same time, Fleming (2018) acknowledges that a pre-existing relationship with the participants could be a disadvantage in that it could exert an influence on them.

As it was, as part of the phenomenon being investigated, it proved challenging for the researcher to maintain an unbiased approach (Ratner, 2002). To mitigate issues of bias and power relations, the researcher ensured that data collection and the data analysis process were conducted in a manner that minimised pre-existing assumptions (the utilisation of a validated TPACK and SAMR questionnaire will support this). This was achieved by examining the teachers' understanding of TPACK and SAMR in their practice, as reflected in their answers to the questionnaire. In addition, interview questions were kept short to avoid using words or adding material that may have exerted influence. Lengthy questions, for instance, could have confused participants and led to inaccurate or irrelevant responses. Every attempt was made to avoid leading questions capable of steering responses towards goals that the researcher may have wanted to achieve – whether consciously or not.

3.10. ETHICAL CONSIDERATIONS

This research study was categorised as a medium-risk study (Ramcharan & Cutliffe, 2001), as it involved the investigation of adult participants' experiences. Some of the participants the researcher knew when he was a student teacher at the school. Such risk as existed was circumvented by following ethical principles. These principles guided the researcher's behaviour throughout the research, to ensure that the study was conducted honestly, objectively and with integrity (Parveen & Showkat, 2017). The researcher attempted to find a balance between professionally achieving the aims of the research and upholding the rights and freedoms of the participants. An application for ethical clearance was made to the Education Faculty Ethics Committee of a university in the Western Cape. Permission was also requested from the WCED to conduct research at a public primary school in the Western Cape. Cohen et al.'s (2007) commentary on informing participants about the processes of this research study was used to make an informed decision concerning their participation. The following was included:

- The purpose, goals and processes of the research were clarified to prospective participants;
- Participants were assured that they would not be discriminated against and that no harm would come to them as a result of their participation;
- Pseudonyms were used for the names of participants and the name of the school;
- Participation was voluntary;
- Participants' identities remained anonymous; and
- Participants had the right to withdraw from the study at any time.

The researcher provided each of the seven selected participants with an ethical consent form (Appendix 4) which they completed before the collection of any data.

COVID-19 protocols were upheld throughout the interview process as well as during the questionnaire distribution. The researcher strictly adhered to physical distancing measures when interviewing participants to avoid contact during COVID-19.

3.11. CHAPTER SUMMARY

Chapter 3 introduced and discussed the research paradigm, research approach, research design, site selection, sample, data collection methods, data analysis methods, trustworthiness, the researchers' position, and relevant ethical considerations. The study used two questionnaires and semi-structured one-on-one interviews to answer the three research questions. In Chapter 4, the data obtained will be analysed and discussed.

CHAPTER 4

FINDINGS AND DISCUSSION

4.1. INTRODUCTION

The previous chapter described the research design and methods used in the study. This chapter presents and discusses the findings as a composite answer to the research questions, beginning with the sub-questions, which sought information about the benefits and challenges of using ICT as experienced by the teacher respondents.

4.2. SUB-QUESTION 1

What benefits did the teachers experience when using ICT during their curriculum delivery at a model school during COVID-19?

To identify the benefits that the teachers experienced when using ICT for curriculum delivery at their school during COVID-19, themes were derived from both inductive (data-driven) and deductive (theory-driven) data analysis. The data was collected via the seven TPACK and SAMR questionnaires, and the seven semi-structured one-on-one interviews. These themes include:

- The benefits of ICT training for curriculum delivery;
- The availability of ICT resources and frequency of use; and
- The benefits of shifting to Google Classroom and WhatsApp for curriculum delivery.

4.2.1. The benefits of ICT training for curriculum delivery

During ICT training, the teachers acquired a variety of skills that enabled them to integrate technology into their teaching. These benefits are outlined in Table 4.1, below.

Table 4.1: Benefits experienced from the teachers' ICT training

Educators	Categories of benefits			
	General pedagogical benefits received during the teachers' ICT training	Specific pedagogical benefits acquired from the teachers' ICT training	Using technology to engage with learners	Teachers creating their own resources
T1	✓			
T2	✓		✓	
T3	✓	✓	✓	✓
T4		✓		
T5	✓	✓	✓	✓
T6	✓	✓		
T7	✓		✓	

4.2.1.1. General pedagogical benefits received during the teachers' ICT training

Six of the seven teachers indicated that the training they received gave them new ideas on how to use technological skills for curriculum delivery. Their general comments include:

T1: So, [ICT training] prepares you and it gives you nice ideas.

T2: Yes, [ICT training] has. It has also given lots of different ideas of what I want to do with technology in the classroom.

T3: I learnt new things… from the CTLI workshops that I attended.

T4: It helped me a lot.

T5: The training was actually very good, because it provided you with the different tools to teach effectively with…

T6: Okay so the training … was very good uhm, we can use all of the devices, we know exactly what to do.

T7: … [ICT training] … played a vital role in the way I use technology in my classroom, so we are clued up.

It is evident from the above that the teachers acquired new and different ideas about using technology to achieve curriculum outcomes. ICT training for teachers is indispensable as it offers up-to-date strategies and methods for teachers to use in the diverse and ever-changing educational landscape (Dube, 2020; Chisango & Marongwe, 2021; Jansen & Farmer-Phillips, 2021). Pozo-Rico et al. (2020) concur that the knowledge acquired by teachers in their ICT training programmes equips them with the methods and strategies to deliver the curriculum. The training helps to equip the teachers with the relevant TK, TCK and TPK (Koehler et al., 2013).

4.2.1.2. Specific pedagogical benefits acquired from teachers' ICT training

Ts 3, 4, 5 and 6 shared their first-hand experience of how the technology and teaching strategies they were exposed to during the ICT training benefitted them. The training equipped them to use specific technological skills and techniques in their classrooms for curriculum delivery. Comments are drawn from both the interviews and the written questionnaires:

> T3: … it was a CTLI course, and it was mainly … like making your own resources to use in the classroom, like making your own stories online and using Google Classroom to make your own and making your own [inaudible] on the Google platform, your own website.
>
> T4: [ICT training] helped me a lot because … in one of the courses, they showed me how to do an anchor chart.
>
> T4 continued: I learnt about JamBoard … I even set my own Google Form … and then I did a mathematics, it was like a quiz or something, I even learnt how to do that, I didn't know how to do that before.
>
> T5: … the training was actually very good, because it provided you with different tools, to be able to use, for example, I would use the POLL Everywhere to send learners … feedback, how you feeling today? how's the COVID situation at home? for example, they just need to respond, and then I get the feedback.
>
> T5 further mentioned: … it was still really effective … I think it was productive, e-teaching and we could do our, our e-assessment as well as based on the tools that we acquired while we had our training, so I think it really helped a lot.
>
> T6: As soon as someone shows [ICT training] or guides me, I won't know what must be done, and I continually become, hands-on with what I was taught … do you

> know ITSI, so it's kind of similar, so you would post your day's lesson onto the Google Classroom, so you will develop a file or a classroom and then you will have one for English, Afrikaans … put on the week's lessons or the day's lessons, you can put on videos and pictures.

Ts 3, 4, 5, and 6 revealed that their ICT training exposed them to innovative ideas and how to use various technological resources such as Google Classroom, Google platform, anchor charts, JamBoard, Google Form, Poll Everywhere and Information Technology Service Intelligence (ITSI) that helped them with their teaching. These teachers were equipped with a range of ICT strategies as well as plenty of ideas and resources through their ICT training (Pozo-Rico et al., 2020). These teachers acquired TK and TPK from the ICT training that they received and transferred it into their curriculum delivery.

4.2.1.3. Using technology to engage with learners

As a result of the ICT training received, five teachers (Ts 2, 3, 5, 6 and 7) explained how they were empowered to use technology to engage with their learners during COVID-19. T2 outlined the benefit of having received ICT training in the use of Google Classroom, which she used to create interactive activities for learners. She described her experience as follows:

> T2: We would interact with the Google Classroom, and we would interact with them on there … would mainly be uploading work and uploading tasks and them submitting it via Google Classroom or and then we had a one day … we made Fridays specific to those children who were at home, and they come in and then we would just ask them, what it is that they didn't understand, because obviously they weren't being taught because of COVID, we made videos and shared it with them, on whatever they didn't understand.

T2 thus indicated that her training enabled her to use Google Classroom effectively to deliver the curriculum to her learners. She used video clips as an intervention strategy because learners "weren't being actually taught" in the customary face-to-face manner. T2 said that she would mainly upload work but also create her own videos and share them with her learners. Her use of ICT would be situated within the Substitution level of the SAMR model, which indicates minimal task redesign (Puentedura, 2006). This teacher possessed the

relevant TK and TPK for using ICT at this level (Koehler et al., 2013). Using the Friday face-to-face schedule in conjunction with Google Classroom, she created a blended learning approach which provided learners with teacher support (Salakhova et al., 2020). In sum, T2 used Google Classroom to engage her learners in effective learning while offering support to those experiencing challenges.

T2 also used a blended learning approach by combining uploaded educational material with self-recorded video explanations on the Google Classroom platform. She possessed the necessary TK as she identified the appropriate ICT platform. In addition, sound PK and TPK were demonstrated in her selection of relevant instructional strategies (i.e., uploading educational material and video explanations) and effective use of them in her curriculum delivery (Koehler & Mishra, 2012).

T3 stated that the ICT training exposed her to many innovative ways of using ICT platforms to engage with her learners. She said: "I could use the ICT platforms … to engage with my learners and they and the parents would give good feedback. The learners would get excited when I used some of the ICTs, like especially the See-Saw". The interactive platform See-Saw affords learners the opportunity to share, create, collaborate, and reflect on what they have learnt using videos, photos, text, links and PDFs (Cepeda-Moya & Argudo-Serrano, 2022). T3 used ICT effectively by selecting a platform that would allow for interaction among herself, her students and their parents. This situates her at the Modification level in the SAMR model (Puentedura, 2006).

