Cape Peninsula
University of Technology

THE PATTERNS OF TECHNOLOGY-MEDIATED INTERACTION BETWEEN TEACHERS AND LEARNERS IN A TIME OF CRISIS

by

IAN MALCOLM KENNEDY

Thesis submitted in fulfilment of the requirements for the degree

Doctor of Philosophy: Informatics

in the Faculty of Informatics and Design

at the Cape Peninsula University of Technology

Supervisor: Professor J.C. Cronjé

District Six, Cape Town

24 October 2023

DECLARATION

I, Ian Malcolm Kennedy, declare that the contents of this thesis represent my own unaided work, and that the thesis has not previously been submitted for academic examination towards any qualification. Furthermore, it represents my own opinions and not necessarily those of the Cape Peninsula University of Technology.

Signed

24 October 2023

Date

ABSTRACT

This thesis is about technology-mediated interaction between teachers and learners in a time of crisis. The study explores the dynamics of access to ICT and the technology practices of secondary school teachers within the backdrop of the COVID-19 pandemic.

The study applies a phenomenological approach grounded in an interpretivist philosophy and supplemented by actor-network theory (ANT). The theoretical foundation is rooted in the ConTIS model, which incorporates the prominent TPACK and SAMR constructs. Additionally, Van Dijk's cumulative model of access to ICT is used to explore the dimensions of access and their impact on teachers' ICT adoption.

Before March 2022, most teachers relied on traditional face-to-face teaching as the prevailing mode of instruction. However, the suspension of in-person teaching prompted by the pandemic necessitated a swift shift to technology-mediated remote teaching practices. In South Africa, disparities in socio-economic and educational contexts significantly impacted educational delivery. The limited availability of digital technology meant that many South African schools could not effectively continue teaching during the pandemic, jeopardising the academic progress of a significant number of learners.

The research findings shed light on the educational landscape post-pandemic, revealing a blended approach to teaching. Teachers, for the most part, reverted to traditional teaching methods while also integrating technology to a greater extent. The study emphasises the intricacy of integrating technology into educational settings and challenges the notion that access to technology follows a linear path toward usage. Instead, successful technology integration requires a more networked and relational perspective on access, highlighting the significance of contexts that necessitate, motivate, and empower teachers to use ICT in their teaching practices.

This study contributes to the academic discourse by underscoring that the adoption of ICT in teaching is a multifaceted process that demands a comprehensive and context-specific approach. To this end, the researcher has introduced an original contribution to the existing body of knowledge - the ContextAware ICT Appropriation (CAIA) model.

By bridging the gap between research findings and pertinent theoretical concepts, the study facilitates an ongoing scholarly conversation within the academic community, paving the way for further research, discussion, and ultimately, informed policy and practice.

ACKNOWLEDGEMENTS

I wish to thank:

- **Professor Johannes Cronjé**, my supervisor: It has been a privilege to be guided by an academic of your stature. Your towering expertise, sage guidance, and commitment to my scholarly development have been pivotal in the fruition of this thesis.

- **Professor Fanie Cloete** and **Dr Wilhelm Rothman**, for their willingness to critically read and comment on my work in progress.

- The members of the **'TERPS'** study group of **Professor Cronjé** for their critique of and recommendations for this thesis.

- The participating **teachers** for sharing their experiences with me.

- My friends, **Oom Koos** and **Tannie Thea** for their encouragement and support.

- My wife, **Christa**, for her unwavering support, encouragement, and patience.

DEDICATION

This work is dedicated to my family.

To my loving wife, your sacrifices and enduring belief in my goals have made this endeavour possible. Thank you for being my rock and my source of inspiration.

To my late parents whose love and encouragement have been the foundation of my academic journey.

To my late brother who inspired me to excel.

May our achievements inspire our children and grandchildren to follow their dreams.

TABLE OF CONTENTS

CHAPTER 4: DISCUSSION OF FINDINGS

CHAPTER 5: CONCLUSION

LIST OF FIGURES

LIST OF TABLES

APPENDICES

ABBREVIATIONS AND ACRONYMS

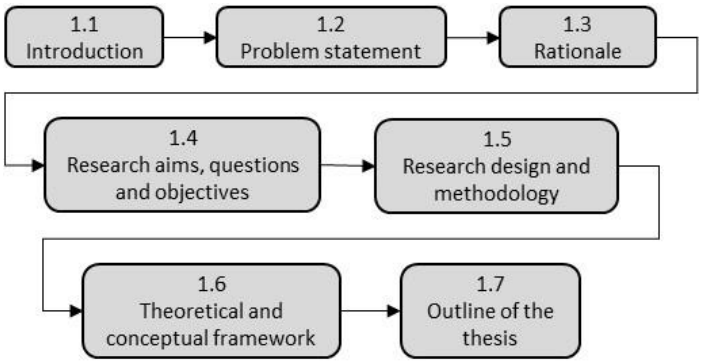
ANT	Actor-network theory
CCT	Centre for Community Technology
ConTIS	Constructivist Technological Instructional Strategies
DSI	Department of Science and Innovation
ERT	Emergency remote teaching
FGI	Focus group interview
ICT	Information and communication technology
NMU	Nelson Mandela University
SAMR	Substitution Augmentation Modification Redefinition
TPACK	Technological Pedagogical Content Knowledge
UNISA	University of South Africa