T5 used the approach of involving parents to engage with learners more effectively. He added the following:

> So, in our communication … I would engage the parent … I would encourage the parent … I'm sending a video lesson, but I want you also to watch the video so that you can have an idea of … what is the outcome of this video and look at the questions or the quiz … and then watch the video and then you will also have an idea, and when a child is going to answer then you will check okay my child is on the right track, he understands what the content of the video is about.

T5 involved his learners' parents in the process of curriculum delivery during COVID-19 by insisting that parents watch videoed lessons with their children so that they could explain aspects of the content to the learners. In so doing, T5 created a synergy between the teacher, learner, parent, and the educational material (Mhlanga, 2021). T5 displayed TK, PK and CK as he needed to select the appropriate technological resources, the level of the content, and the mode of delivery of the lesson (Mishra & Koehler, 2006). These processes of technological use, parent involvement, learner support and curriculum delivery situated T5 at the Substitution level according to the SAMR model (Puentedura, 2006; Pozo-Rico et al., 2020).

T7 shared her first-hand experience of engaging with her learners during the pandemic as follows:

> T7: On Google Classroom … I put all their work on there, and they like it because they can chat to each other on Google Classroom, and you like I take photos of the board and then I upload it onto Google Classroom say if the child forgot to do his homework and whatever, he can just go check there, so [the learners] loved that.

T7 indicated that she used Google Classroom to upload photos of the classroom board. These photos would then be used as homework reminders. The teacher indicated that her learners were pleased that their teacher could engage and communicate with them during the pandemic. T7 displayed her PK, TK, and TPK by selecting the appropriate educational material and sharing information via the Google Classroom platform. This engagement was essential to keeping learners motivated and interested in the teaching and learning process (Mhlanga, 2021). According to the SAMR model (Puentedura, 2006), this teacher's use of ICT as a basic information-sharing platform situated her curriculum delivery at the Substitution level.

4.2.1.4. Teachers creating their own resources

As a result of the effective ICT training received prior to COVID-19, two teachers explained how they were able to create their own resources. T3 shared her experiences as follows:

> T3: … I tried using See-Saw and that is also where you basically, it's kinda like Zoom where you can interact with the children, but I barely used that with my weaker learners. It's like a live, and also where you can make your own resources … my ICT training played a role in the ICT resources that I use in my lessons and my teaching.
>
> So, you making your own content and putting it in like a website.
>
> … so, I was thinking of maybe doing that, using that, and making my own like website where I'll make it like a trial start with my own class, they can get information and then maybe open it to other schools. So, I want to try to make my own content basically online.

T3 indicated that her ICT training equipped her to make her own resources using digital platforms, thus further developing her technological skills (Lestari & Asari, 2022). T3 initiated live video lessons with her learners, in addition to creating her own digital resources (content) and educational stories. She also innovatively designed her own website. This highlighted her TPK as she was able effectively to design and create her own ICT-based resources (Mishra & Koehler, 2006). According to the SAMR model, T3 reached the Redefinition level, as she was now using ICT to redesign her curriculum delivery (Puentedura, 2006). She attributed her skills and ICT proficiency to her rigorous ICT training. This finding is in line with that of Tunjera and Chigona (2020), who also found that ICT professional development equips teachers with various instructional strategies to use in their curriculum delivery.

T5 asserted that ICT training played a pivotal role in his using ICT in his teaching. He took the approach of creating video content for his learners to establish an interactive remote teaching and learning environment. He mentioned the following:

> I mean with the TPACK course we did; we were able to engage with the technological side, the pedagogical side and it prepared me well. I would record myself teaching a lesson and send it to the learners … I would communicate with them on Google Classroom if they have any questions.

T5 explicitly credited the TPACK training course that he had attended with the technological and pedagogical proficiency he had attained (Mishra & Koehler, 2006). T5 designed his own video lessons as well as a feedback platform which, according to the SAMR model, would situate his curriculum delivery using ICT at the Modification level (Puentedura, 2006).

Summary

Through a process of inductive and deductive data analysis within the theme of 'benefits of ICT training for curriculum delivery', the researcher recognised that the teachers were enabled by ICT training to acquire and utilise skills for engaging learners in remote instruction. Some teachers could create their own resources using ICT, while some became acquainted with how to use ICT and specific applications to teach a particular content.

Two teachers (Ts 3 and 5) reported having gained innovative pedagogical ideas during their ICT training, which assisted them in delivering the curriculum during COVID-19. ICT training enables teachers to adopt and integrate versatile and flexible teaching strategies (Jansen & Farmer-Phillips, 2021). Ts 3 and 5 provided examples of how they engaged their learners through ICT during the pandemic. These teachers mentioned using online educational platforms such as See-Saw, as well as a controlled (COVID-compliant) blended learning approach of face-to-face teaching merged with video lessons. The teachers displayed the appropriate TK, TPK, and TCK as they created a synergy between the content, the lesson delivery, and the appropriate technological tools (Mishra & Koehler, 2006). Ts 3 and 5 created their own technological resources, platforms or approaches to strengthen their connection with their learners during the pandemic. This was done via video lessons, online platforms, or internet communication. These teachers achieved an Augmentation of their pedagogical strategies by innovating aspects of curriculum delivery (Puentedura, 2006).

4.2.2. The availability of ICT resources and frequency of use

Setyosari et al. (2020) assert that the availability of technology is a core contributor to teachers' use of ICT in their curriculum delivery. The availability of ICT resources at the school in this study influenced how the teachers used ICT as well as the frequency of that use. Table 4.2 outlines the ICT resources that were available for the Ts to utilise, as gleaned from the interviews and questionnaires.

Table 4.2: ICT resources available at the MS

Available ICT resources							
	T1	T2	T3	T4	T5	T6	T7
E-beam	✓	✓	✓	✓	✓	✓	✓
Visualiser	✓	✓	✓		✓	✓	✓
Laptop	✓	✓	✓	✓	✓	✓	✓
Whiteboard	✓	✓	✓	✓	✓	✓	✓
Data Projector		✓	✓	✓		✓	✓
Tablets	✓	✓		✓		✓	✓
TV's			✓	✓			

All the teachers in this study were in smart classrooms where they had access to various technological resources. Saini and Goel (2019) characterise smart classrooms as being equipped with interconnected ICT devices that mediate learning and increase the chances of teachers delivering the curriculum more thoroughly and consistently. According to Mugani (2020:73), "smart classrooms have made teachers' life and teaching easy as the system is conducive to a variety of teaching methods". This is supported by Tunjera and Chigona (2020), Jansen (2020), and Jansen and Farmer-Phillips (2021), who found that the easy availability of technological resources influences teachers to use them more regularly.

Teachers 1, 2, 3, 4, 5, 6 and 7 estimated how often they use ICT resources in their curriculum delivery. Their comments include:

T1: Every day – laptop. Sometimes – visualiser.

T2: Every day in class. Getting started with learners and their tablets.

T3: Emphasis on "TRY". I honestly try. I do use my white board and e-beam quite often though. Frequently used tech: whiteboard (e-beam), laptop, tablets.

T4: I use technology almost every day when teaching. Whiteboard, laptop, data projector…

T5: The interactive whiteboards, we have the e-beam, I use the visualiser a lot. If I explain a sum, for example, I record it, I record it but I park it, if somebody tells me, if a parent sends me a message there's a problem for example then I take that recording then I send it, then it's like me being present and explaining it to them.

T6: ICT things that we got at school like we got a visualiser, like it's a new version of the old school projector; and there's the e-beam that we use and our whiteboard

with a projector and the learners with their tabs obviously at school, that is the things that I try to use every day.

T7: I try to use technology every day in my teaching … all the teachers have laptops and then each class has a whiteboard that we use and then you have the e-beam and then you have the overhead projector that we use.

Ts 1, 2, 3, 4, 5, 6 and 7 added that they frequently used technological tools such as laptops, visualisers, tablets, E-beams, whiteboards and data projectors. Koehler and Mishra (2009) note that if teachers possess the TK to select suitable ICT resources, they are likely to incorporate them into their everyday instruction. TK is concerned with knowledge about ICTs, including the use of interactive whiteboards, computers and the internet.

Laptops, as highlighted by Ts 1, 3, 4, 5, 6 and 7, were a frequently used ICT tool. Petchame et al. (2021) observe that teachers can connect their personal laptops to smartboards (whiteboards) to project content. This apparatus allows teachers to complete administrative duties and record-keeping quickly, which in turn allows for more teaching time. Teachers are required to understand the hardware and software functions of laptops to use them effectively, not only as an administrative resource but also for the purpose of curriculum delivery (Puentedura, 2006; Mishra & Koehler, 2006).

Ts 1, 5 and 6 mentioned the visualiser as an ICT resource that they frequently used in their teaching. Visualisers enable teachers to display content from textbooks, worksheets, and other resources on the whiteboard. The addition of a visualiser enhances the function of the whiteboard and marks a shift from Augmentation to Modification (Sompakdee et al., 2021). Teachers need to understand the properties of this ICT tool to make full use of it, a crucial aspect of TK (Savec, 2017).

Ts 2 and 3 mentioned the frequent use of tablets in their teaching. According to Davidovitch and Yavich (2022), tablets can enhance the teaching and learning environment and improve learner achievement. Teachers can control and facilitate the learning materials made available on the tablets. The effective use of this resource, according to the SAMR, is situated at the Modification level (Puentedura, 2006).

Ts 3, 5, 6 and 7 mentioned the E-beam as a resource that they often integrate into their curriculum delivery. Walker (2019) indicates that E-beams enable ordinary whiteboards to transform into interactive touch surfaces where teachers and learners are able to manipulate digital content. In the SAMR model, this change is located at the Augmentation level (Puentedura, 2006). Functional change occurs as the E-beam enables interactivity and manipulation of the digital content displayed on the whiteboard. Teachers need the necessary TK and TPK to select, manage and use this ICT resource effectively (Mishra & Koehler, 2006; Savec, 2019).

Ts 3, 4 and 6 frequently used the interactive whiteboard to enhance the teaching and learning experience in delivering the curriculum. According to Tunjera and Chigona (2020), using interactive whiteboards to manipulate and manoeuvre images and content, thereby creating interaction between content, teacher and learner, would be situated at the Modification level. Esfijani and Zamani (2020) add that when the conventional purpose of an ICT resource is altered to enhance the teaching and learning environment, then substantial change has occurred. They confirm that this use of the whiteboard is located at the Modification level.

The data projector was frequently used by T4 in her instruction. Feierman (2018) points out that the data projector is used to display clear and colourful images on a flat white surface such as a whiteboard. This resource is situated at the Augmentation level as it provides functional change and stimulates learning experiences (Tunjera & Chigona, 2020). When selecting instructional resources, teachers must be in possession of the necessary TCK to choose both the appropriate technology and the appropriate content to facilitate the teaching and learning process (Mishra & Koehler, 2006; Lestari & Asari, 2022).

Summary

As a result of inductive and deductive data analysis within the theme ‘the availability of ICT resources and frequency of use’, it was evident that Ts 1 to 7 all had technology which was available for them to use. These teachers came from a MS which had abundant resources, and ready access to these enabled teachers to integrate them into their teaching and learning. Ts 1 to 6 claimed to use ICT every day in their classroom teaching.

4.2.3. The benefits of shifting to Google Classroom and WhatsApp for curriculum delivery

During the most severe period of the pandemic, which in South Africa was known as the "hard lockdown", the seven teachers were required to change their teaching practice by using alternative ICT resources such as Google Classroom and WhatsApp. These teachers shifted from using classroom-based, face-to-face ICT resources mentioned in the previous sub-theme, such as e-beams, visualisers, whiteboards, and data projectors, to more remote technological platforms, particularly WhatsApp and Google Classroom. **Table 4.3** outlines which teachers used Google Classroom and WhatsApp, as well as how they used these platforms.

Table 4.3: Teachers' use of Google Classroom and WhatsApp

Category	Google Classroom	WhatsApp	Using Google Classroom for curriculum delivery	Using WhatsApp for curriculum delivery
T1	✓	✓	Uploaded work/ videos	Sent videos
T2	✓		Uploaded work/ videos	
T3	✓	✓	Uploaded work/ videos	Sent links (educational materials)
T4	✓	✓	Uploaded work/ videos	Live lessons (online lessons) and oral presentations (learners)
T5	✓	✓	Uploaded work/ videos/ quizzes	Voice notes
T6	✓	✓	Uploaded lessons, videos, pictures	–Uploaded pictures –Learner orals
T7	✓	✓	Uploaded work/ videos	Uploaded work

4.2.3.1. Using Google Classroom for curriculum delivery

All the teachers commented on the use of Google Classroom for curriculum delivery, as follows:

T1: I had my Google Classroom set up already. So, my children knew that I already worked with Google Classroom, and I taught them how to use Google Classroom … so I would upload work, like worksheets.

T2: … so, they would interact with the Google Classroom, and we would interact with them on there, and it would be mainly because they were so little, it would mainly just be us uploading work and uploading tasks and them submitting it via Google Classroom.

… we would give videos, another teacher obviously made videos and whatever they didn't understand, that's the day they came in, and it would just be the 10 of them and then would discuss, like teach whatever they didn't understand.

T3: Google Classroom mainly had videos there … the videos to support what I was teaching and then there was worksheets then there was links for extra, to help parents maybe teach certain concepts … you can interact with the children, but I barely used that with my weaker learners. It's a live … I did a live, and also where you can make your own resources.

T4: … I could still interact and talk to and … hear my learners' questions and so I think that I achieved or accomplished what I set out with using the ICTs, the Google Classroom, and the WhatsApp now. In Grade 1 the parents record the learners when they present oral presentations, and it gets sent to me via WhatsApp.

… okay like with Google Classroom I think it helped me a lot and my learners, because they could see me on the live lessons, like video lessons.

T5: … we have the Google Classroom, I posted a lot of work in the Google Classroom on a daily basis, for our, in my case, for our Grade 7s. I can send them something, I can use a, lot of times I use a flipped classroom approach, I said read this, watch this video, we'll chat tomorrow, I'll send you a question on it for example, I'll send you a quiz on it for example, you must be able to write something for me on it.

T6: … the Google Classroom … so you would post your day's lesson onto the Google Classroom, so you will develop a file or a classroom and then you will have one for English, Afrikaans etc, put on the week's lessons or the day's lessons, where I did a live video lesson and pictures.

T6: So, there's interaction between them also, you can post videos of yourself on the Google Classroom.

> T7: … then also, I did all my work on Google Classroom. So … at the time that we were at school and most of the learners were at home, so our first way of connecting with the learners were booklets that were sent home, because not many learners have access to Wi-Fi at home. Google Classroom … sometimes I did a live lesson, that is what we used to interact with the learners when they were at home.

Ts 1 to 7 used Google Classroom to distribute educational material, teach and offer support to learners and parents who were experiencing challenges with accessing the content. Sharda and Bajpai (2021:356) observe that Google Classroom "provides an accessible medium for the exchange of information", while Isda et al. (2021) note that Google Classroom allows for the easy distribution of learning materials between teachers and learners. The teachers in this study needed to possess CK, PK, TK and TCK to upload digital learning materials with appropriate subject matter at the appropriate grade level (Mishra & Koehler, 2006). To select appropriate digital content required sound CK, and then deciding on how this content was to be delivered assumed competent PK (Mishra & Koehler, 2006). In terms of the SAMR model, the task of uploading digital resources is associated with the Substitution level as it does not automatically translate to improved pedagogies and learning (Puentedura, 2006).

Ts 3, 4, 6 and 7 indicated that they used Google Classroom to share videos and conduct live video lessons. Ayun et al. (2021) emphasise Google Classroom's capacity to accommodate teachers' uploading pre-recorded video demonstrations or interacting with learners in live virtual lessons. The sharing of pre-recorded video content is situated on the Substitution level, whereas the live video lessons would be located on the Modification level (Puentedura, 2006). This use of ICT also displays these teachers' TCK and TPK (Koehler & Mishra, 2009).

The CK of teachers is important, as the content needs to link directly to the grade level being taught. The shift to Google Classroom-based lessons draws on the teachers' PK because they were required to alter their pedagogical approach to delivering lessons. T3 and T4 added that they participated in live video lessons to sustain contact and continuity with their learners. Synchronous lessons (live video lessons) that afforded opportunities for remotely sharing ideas, answers and questions indicate significant task redesign or Modification (Puentedura, 2006; Sharda & Bajpai, 2021). The Modification level of teaching and learning with ICT

becomes immersive and interactive, permitting task flexibility and innovation (Esfijani & Zamani, 2020).

Ts 3, 4 and 6 claimed that Google Classroom sustained interaction between themselves and their learners. Sharda and Bajpai (2021) support this finding, observing that Google Classroom involves all learners in discussion, sharing information and posing questions about the topic being taught. Google Classroom supports collaborative learning and manages educational content and assignments, which promotes learner-centred learning (Syafi, 2020). The teachers welcomed the fact that learners and parents collaborated with them on this platform to continue teaching and learning engagements during COVID-19.

4.2.3.2. Using WhatsApp for curriculum delivery

Ts 1 to 7 shared their experiences of using WhatsApp to interact with learners duringCOVID-19 to sustain curriculum delivery. They commented:

> T1: … obviously on WhatsApp as well … so Maths we would send daily via WhatsApp, so even if it was like 5 or 6 sums, we obviously encouraged children to read through it at home and all of that and they would have the pack with them.
>
> … now that I think about it, voice notes a lot, I didn't want to record myself so that wasn't going to be a vibe, but I downloaded like Maths antics videos and then I would forward the videos, as well as sometimes I would write it down on a piece of paper and take a picture and then I would send a voice note as well.
>
> T2: … oh obviously I used WhatsApp and I think those were the only two platforms that we made use of, because there were still some children that did not have access to Google Classroom, they had no internet at home, so it was still a struggle, but there weren't many of them, ja, so that's the main two.
>
> T3: So the WhatsApp was mainly for parents who couldn't access Google Classroom, because of data usage and so, but the content that I put on Google Classroom I tried to put it on WhatsApp as well, so everything I put on Google Classroom, I'll send a link, if they, I made it optional so … really wanted to get that extra help then there was like certain things. So, I'll send the main things on WhatsApp, but I'll put links or if they now feel they have data to use.

T4: … we set up a WhatsApp group also … they could see me on the live lessons, like video lessons, and also, we could interact with each other better.

T5: I used my phone WhatsApp to send voice notes.

T6: … The main thing that I used was the WhatsApp group. Learners did their orals in 2021 via WhatsApp/Google classroom.

T7: I used WhatsApp … I would post the work onto WhatsApp … I would send videos for, like to offer assistance when the parents maybe struggled.

… we sent work via WhatsApp messaging, because there were actually many teachers that did a course on WhatsApp that showed you how to integrate your lessons using the WhatsApp chat group.

Ts 1 to 7 described WhatsApp as a reliable platform for learners and parents to interact with educational materials. These findings echo those of Nel and Marais (2020), who reported that WhatsApp was a sustainable and interactive tool for teaching and learning, particularly during COVID-19. They claim that WhatsApp reached the majority of learning communities, as the basic requirement was being in possession of a mobile cell phone with mobile data. The teachers realised that Google Classroom was not always accessible to all learners and therefore initiated the WhatsApp group platform to overcome this barrier. The teachers used WhatsApp to share educational explanations, worksheets, and other learning materials. Within the SAMR model, the teachers' use of WhatsApp was situated at the Substitution level (Puentedura, 2006) and acted as an inclusive ICT platform during COVID-19 (Nel & Marais, 2020).