GLOSSARY

Term	Description
Access to ICT	The ability to use and benefit from Information and Communication Technology (ICT) resources, such as computers, the internet, and digital tools, typically in the context of education, work, or daily life.
Affordance	A quality or characteristic of technology that suggests its potential uses or actions. It relates to how a user perceives and interacts with an object based on its design and features.
Appropriation	The process of adapting and adopting technology to serve a particular purpose, often in a way that was not originally intended. It involves making a tool or concept one's own.
Digital devices	Electronic tools or equipment designed for processing and storing digital information, including smartphones, tablets, and computers.
Digital divide	The gap in access to and use of digital technologies between different groups or regions, often reflecting disparities in income, education, or infrastructure.
Digital inequality	Unequal distribution of digital resources, skills, and opportunities, leading to disparities in individuals' ability to benefit from digital technologies.
e-Learning	A mode of education that uses digital technologies, such as the internet, to deliver educational content, often asynchronously and remotely.
Emergency remote teaching	A rapid, temporary shift to online teaching and learning, typically in response to unexpected events or crises, such as a pandemic or natural disaster.
e-Readiness	The level of preparedness of an organisation, community, or individual to effectively use and benefit from digital technologies and the internet.
ICT	A broad term encompassing technologies used for the collection, processing, transmission, and storage of information, including computers, software and the internet.
Integration	The process of combining or incorporating various technologies or systems to work together seamlessly and efficiently.
Mobile devices	Handheld electronic devices designed for on-the-go use, such as smartphones and tablets.
Pedagogy	The theory and practice of teaching and education, encompassing instructional methods, strategies, and approaches to support learning.

Posthumanism	A philosophical framework that explores the changing nature of humanity and its relationship with technology, often blurring the boundaries between humans and machines.
Technology	Digital devices such as computers, laptops and tablets designed to make tasks easier or more efficient.
Technology practices	The habits, routines, and behaviours associated with using and interacting with technology in daily life, work, and culture.
Technology teaching	The act of instructing and facilitating the use of technology for educational purposes.
Use	The act of employing a technology for a particular purpose or function, typically in practical or everyday contexts.

CHAPTER 1
INTRODUCTION



Structure of Chapter One

Empowering teachers with access to ICT opens the door to endless possibilities, but it's their thoughtful use that turns technology into transformative teaching.

1.1 Introduction

The appropriation of educational technology by teachers hinges upon their access to Information and Communication Technology (ICT). This study explores the intricacies surrounding teachers' access to ICT and their technological practices in times of crisis. The primary objective is to gain a more profound comprehension of how teachers appropriate ICT by exploring their real-life experiences during the COVID-19 pandemic.

It is of utmost importance to reflect on teachers' “teaching with technology” practices during the pandemic, given the scarcity of systematic reviews on school education during emergencies (Bishop, 2021; Crompton et al., 2021; Piyatamrong et al., 2021). Such research is required to explore what strategies proved effective and can be carried forward when schools return to normalcy or in anticipation of future crises (Bond, 2020; Hartshorne et al., 2020).

Given the unparalleled nature of the COVID-19 pandemic, it is difficult to find comparative studies in similar contexts, although instances exist of smaller-scale regional disruptions resulting from events like floods or conflicts (Czerniewicz et al., 2019; Barbour et al., 2020; Anthony Jnr & Noel, 2021). By establishing linkages between the literature review, theoretical frameworks, and research findings, this study contributes to the ongoing academic discourse, paving the way for further research and discussion in the field.

1.2 Problem statement

The COVID-19 pandemic presented the most formidable test to the global education landscape in history (Bozkurt et al., 2022). While the pandemic necessitated the suspension of in-person classroom activities, 21st-century technology offered a substantial means to sustain educational operations (Bozkurt & Sharma, 2020; Arnett, 2021; Fuchs, 2022).

In South Africa, variations in socio-economic and geographical contexts significantly affected the availability of ICT. This circumstance posed a formidable challenge to the delivery of education during the pandemic, particularly in regions where access to digital technology and pedagogy was limited (Padmanabhanunni & Pretorius, 2023). Consequently, only a small number of schools transitioned to technology-mediated remote teaching, while most schools experienced little to no educational activity, thereby endangering the academic progress of many students (Dube, 2020).