Ts 3 and 7 believed that they were able to make educational materials more accessible to parents by using the WhatsApp platform. WhatsApp allowed them to create a group chat where all learning materials could be viewed by parents. By creating these WhatsApp groups, Ts 3 and 7 developed a learning community where they could share educational content, facilitate explanations, and support learners and parents experiencing challenges (Al-Qaysi et al., 2020). These teachers' use of WhatsApp to deliver lessons and support parents is situated at the Substitution level (Puentedura, 2006; Al-Qaysi et al., 2020). In addition, Ts 3 and 7 displayed the necessary TK, PK, TPK and TCK by selecting the appropriate content, ICT tool (i.e., WhatsApp), as well the supportive pedagogical strategies (i.e., video explanations and

voice notes) to deliver the curriculum and support parents (Mishra & Koehler, 2006; Jansen, 2020; Patrick et al., 2021).

Ts 1 to 7 revealed that they uploaded work via the WhatsApp messenger platform. They sent pictures, video recordings and voice notes to their learners to offer as much assistance as possible with the work assigned. These teachers possessed the relevant CK, TK, TCK, TPK and TPCK as they were required to engage and support their learners via a mobile platform (Letsari & Asari, 2022). The PK factor was also important as the teaching was now being executed via a cell phone, computer, or tablet.

Summary

Under the theme of 'the shift to Google Classroom and WhatsApp for curriculum delivery', it emerged that Ts 1 to 7 used these two platforms during COVID-19 to continue teaching and learning. These 7 teachers used Google Classroom to interact in live video lessons and to upload educational material for their learners, activities situated on the 'modification' and 'substitution' levels, respectively (Puentedura, 2006). The teachers also used WhatsApp to reach learners who did not have access to Google Classroom. WhatsApp was used to upload pictures, video explanations and voice notes to support learners. This is situated on the Augmentation level in the SAMR model (Puentedura, 2006). The teachers had sound CK as they were required to identify appropriate learning materials for their grades. Their TK was thorough as they had to select the most effective ICT platforms. Moreover, the PK of these teachers was comprehensive as they were required effectively to deliver the curriculum using technological resources (Mishra & Koehler, 2006; Lestari & Asari, 2022).

4.3. SUB-QUESTION 2

What challenges did the teachers experience when using ICT during their curriculum delivery at a model school during COVID-19?

Themes adjacent to the challenges the teachers experienced when using ICT for curriculum delivery at their school during COVID-19 were derived from inductive and deductive data analysis. The data was collected from the TPACK and SAMR questionnaires and the semi-structured one-on-one interviews. The themes are as follows:

- The digital divide during COVID-19;
- ICT training challenges; and
- Parent communication challenges.

4.3.1. The digital divide during COVID-19

The digital divide was an overwhelming factor, particularly during COVID-19 when ICT platforms were the only way forward. There were many disadvantaged households that could afford neither ICT resources nor internet access (Mhlanga, 2021; Adu et al., 2022). Although the school in this study was equipped with ICT resources long before COVID-19 struck, the transition to Google Classroom and WhatsApp added the remote element. Inevitably, this meant that some learners were marginalised in terms of internet access and obtaining educational resources (Jansen & Farmer-Phillips, 2021). Table 4.4, below, depicts the different challenges experienced by teachers as a result of the digital divide among their learners.

Table 4.4: Digital divide challenges experienced by teachers during COVID-19

Category	No internet access for learners	No ICT devices for learners	No mobile data for learners
T1	✓		✓
T2	✓	✓	
T3	✓	✓	
T4	✓		
T5	✓		✓
T6	✓		
T7	✓	✓	

Ts 1 to 7 shared their experiences of the digital divide during COVID-19 in the interviews and TPACK and SAMR questionnaires. These are reduced for convenience's sake to three categories.

4.3.1.1. No internet access for learners

A lack of Wi-Fi or mobile data access was a pivotal factor during COVID-19, as many teachers, learners and parents relied on ICT platforms to proceed with the teaching and learning process. In South Africa, Wi-Fi and mobile data prices are inflated and, at least in part because of this, many teachers, learners, and parents lacked consistent connectivity during the pandemic (Spaull, 2020). Ts 1 to 7 shared their experiences of learners not having access to mobile data during their curriculum delivery:

T1: Wi-Fi problems … Even if we tried to do like lives, the issue is always going to be like the parents didn't have data or Wi-Fi or data or whatever the case may be. There's always going to be that connectivity excuse.

… Yes, for us, it's just R399 per month to pay for Wi-Fi, but there's some people who can't afford that – for us to do a live, you know, so I think that is also a big challenge and that is why we didn't do live classes and all of that stuff.

T2: the main problem is that they didn't have access at home, some of them.

T3: … like not all learners have internet access at home.

T4: obviously all learners do not have access to the internet, which makes it difficult.

T5: … there's always a problem you know, connectivity like no Wi-Fi or data at home is a problem.

T6: The main thing that I used was the WhatsApp group, the Google Classroom I tried but there were too many learners who didn't have access to like Wi-Fi at home.

T7: … the main challenges of using ICT during COVID was that we couldn't get to each and every learner, because obviously all of our learners didn't have access to Wi-Fi.

These findings indicate that most teachers in the study experienced challenges stemming from the digital divide. Even though they were equipped with ICT infrastructure and resources for face-to-face classroom teaching, COVID-19 created a new landscape with a remote dynamic. The obstacle to learning of a lack of internet access was a common thread among all seven teachers. These results confirm the findings of Jansen and Farmer-Phillips (2021) that the digital divide was aggravated during COVID-19. The activity of the teachers in this study was restricted by the lack of internet access among many learners. As a result,

the teachers were obliged to resort to WhatsApp communications with parents and learners, situating their use of ICT at the substitution level within the SAMR model (Puentedura, 2006).

T2 and T3 elaborated on the challenges caused by the lack of internet access when they attempted to engage all their learners in ICT-based lessons. They mentioned the following:

> T2: … children did not have internet at home, some parents would also message to say the data ran out so they can't access Google Classroom this weekend or this week and you would send work for the weekend then obviously children came back and did not do anything.
>
> T3: So, the lack of internet access sometimes created a challenge … when you are trying to get everyone to be connected and join in on the lesson.

T2 mentioned that attempts to share educational material on the Google Classroom platform were sometimes thwarted by the absence of mobile data on the learners' side. On the evidence of these findings, it is apparent that some learners were marginalised in terms of retrieving educational materials and engaging in educational activities (Van der Berg & Spaull, 2020).

T3 used the expressions 'connected' and 'join in on the lesson', which indicates that she taught live lessons, placing her use of ICT for curriculum delivery at the substitution level (Puentedura, 2006). She demonstrated innovation and invoked a combination of TK, CK, TCK and TPK when attempting to support her disadvantaged learners who did not have Wi-Fi or internet access within the new COVID-19 model of education (Mishra & Koehler, 2006; Jansen, 2020). Within the SAMR model, T3's use of ICT would be placed at the modification level (Puentedura, 2014). The learners in her class who could not access the internet could have been left uninvolved and unengaged, incurring a learning deficit (Parker et al., 2020). The lack of access to the internet and learning materials served to manifest the digital divide among her learners, which was not evident before the advent of the pandemic. These two teachers have contributed to our understanding of knowledge gaps among learners, particularly in the context of COVID-19 (Jansen, 2020).

4.3.1.2. No ICT devices for learners

Another challenge mentioned by Ts 2, 3 and 7 was the shortage of mobile devices among learners. This presented a challenge to sustaining contact during the pandemic. Here are their comments:

> T2: some learners have to share devices at home, so they don't always have their own device the whole time.
>
> T3: … or maybe even like devices, learners don't have devices, so now they can't regularly get or do the work.
>
> T7: The negatives is sometimes that not all your children have technology, or the child's using the mommy's phone, but the mommy went to work, so his is lost also. So, he couldn't do his work, so that's the negative about it, whichever one you are doing, that would be uploading work and explaining it, or making a live lesson.

Ts 2, 3 and 7 acknowledged that their learners were not equipped with the relevant ICT devices to sustain teaching and learning engagement during COVID-19. This marginalised the learners concerned and created a learning deficit among them (Dube, 2020; Parker et al., 2020). The shortage of ICT equipment placed substantial strain on teachers and in turn resulted in a substitution level use of ICT to engage learners with limited access to devices (Puentedura, 2006; Mhlanga, 2021).

4.3.2. ICT training challenges

There were many challenges mentioned by the teachers concerning the ICT training that they had previously received. Before COVID-19, the teachers in this study were provided with classroom-based, face-to-face ICT training and resources. They were not trained for remote teaching and learning engagements. The teachers described the challenges they consequently faced in various ways, as displayed in Table 4.5, below:

Table 4.5: Challenges experienced by teachers regarding ICT training in preparation for and during COVID-19

Category	Lack of practical ideas	Teacher mindset towards ICT training	Depth of ICT training
T1	✓	✓	
T2	✓	✓	
T3		✓	✓
T4	✓		
T5		✓	✓
T6		✓	
T7	✓		✓

4.3.2.1. Lack of practical ideas

Ts 1, 2, 4 and 7 highlighted the lack of practical ideas for use in their curriculum delivery as a challenge associated with using ICT. These were their comments:

> T1: sometimes the department, they set the stuff so high, sometimes they don't realise what's actually happening in the class, like it's so nice, like do this, they tell you do this nice lesson plan, and play a video to the children, but it's like, sometimes I feel it's a bit unrealistic.
>
> T2: So, one thing like actual specific applications that we can make use of in class besides they just keep to talking about the Kahoot, the Kahoot, the quizzes and things like that, actual things that we can use in class that is going to make, the tablets work using. I think that's the main thing that they are lacking in the training front, because they do they show us how to be creative, but I think that's the main thing that I am, that I want out of training, give me more of what can be done, more ideas.
>
> T4: … so for me, speaking as a FP teacher, I would think they would need to show us resources or there must be a program. I'm not speaking about green shoots, you know other programs that we can use, on the tabs, in the classroom, you know it mustn't, you know it mustn't just be okay there's training … for me as a teacher there must be things that we can do on the tabs with the learners.
>
> … I'm speaking about grade 1 now, if I give them the tabs now, I don't know what I can [inaudible], you know, there's no program on the tabs for them to do, I now need to think okay, there's games, okay they can play games.

> T7: I think the training that we received is for all schools, all schools can use that training, but they don't show you, how to do a Google Form or use green shoots, they don't show you that, that stuff, it's more a blanket approach of this is how you do it, finish.

Teachers 1, 2, 4 and 7 pointed to a lack of pedagogical knowledge and strategy input in their ICT training before COVID-19. The teachers' TK, TCK, TPK and TPCK should have been the target of this ICT training: to equip them with the pedagogical knowledge and skills to implement ICT in their teaching (Mishra & Koehler, 2006; Parker et al., 2020; Lestari & Asari, 2022), they ought to have been provided with concrete contextual examples to use in the classroom (Serhan, 2020). In terms of the SAMR model, insufficient training can retard teachers' progress up the levels of ICT use (Puentedura, 2006). The teachers all felt that their ICT training lacked practical classroom implementation strategies, which created an augmentation/ substitution level culture of ICT use (Puentedura, 2006).

4.3.2.2. Teacher mindset towards ICT training

Al-Mamary and Al-Shammari (2022) state that teachers need to have the intrinsic motivation to learn more about ICT integration in lessons by empowering themselves through ICT training programmes. Teachers need to have a 'growth mindset' on how ICT can benefit their classroom practice. Ts 1, 2, 3, 5 and 6 commented on the importance of the mindset of teachers towards ICT training for effective integration into curriculum delivery. These were their statements:

> T1: I think just training in a direction where I think again like our mindset, like the mindset of teachers must just change to, so like yes, we have tablets that they can use, they can do their green shoots in my class, and you know but also using the tablet in a way that where they got their work.
>
> T2: … teachers should try and take it upon themselves to be better at using ICT, teachers should make the effort to learn how to use ICT in their classrooms. Yes, there are a lot of challenges and things, but if you know a lot about ICT, or a lot more than you initially did, then you will be able to overcome those challenges a bit easier. So, teachers should make the effort to go for training and better prepare themselves for, like the new direction that education is heading towards.

T3: I think the use of software is difficult and you need to be fully equipped or have personal notes or experiences, like before incorporating it into your classroom. I think teachers maybe need, like, to be fully educated in software that needs to be implemented in the class.

T5: … So, for me sometimes the training, the ICT training is a bit of a, sometimes it doesn't give the teachers enough to carry them or give them that push, especially when they have this, maybe negative mindset or fear of using ICT in their teaching in the classroom.

… for me I think it's got a lot to do with the mindset, the mindset of the teacher, for example. So, if the teacher is not open to say listen here, I for myself would like to improve my teaching and learning and move with the times in terms of ICT teaching and learning, then it will be a bit of a challenge.

T6: … it boils down to the amount of effort that the teacher puts into continuously using those devices. So again, if you lazy I suppose, or you don't have the time to put in the effort to develop certain things.

Ts 1, 2, 3, 5 and 6 indicated that despite all the ICT training that was offered, the onus was ultimately on the teachers and their mindset towards ICT for curriculum delivery. These findings are similar to those of Venketsamy and Zijing (2022), who concluded that the attitude that teachers hold towards the benefits of ICT in teaching and learning will determine the extent of the integration of technology into their practice. There is no doubt that the mindset regarding ICT among the teachers in this study contributed to the level of ICT use in their classrooms (Puentedura, 2006; Parker et al., 2020).

4.3.2.3. Depth of ICT training

ICT training was provided to the teachers in this study, but Ts 3, 5 and 7 suggested that the training lacked depth and substance:

T3: most of [the ICT training] is also mainly for INTERSEN, so they invite the FP to come and like to, but yet they, if they like giving examples and stuff they will just talk about like grade 4 to 7, like they come to our school, but everyone needs to be in the training.

T5: I always have the feeling that when we go for training, or when we go for training here at school, that it's always so rushed, it's like a once-off thing, and then you must just run with it.

T7: I think, the training that they gave, but not sufficient enough to keep you going man, because they just introduced the thing, and they don't come back … they introduced ICT to you, but they didn't go in depth.

The teachers thus revealed that even though training was provided to equip them with the necessary ICT knowledge and skills, it was insufficient and unfolded too rapidly. If ICT training does not emphasise quality and sustainability then it could have a negative influence on teachers' TPACK (Venketsamy & Zijing, 2022). It could affect the level of ICT use in their classroom practice (Puentedura, 2006).

4.3.3. Parent communication challenges

During COVID-19, many teachers found that sustaining communication with parents was problematic, in many instances as a result of ICT-related challenges (Mukuna & Aloka, 2020). Ts 2, 4 and 7 felt that communication with parents during COVID-19 was a major challenge. These were their comments:

T2: I think there was still some anxiety because some parents … they don't have any idea of ICT.

T4: I think the parents they were a bit confused, because like we gave them the password for the learner and their username. Then parents were messaging me, Miss I can't get onto the Google Classroom, and then I couldn't understand but here's the username and password.

T7: So, for me another disadvantage was that sometimes the parents couldn't assist learners at home, those who have wi-fi, their parents maybe struggled to assist them with the work that you sent, so this put them also at a disadvantage where that is concerned.

… I started Google Classroom and then I had to make little videos, so I will do everything myself, and then put it on the group chat to show the parent this is how you sign up … The difficulty comes in when that child don't have a password then you must now run to this one and go find that password.

The parents in this study were anxious as they were not sufficiently skilled in the use of technology to assist their children at home. This finding aligns with Mukuna and Aloka (2020) and Jansen and Farmer-Phillips (2021), who claim that communication with parents became increasingly challenging during the pandemic. This was not only because of physical distancing measures, but also as a result of the stress induced by the requirement that ICT platforms be utilised to communicate and interact. Elements of miscommunication challenged teachers' TK, TPK and TCK because they had constantly to innovate and adjust their level of ICT use (Mishra & Koehler, 2006; Puentedura, 2006; Mukuna & Aloka, 2020).

Summary

Ts 1 to 7 reported experiencing various challenges with ICT use during COVID-19, including the digital divide among their learners, ICT training deficits, and parental communication. These challenges placed substantial strain on the TPACK of these teachers as they were expected to fall back upon the ICT training received before the onset of the pandemic. The teachers were required to absorb the ICT-related challenges experienced by many of their learners while simultaneously attempting to deliver the curriculum. In many instances, the teachers had to adjust the delivery of their lessons using ICT to accommodate students who did not have sustainable access to technological devices and resources at home. This was extremely time-consuming. The TPACK framework provided a clear outline of the competencies that the teachers were required to possess to use ICT effectively in their curriculum delivery. The SAMR model outlined the various levels at which these teachers were situated in terms of actual ICT use for curriculum delivery.

4.4. CHAPTER SUMMARY

This chapter aimed to answer the main research question, "How did the teachers use ICT for curriculum delivery at a model school during COVID-19?", the first sub-question, "What benefits did the teachers experience when using ICT for curriculum delivery at a model school during COVID-19?", and the second sub-question, "What challenges did the teachers experience when using ICT for curriculum delivery at a model school during COVID-19?" Significant findings were derived, inductively, from the qualitative data that emerged from the questionnaires and semi-structured one-on-one interviews, as well as deductively, from the application of the TPACK and SAMR theorisations.

To answer the main research question, the two sub-questions had to be answered. The first sub-question presented the benefits that the seven teachers experienced when using ICT for curriculum delivery during COVID-19. The benefits were: (i) the benefits of ICT training for curriculum delivery, (ii) the availability of ICT resources and frequency of use, and (iii) the benefits of shifting to Google Classroom and WhatsApp for curriculum delivery. All seven of the teachers identified the technical and pedagogical knowledge acquired from their previous ICT training as preparing them for teaching during COVID-19.

The second sub-question outlined the challenges that the teachers experienced while delivering the curriculum during COVID-19. These challenges include (i) The digital divide during COVID-19, (ii) ICT training challenges, and (iii) Parent communication challenges. The seven teachers clearly indicated that the digital divide amongst their learners was the biggest challenge to sustaining curriculum delivery during COVID-19.

From data gathered to answer the main research question, it was concluded that teachers used various ICT platforms, resources and strategies to deliver the curriculum to their learners during COVID-19. These included WhatsApp, Google Classroom, Microsoft Teams, green shoots, Kahoot, Quizzes, an interactive whiteboard, video recordings, voice notes, online tests, e-beams, visualisers, data projectors, and TVs. As a result of many learners not having internet access and/or ICT devices, several platforms, resources, and strategies were simply not sustainable. Even though the teachers had received ICT training before COVID-19 and used it in their practice, their ICT knowledge and skills were nevertheless challenged by the "new normal" mode of remote teaching during the pandemic (Mishra & Koehler, 2006; Jansen & Farmer-Phillips, 2021). Their level of ICT use was also affected by the unstable educational climate brought about by COVID-19 (Puentedura, 2006, Mhlanga, 2021).

CHAPTER 5

DISCUSSION, RECOMMENDATIONS AND CONCLUSION

5.1. INTRODUCTION

In this chapter, the findings of the study are discussed. The discussion will summarise the contribution of these findings to the understanding of technology use and curriculum delivery in education. It will conclude by offering recommendations for teaching, policy development and further research.

The aims of this study were, first, to identify how the seven teachers used ICT for curriculum delivery at a MS during COVID-19; secondly, to explore the benefits the teachers enjoyed using ICT for curriculum delivery; and thirdly, to identify the challenges they faced in using ICT for curriculum delivery. Reference is made in the discussion to theoretical concepts derived from the TPACK framework and SAMR model.

5.2. SUMMARY OF THE FINDINGS

To answer the main research question "How did teachers use ICT for curriculum delivery at a model school during COVID-19?" this study focused on the benefits and challenges, the pluses and minuses that they experienced. A summary and discussion of these will ensue.

During the pandemic, teaching was tough, and schools and teachers had to make a conscious shift from paper to technology, making them reliant on ICTs. From the interviews, it emerged that the teachers regarded the ICT training that they had received before the pandemic as a significant benefit. They felt that their ICT training had equipped them with some sound foundational knowledge of the use of technology in teaching. The training had prepared them to use technology in their classrooms by giving them some valuable ideas on how to use different technological tools to teach effectively. The teachers were sufficiently confident to create ICT-based resources, they acquired E-assessment strategies and were able to assign tests and quizzes. In sum, this ICT training endowed them with the TK, TCK and TPK (Mishra & Koehler, 2006) to use ICTs in their curriculum delivery. In terms of the SAMR

model, the teachers were situated at various levels, ranging between Substitution and Redefinition (Puentedura, 2006). This suggests that the teachers in this study were equipped, through their ICT training, with the technological knowledge and skills to deliver the curriculum effectively to their learners.

The findings revealed that a second major benefit was the teachers' use of Google Classroom and WhatsApp in their teaching. Prior to the pandemic, the teachers used a limited range of ICTs in face-to-face classroom teaching, whereas the onset of COVID-19 compelled them to shift to a more radical, remote-style use of ICT that involved Google Classroom and WhatsApp. They used Google Classroom to upload tasks, worksheets, videos, resources of their own making, booklets and passages to read. The teachers used these tools to clarify and discuss concepts taught, for extra support and to collaborate with parents. Live video lessons helped to amplify interaction among the teachers, learners and parents, and thereby strengthen curriculum delivery. By making use of these resources, the teachers revealed that they had the relevant TK, TCK and TPK (Mishra & Koehler, 2006). According to the SAMR model (Puentedura, 2006), these teachers used ICT with substantial task redesign, which meant that their work could be situated at the Augmentation and Modification levels.

The teachers revealed that, besides Google Classroom, WhatsApp was an invaluable ICT-tool employed in their curriculum delivery during the pandemic. WhatsApp was used to accommodate learners and parents who did not have sustainable internet access or regular mobile data. The teachers used WhatsApp for sending video explanations of concepts, voice notes, pictures, live video calls, and group chat messages. The teachers used these strategies to interact with their learners and provide them with educational tasks, supplementary explanations and support. They possessed TK, TCK and TPK as they created the opportunity for their learners to interact with learning materials (Mishra & Koehler, 2006). According to the SAMR model (Puentedura, 2006), in respect of their use of WhatsApp the teachers were situated at the Substitution and Modification level, as they used ICT with minimal task redesign.

This study has shown that the teachers experienced two types of challenges: one type was essentially socio-economic, involving technological deficits on the part of learners and parents. The other type consisted of challenges that teachers experienced in the teaching process itself. These will be discussed separately.

The challenges stemming directly from the socio-economic issues that learners and parents faced included the following: no access to Wi-Fi or mobile data and a lack of ICT devices among learners. The teachers mentioned that at times there was no communication from parents as a result of their having no internet or mobile data access. Parents complained about the high cost of mobile data. The fact they were unable to afford or sustain internet access for themselves or their children created substantial obstacles for teachers. Many learners in their classes could not access or interact with the learning materials that were sent to them.

The teachers also reported the following ICT challenges within their classrooms: a lack of practical ideas, a negative mindset regarding ICT use, and a lack of depth in their ICT training. They felt that the training was somewhat rushed and not always appropriate for their practice and purposes. That being said, they conceded that the success of the training was at least in part dependent on the teachers' attitude towards ICT use. Ultimately, the teachers felt that their ICT training did not fully prepare them for curriculum delivery during the pandemic.

The TPACK framework was used to assess the knowledge that the teachers needed to use ICT in their teaching, while the SAMR model was applied to ascertain the levels at which they used technology in their curriculum delivery. Between them, these theories provided the researcher with a lens through which to observe and interpret the findings. The benefits of the TPACK framework were that the specific components such as the TK, PK, CK, TCK, TPK, and TPCK of the teachers could be linked to the actual use of ICT in their teaching. When the teachers selected a particular ICT platform or tool to deliver lessons to their learners, the TPACK framework helped determine which component of knowledge the teacher was drawing on. The SAMR model enabled the researcher to describe the way teachers used ICT in their curriculum delivery in terms of the various levels of integration, based on the level of innovation of the platform or tool used.

In conclusion, these seven teachers experienced both benefits and challenges when using technology during COVID-19 and attempting to deliver the curriculum to their learners. The most salient result was that – even though the teachers were provided with ICT resources and training before the onset of COVID-19, and taught at a quintile 5 MS with access to a wide variety of technology and support – they were unable to make a smooth transition to teaching during COVID-19.

5.3. LIMITATIONS

Du Plooy-Cilliers et al. (2014) observe that limitations and challenges are present in every research study. The limitations associated with this study include:

- using a small sample size of only seven teachers; and
- the researcher's inability to use observation as a data collection instrument because of COVID-19 physical distancing measures.

5.4. RECOMMENDATIONS

This study explored seven primary school teachers' use of ICT for delivering the curriculum at a model school during COVID-19. Based on the findings of this study, the following recommendations are proposed for teachers, the WCED, DBE and future research:

5.4.1. Recommendations for *teachers* to improve their ICT use for curriculum delivery at a model school.

Adu et al. (2022) indicate that South African teachers experienced immense challenges in their attempts to teach with ICT during COVID-19 because of their poor pedagogical skills. The following recommendations are therefore made to improve teachers' pedagogical skills for teaching with ICT. It is recommended that:

- teachers engage in regular ICT training workshops and seminars to stay abreast of the latest ICT developments
- teachers familiarise themselves with a variety of CT platforms to stimulate their understanding of technological resources and extend the range of their pedagogical practices
- teachers use blended learning to ensure that the diverse needs of their learners are catered for through a more inclusive pedagogy
- teachers equip themselves with a bank of educational ICT resources so that they have consistent access to a variety of materials extending the criticality of their learners.

5.4.2. Recommendations for the *WCED and DBE* regarding their policies covering the use of ICT in teaching at a model school.

Parker et al. (2020) and Adu et al. (2022) assert that the COVID-19 pandemic, along with the prevailing dynamic in contemporary teaching, suggest the need for major policy reform to assist teachers in using ICT effectively at an institutional level. The following recommendations are made for the development of policy governing teaching with ICT. It is recommended that:

- the teaching and learning policies relating to ICT use in schools, including social media and other digital platforms, be updated in line with the developments brought about by COVID-19
- the ICT policies and guidelines for schools be updated according to the changes that accompanied the new educational practices occasioned by COVID-19
- the ICT training policies of the WCED and DBE be revised and updated to address the current and growing diversities in the use of technology.

5.4.3. Recommendations for *future research*

While there have been several studies of teaching with ICT in rural schools in SA during COVID-19 (Munje & Jita, 2020; Van der Berg & Spaull, 2020; Chisango & Marongwe, 2021), little attention has been paid to how technology-rich schools such as the MS in this study adapted to teaching during the pandemic. The following recommendations for future research are therefore made.

- It is recommended that the WCED, DBE and Higher Education Institutions (HEIs) work together on large-scale research into how teachers are using ICTs in classrooms, the effectiveness of ICT training, and ICT training for the new educational landscape.
- The sample for this case study comprised seven primary school teachers, which was adequate in terms of time and size for the study. However, a larger sample of teachers from both rural and urban schools would be required for a more extensive and nuanced understanding of the subject

- This study explored how teachers used ICT for curriculum delivery during COVID-19. It is recommended that future studies investigate what lessons have been learnt from this experience and how teachers are using technology in the aftermath of COVID-19.

5.5. CONCLUSION

This study aimed to explore how teachers used ICTs for curriculum delivery at a MS during COVID-19. Four concluding comments will be provided.

First, the findings highlighted that for teachers to use ICTs effectively, both in normal circumstances and more particularly, in an emergency, there need to be adequate and appropriate (government) policies on technology training as well as more effective, up-to-date training programmes. Training should make teachers aware of the various ICT platforms and resources available as well the range of pedagogical strategies they can implement in their practice. This study highlights the importance of WCED support mechanisms when it comes to ICT training and implementation at an institutional level. These will encourage teachers to engage with innovative ICT platforms and boost the efficiency of their use of ICT for curriculum delivery.

Second, by merging elements of Mishra and Koehler's (2006) TPACK framework and Puentedura's (2006) SAMR model, a sound conceptual framework was used to analyse and develop an understanding of the findings. The researcher used a questionnaire which interrogated the teachers' understanding of their own TPACK and investigated the level of their ICT use via application of the SAMR model. All the questions in the interviews relating to the TPACK and SAMR theorisations were posed to gain an in-depth understanding of the teachers' knowledge of technology and the degree to which this enhanced their curriculum delivery during COVID-19. The use of both frameworks was successful as it allowed for an understanding of not only the knowledge that the teachers needed but also of how sophisticated and innovative their use of ICT was.

Third, the literature, cognate theories, and the findings of this study highlight that even though the teachers received ICT training before COVID-19, they experienced challenges in their curriculum delivery during the pandemic. It is therefore imperative to provide teachers

with appropriate ICT training to develop their pedagogical strategies so as to use ICT effectively in their curriculum delivery, no matter what the circumstances.

The fourth and final conclusion of this study is that to date, there have been no curricular documents guiding teachers' pedagogy using ICT. Yet many of the relevant pedagogical approaches are described in books, academic journals, and conference papers. HEIs need to work more closely with the DBE to introduce student teachers to a wide variety of synchronous and asynchronous ICTs and blended teaching that will enable their lessons to challenge learners to develop higher-order thinking skills.

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APPENDICES

APPENDIX 1: GENERAL QUESTIONNAIRE SCHEDULE: ALL MEMBERS OF STAFF.

Date: 20 January 2022

Dear Principal and Educators

I am currently studying my Master's Degree at the Cape Peninsula University of Technology (CPUT) and the title of my study is ***Teachers' use of Information and Communication Technology for curriculum delivery at a model school during COVID-19.***

I would like to invite you to participate in completing this questionnaire. After analysing the results of this questionnaire, I will select approximately seven educators to interview and complete one questionnaire at times (after school hours) and days that suit each individual.

The focus of this questionnaire is to find out about your experiences using ICT's during the Covid-19 pandemic 2020 - 2022. The questionnaire should only take 15 minutes to complete. Some questions will require one-word answers, and some will require a short, succinct narrative. I ask that you be professional and honest in your responses.

Although I ask for your name, please note that no names will be used in my thesis or journal articles that come from this research or any conference presentations. All information will remain anonymous and confidential.

Yours in Education

Mr. Shabbeer Wyngaard

Thank you for completing this form

Name of Educator: _____

Questions	Answers
1. How long have you been working at this school?	
2. How would you define a Model school?	
3. Have you received training to use ICT in your teaching?	
4. When did you receive this ICT training?	
5. Did you receive any ICT training *before* that which you have stated in Question 4?	
6. Are you an ICT champion at your school?	
7. How, did you use ICT for teaching and learning *before* COVID-19?	
8. How have you used ICT for teaching and learning *during* COVID-19?	
9. Please provide some examples where possible	
10. What would you say are the differences between teaching with ICT *before* COVID-19, compared to *during* COVID-19?	

APPENDIX 2: TPACK AND SAMR QUESTIOANNAIRE FOR TEACHERS' USE OF ICT FOR CURRICULUM DELIVERY AT A MODEL SCHOOL DURING COVID-19

This research study focuses on teachers' use of ICT for curriculum delivery at a model school during COVID-19. The aim of the questionnaire is to gain insights into teachers' use of ICT for curriculum delivery at a model school during COVID-19.

PART 1: BIOGRAPHICAL INFORMATION OF PARTICIPANTS
1.1 Surname:
1.2 Name:
1.3 Age group (Place a ✓next to the appropriate selection): **20-29** **30-39** **40-49** **50-59** **60-65**
1.4 Gender (Place a ✓next to the appropriate selection): **Male** **Female**
1.5 Your primary email address:
1.6 Years in teaching:
1.7 Years at current school:
1.8 Grade(s) you are currently teaching (you may select more than one): **Grade 1** **Grade 2** **Grade 3** **Grade 4** **Grade 5** **Grade 6**

Grade 7

1.9 Since 2017, the WCED has provided the following training. Please select the appropriate training relating to yourself. **(please use a ✓)**

PART 2: TRAINING RECEIVED			
Training type	**Year**	**Did not attend**	**Did attend**
2.1 ITSI	2017		
2.2 Smart classroom training (setting up a projector, e-beam, how to use the interactive whiteboard)	2017		
2.3 Google Application (google forms, docs, etc.)	2018		
2.4 Google Application (google forms, docs, etc.)	2019		
2.5 Microsoft Office 365 orientation. (Online)	2020		
2.6 Other training received:			

PART 3: TPACK AND SAMR SELF-ASSESSMENT

TPACK

The following section will explore your understanding of the various knowledge bases that teachers are required to possess when integrating ICT in a technology-rich learning environment.

Please complete the following section by placing a ✓next to the appropriate selection and elaborate on your responses where applicable.

TK (Technology Knowledge)	Agree	Neutral	Disagree
3.1 I know how to independently solve technical problems (e.g. network problems, software, troubleshooting)			

Elaborate:

3.2 I am able to easily learn about technology (e.g. I understand technology hardware and software)			
Elaborate:			
3.3 I keep abreast with new technologies.			
Elaborate:			
3.4 I frequently use technology.			
Elaborate:			
3.5 I possess the technical skills needed to use technology.			
Elaborate:			
TCK (Technological Content Knowledge)	Agree	Neutral	Disagree
3.6 I am aware of technologies which I can use to develop my classroom practice and my learners' understanding of subject content (e.g. ICTs that enhances my teaching and learning).			
Elaborate:			
TPK (Technological Pedagogical Knowledge)	Agree	Neutral	Disagree
3.7 I am able to select technologies that enhances the teaching and learning approaches for a lesson.			

Elaborate:			
3.8 My teacher training programme has resulted in me thinking more critically about the influence that technology has related to my teaching approaches.			
Elaborate:			
3.9 I can choose technologies that enhance the content for a lesson.			
Elaborate:			
3.10 I use strategies that combine content, technologies, and teaching approaches that I learned about in my coursework in my classroom.			
Elaborate:			
3.11 I can select technologies to use in my classroom that enhance what I teach, how I teach, and what students learn.			
Elaborate:			
3.12 I adapt to the use of the technologies that I am learning about different teaching activities.			
Elaborate:			
TPACK (Technological Pedagogical Content Knowledge)	Agree	Neutral	Disagree
3.13 I am able to teach lessons that combine the			

subject content with technologies and use a variety of teaching approaches.			
Elaborate:			
SAMR The following four questions will ask how you evaluate the manner in which you integrate technology into your teaching practice.			
S (Substitution)	Agree	Neutral	Disagree
3.14 I am able to use technology to replace tasks that could be done without it. **(e.g. Instead of using a poster to present information, I use PowerPoint.)**			
Elaborate:			
A (Augmentation)	Agree	Neutral	Disagree
3.15 I am able to use technology in a way to enhance the lesson. **(e.g. Instead of creating a paper-based test, Google Form is used.)**			
Elaborate:			
M (Modification)	Agree	Neutral	Disagree
3.16 I am able to use technology to transform the learning process. **(e.g. An essay writing task is transformed into a soundtrack format, and audience can listen to the playback.)**			
Elaborate:			

R (Redefinition)	Agree	Neutral	Disagree
3.17 I can use technology to produce, previously impossible tasks. **(e.g. Learners are taught how to create a video/ documentary presentation on an educational topic and share it electronically.)**			
Elaborate:			

APPENDIX 3: SEMI-STRUCTURED ONE-ON-ONE INTERVIEW SCHEDULE FOR TEACHERS' USE OF ICT FOR CURRICULUM DELIVERY AT A MODEL SCHOOL DURING COVID-19

Name of Participant:

Date:

Venue:

INTERVIEW QUESTIONS	REASONS FOR THE QUESTIONS	POSSIBLE PROBING QUESTIONS	BODY MOVEMENTS
1. Thank you for agreeing to take part in the interview process. If I may ask, what are the joys of teaching during COVID-19?	To set the scene, to calm the interviewee and to begin by engaging their experiences of teaching during COVID-19	1.1 What are a few of the highlights of teaching using ICT during COVID-19?	
2. What ICTs are available for you to access at this school?	To gain insights into the available ICT resources the and the dominant ICT resources used for classroom teaching	2.1 In what condition would you say these resources are? 2.2 Which ICT resources do you use in your classroom teaching? 2.3 In which subjects do you most often make use of these ICT resources? 2.4 Could you provide a brief example of a lesson whereby you have used these resources?	
3. What were the benefits of having access to ICT	To explore the benefits of having	3.1 Could you explain a few of the prominent benefits of having access to ICT during	

during COVID-19?	access to ICT during COVID-19	COVID-19?	
4. What challenges did you continue to experience in your teaching even though you had access to ICT during COVID-19?	To explore the challenges of having access to ICT during COVID-19	4.1 Could you explain a few of the prominent challenges of having access to ICT during COVID-19?	
5. How have you made use of ICT for curriculum delivery during COVID-19?	In order to investigate teachers' use of ICT during COVID-19	5.1 What were the differences and similarities of using ICT for teaching prior to and during COVID-19?	
6. How has ICT use positively contributed for the sustaining of curriculum delivery during COVID-19?	To explore teachers' experience using ICT to sustain curriculum delivery during COVID-19	6.1 Would you be able to provide a few examples?	
7. What were the learners' and parents' experiences of teaching and learning with ICT during COVID-19?	To establish learners' and parents' experiences of teaching and learning with ICT during COVID-19	7.1 Could you provide a few examples of learners' and parents' experienced with ICT for teaching and learning during COVID-19?	
8. What is the difference between using ICT for curriculum delivery before and during COVID-19?	In order to explore the difference between ICT use before and during COVID-19	8.1 Could you provide a few examples of using ICT for curriculum delivery before and during COVID-19?	

9. To what extent do you think that your previous ICT training prepared you to use ICT for curriculum delivery during COVID-19?	To determine the extent to which previous ICT training prepared teachers to use ICT for curriculum delivery during COVID-19	9.1 Would you be able to provide a few examples?	
10. What was your overall experience of teaching during COVID-19?	To explore teachers' overall experiences of teaching during COVID-19.	10.1 Could you provide a an example of a positive and negative experience of teaching during COVID-19?	
11. What recommendations would you suggest for teachers to use ICTs in their curriculum delivery?	To identify the recommendations of teachers' regarding ICT use for curriculum delivery	11.1 What are the key factors you feel teachers should be aware of when using ICT for curriculum delivery?	
12. What recommendations would you offer to strengthen ICT training?	To find out how ICT training can be strengthened	12.1 Could you provide a few examples?	

APPENDIX 4: ETHICAL CONSENT FORM

Cape Peninsula University of Technology

Faculty of Education Ethics Committee (CPUT) for Non-Clinical Research Involving Human Subjects

Ethics informed consent form

CONSENT TO PARTICIPATE IN A RESEARCH STUDY

Category of Participants (tick as appropriate):

Principals		*Teachers*	√	*Parents*		*Lecturers*		*Students*	
Other (specify)									

You are kindly invited to participate in a research study being conducted by **Shabbeer Wyngaard (EFEC 3-12/2021)** from the Cape Peninsula University of Technology. The findings of this study will contribute towards (tick as appropriate):

An undergraduate project		*A conference paper*	
An Honours project		*A published journal article*	
A Masters/doctoral thesis	√	*A published report*	

Selection criteria

Two teachers from the Foundation Phase (FP), Intermediate (IP), Senior Phase (SP), and the ICT champion (seven in total) will be purposively selected for this study using an invitation questionnaire which will obtain information that will allow the researcher to establish which participants will significantly contribute to the study. Purposive sampling, strategically selects the elements that one seeks to include in the sample, based on a predetermined set of criteria. The criterion for the sample includes:

- Teachers must have received MS training for the use of ICT resources in classroom teaching.
- They must have taught at the school from the beginning of the MS project.
- They are currently teaching at the MS.

Title of the research:

Teachers' use of Information and Communication Technology for curriculum delivery at a Model school during COVID-19.

A brief explanation of what the research involves:

This research explores teachers' use of ICT for curriculum delivery at a Model school during COVID-19. As an educator at a under resourced school, I experienced the complex transition and alterations in teaching practices that teachers were required to effect during COVID-19. This observation has ignited an interest in myself to attempt to understand how teachers at a technology-rich school experienced teaching during COVID-19 and if there were any benefits and challenges that they experienced. Due to the fact that there is a dearth of research literature available in relation to how teachers used ICT at Model schools (technology-rich) for curriculum delivery during COVID-19, I seek to contribute via this research study to the existing but limited research literature in this respect.

Benefits of research

This research study will contribute to the shortage of literature regarding how teachers used ICT for curriculum delivery at a model school during COVID-19. In addition, this study will also provide recommendations for strengthening teachers' use of ICT at model schools (technology-rich schools).

Incentives

I will not use any incentives to encourage the participants to contribute during the data collection process. I will inform participants that there participation will be done on a voluntary basis.

Procedures (duration)

I will first meet with the participants and inform them that they have been selected to participate in my research study, and more specifically, the data collection process.

The participants will be handed CPUT ethical consent forms which they will be required to complete prior to engaging in the one-on-one interviews and TPACK and SAMR questionnaire.

I will proceed to explain the data collection instruments (interviews and TPACK and SAMR questionnaire) as well as the purpose of using these instruments to the participants the purpose of each data collection instrument.

The TPACK and SAMR questionnaire will be handed out to the participants, and they will be allowed to complete it after school hours, with myself being present to field any questions that they might have. The questionnaire will be allocated a duration of 30-45 minutes. The interviews will be conducted in a venue that suits the participants. These interviews will be scheduled for 1 hour.

Right to withdraw/ voluntary participation

I am aware that ethical conduct transcends the boundaries of simply completing a consent form. When researching participants' responses on their use of ICT during the unpredictable time of COVID-19, I am required to be transparent and flexible. I construct relationships, provide feedback, and establish trust with the participants. Transparency needs to be ensured by myself about prospective risks and benefits of researching the teachers' responses to the interviews and the questionnaire and consistently be aware and recognise the intricacies of the process. Completing and signing ethical consent forms is the first step of conducting respectful research.

Ensuring that the rights of participants are respected and upheld throughout the study is a complex and multidimensional process. The process of ethics in this research project is ongoing as it involves continuous dialogue between the principal, the participants, and the researcher to establish an ethical research project. The participants will complete and sign an ethical consent form, after which I will abide by the contents of this form which will contribute to creating a respectful research environment.

Before any data will collected, the participants will complete ethical consent forms. The participants will be assured of the right to withdraw from participating in the interviews and questionnaire at any point during the process. This information will be clearly outlined on the consent form to ensure that the participants understand this before they proceed to sign. I will verbally explain this process to the participants and will answer all questions that the participants may have which will allow them to make informed decisions about whether to participate in this study.

I will explicitly mention to participants that they have the right to withdraw from this study at any point, they have the right to ask questions if anything is unclear, the right to receive information about the outcome or findings of the study, the right to ask me to switch off the recording device, and that the information (data) collected will not be shared with anyone nor revealing the participants identity in any way.

Confidentiality and anonymity

Information obtained in this study (names of institutions, schools or names of participants, colleagues, parents, and children) which can be identified with participants, will remain confidential and will only be disclosed with permission from participants. Maintaining confidentiality and anonymity by using pseudonyms will be maintained throughout this study and even once the study is completed.

The data that will be collected from the interviews and questionnaires will be made available for the participant to review and edit any information which concerns the participant. Regarding interviews, some participants may disclose personal information, although the researcher will have encouraged them not to do so. This may not guarantee confidentiality, which will be mitigated by myself managing the participant with respect and not include it in the research study.

Potential risks, discomforts or inconveniences

There are no anticipated risks, discomforts, or inconveniences that this study presents to the school nor the participants themselves, to the community of the

participants, to the researcher, or to the University. However, the researcher is aware that there may be a prospective risk in the form of a breach of confidentiality. Even though participants will be briefed not to mention any children, schools or colleagues' names, participants may unwittingly forget this prior arrangement and disclose names.

Some participants may experience minor distress, as the interviews may require the participants to conduct personal reflections, in the form of retelling and reflecting on their stories. I will use pseudonyms and restrict access to the data to ensure that sufficient consent processes have been implemented. If any other possible risk present itself during this study, I will manage it in a professional manner in close consultation with his supervisor.

Dissemination of results

I will present the findings of this research study to the institution (school) and to the research participants. The justification for providing a summary of the results is to avoid the institution (the school) and the research participants feeling as though they were merely used for the benefit of the research study. The researcher will share the findings with the institution (school) and the research participants to underline the important role that the institution (school) and the participants contributed to this study.

The findings of this study will be used only for academic purposes in the form of being presented in my Master's degree and one research question of the Masters theses will be published in a peer reviewed journal article. The publications of this study will not disclose the identity of the school and nor the participants. All ethical measures will be professionally adhered to throughout this study.

Kindly complete the table below before participating in the research.

	Tick the appropriate column	
Statement	Yes	No
1. I understand the purpose of the research.		
2. I understand what the research requires of me.		
3. I volunteer to take part in the research.		
4. I know that I can withdraw at any time.		
5. I understand that there will not be any form of discrimination against me as a result of my participation or non-participation.		
6. Comment:		

Please sign the consent form. You will be given a copy of this form on request.

Signature of participant	Date

Researchers

	Name:	Surname:	Contact details:
1.	Shabbeer	Wyngaard	079 065 9421
2.			
3.			

Contact person: Shabbeer Wyngaard	
Contact number: 079 065 9421	Email: shabeerswyngaard@gmail.com

APPENDIX 5: CONSENT FROM THE CAPE PENINSULA UNIVERSITY OF TECHNOLOGY

Faculty of Education
Highbury Road
Mowbray
7700
Tel: +27 21 959 6583

FACULTY OF EDUCATION

On the **9 December 2021** the Chairperson of the Faculty of Education Ethics Committee of the Cape Peninsula University of Technology granted ethics approval **(EFEC 3-12/2021)** to **S. Wyngaard** for an MEd degree.

Title:	**Teachers' use of Information and Communication Technology for curriculum delivery at a model school during COVID-19**

Comments:

The EFEC unconditionally grants ethical clearance for this study. This clearance is valid until **31st December 2024**. Permission is granted to conduct research within the **Faculty of Education only**. Research activities are restricted to those details in the research project as outlined by the Ethics application. Any changes wrought to the described study must be reported to the Ethics committee immediately.

Dr Zayd Waghid

Chair of the Education Faculty Ethics committee (EFEC)

Faculty of Education

Date: 15 December 2021

APPENDIX 6: CONSENT FROM THE WESTERN CAPE EDUCATION DEPARTMENT

Western Cape Government
Education

Directorate: Research

meshack.kanzi@westerncape.gov.za
Tel: +27 021 467 2350
Fax: 086 590 2282
Private Bag x9114, Cape Town, 8000
wced.wcape.gov.za

REFERENCE: 20220118-9115
ENQUIRIES: Mr M Kanzi

Mr Shabbeer Wyngaard
15 Rod Close
Lotus River
Cape Town
7941

Mr Shabbeer Wyngaard,

RESEARCH PROPOSAL: TEACHERS' USE OF INFORMATION AND COMMUNICATION TECHNOLOGY FOR CURRICULUM DELIVERY AT A MODEL SCHOOL DURING COVID-19.

Your application to conduct the above-mentioned research in schools in the Western Cape has been approved subject to the following conditions:

1. Principals, educators and learners are under no obligation to assist you in your investigation.
2. Principals, educators, learners and schools should not be identifiable in any way from the results of the investigation.
3. You make all the arrangements concerning your investigation.
4. Educators' programmes are not to be interrupted.
5. The Study is to be conducted from **18 January 2022 till 30 June 2022.**
6. No research can be conducted during the fourth term as schools are preparing and finalizing syllabi for examinations (October to December).
7. Should you wish to extend the period of your survey, please contact Mr M Kanzi at the contact numbers above quoting the reference number.
8. A photocopy of this letter is submitted to the principal where the intended research is to be conducted.
9. Your research will be limited to the list of schools as forwarded to the Western Cape Education Department.
10. A brief summary of the content, findings and recommendations is provided to the Director: Research Services.
11. The Department receives a copy of the completed report/dissertation/thesis addressed to:

The Director: Research Services
Western Cape Education Department
Private Bag X9114
CAPE TOWN
8000

We wish you success in your research.

Kind regards,
Meshack Kanzi
Directorate: Research
DATE: 18 January 2022

thesis

ORIGINALITY REPORT

12%	12%	5%	5%
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

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Epsilon Editing

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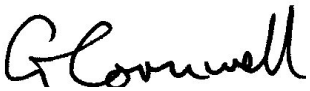
dgncornwell@gmail.com
tel. 084-9897977

11 December 2023

TO WHOM IT MAY CONCERN

This serves to confirm that the Master's thesis by Shabbeer Wyngaard, "Teachers' use of Information and Communication Technology for curriculum delivery at a model school during COVID-19," has been proofread and edited to my satisfaction for English idiom and correctness of expression. The referencing has been checked for accuracy and formatting according to the CPUT Harvard style.



Professor D G N Cornwell
(PhD, Rhodes University)