1.3 Rationale

The bulk of scholarly attention in the context of the COVID-19 educational disruption primarily focused on learners and the existing disparities within the educational system (Schleicher, 2020; Vaughn, Sayed et al., 2021). Only a few studies have delved into the lived experiences of teachers during this crisis, rendering this research both pertinent and indispensable (Sayed et al., 2021).

This study addresses the imperative necessity to further explore the intricacies of teachers' access to ICT and their technological practices in times of crisis. Such research is crucial for achieving a more profound and comprehensive understanding of how to respond to such crises with resilience and adaptability (Haider & Al-Salman, 2020; Sharin, 2021; Bozkurt et al., 2022). The knowledge derived from this study will offer valuable insights into how to proceed and ensure the continuity of education in the post-pandemic era.

1.4 Research aims, questions and objectives

This section discusses the aim and objectives of the study as succinctly expressed in the title and research questions.

1.4.1 Research aim

The research aims to explore access to ICT and the technology practices of teachers during the COVID-19 pandemic, shedding light on the complex dynamics that either facilitate or hinder the adoption and use of ICT.

1.4.2 Research questions and objectives

The research questions, objectives and instruments of the study are set out in Table 1.1.

Table 1.1: Research questions, objectives and instruments

Research questions	Objectives	Instruments
What teacher **technological pedagogical knowledge** transpired from the COVID-19 pandemic?	To explore the impact of the COVID-19 pandemic on the technological pedagogical knowledge of teachers.	Secondary literature review Individual online questionnaire Focus group interview
How did teachers adapt their u**se of technology for teaching** and learning during the COVID-19 pandemic?	To explore how teachers used ICT to change or transform their teaching practices during and after the COVID-19 pandemic.	

1.5 Research design and methodology

The study applied a phenomenological orientation, underpinned by an interpretivist philosophy and actor-network theory (ANT) (Tatnall, 2019; Rowan & Bigum, 2003), to explore the dynamics of access to ICT and technology practices of teachers.

1.5.1 Research approach and design

An interpretative phenomenological approach was deemed appropriate as it allows the researcher to get a thorough understanding of the phenomenon by exploring the lived experiences and perceptions of participants (Cohen et al., 2007; Pietkiewicz & Smith, 2012). ANT was applied as a theoretical lens as it emphasizes the agency of both human (teachers and learners) and non-human actors (technology) in the process of ICT appropriation.

A qualitative research design was employed to explore how teachers experienced accessing and using ICT in their teaching practices amid the COVID-19 pandemic. This design allows the researcher to gain a thorough and profound insight into a complex phenomenon by revealing concealed experiences within a specific social setting (Merriam, 1998; Denzin & Lincoln, 2011; Creswell & Creswell, 2018). Since qualitative findings do not lend themselves easily to generalisation owing to the absence of statistical analysis (Hammersley 2007, Merriam, 2009), this study explored patterns that may resonate with similar research.

The research further followed an inductive approach to explore teachers' lived experiences about the phenomenon under study (Maxwell 2008). The inductive approach involved collecting empirical data that is relevant to the topic of interest and comparing the findings with and their impact on existing knowledge. The researcher applied inductive reasoning to generate meanings from the data set collected to search for causal patterns from those observations and develop explanations for those patterns.

1.5.2 Unit of analysis, sample and delineation

The unit of research was teaching practices that involve the use of ICT, and the unit of analysis was the actions and opinions of individual teachers. The researcher used purposive sampling, which is a form of non-probability sampling technique. This approach enabled the researcher to carefully select specific participants known for their use of educational technology and their potential to offer valuable and dependable data (Saunders et al., 2003; Korstjens & Moser, 2018; Taherdoost, 2018). The research was restricted to active teachers in secondary schools.

1.6 Theoretical and conceptual framework

The theoretical and conceptual frameworks for this study were developed from the literature review in Chapter 2.

The study applied the ConTIS matrix (Tunjera, 2019), a model that recently originated from the field of educational technology and incorporates the prominent and well-established TPACK (Mishra & Koehler, 2006) and SAMR (Puentedura, 2009) constructs, as theoretical foundation. The TPACK model centres on teacher knowledge related to technology integration, while the SAMR model is a framework for teachers to transform the learning process by integrating ICT into their teaching practices.

The conceptual framework designed for this study integrates the identified gaps in knowledge and the research questions derived from the literature review. This framework focuses on particular study concepts or variables, delineating their connections and interplay.

The theoretical and conceptual frameworks are integrated into a comprehensive framework (Figure 1.1) by indicating the research questions and their underpinning theories, RQ1: TPACK and RQ2: SAMR, on individual axes at right angles to one another. The responses to the questionnaire items are plotted on the framework to illustrate what technological pedagogical knowledge transpired from the pandemic and how teachers adapted their pedagogy and use of technology during the pandemic.

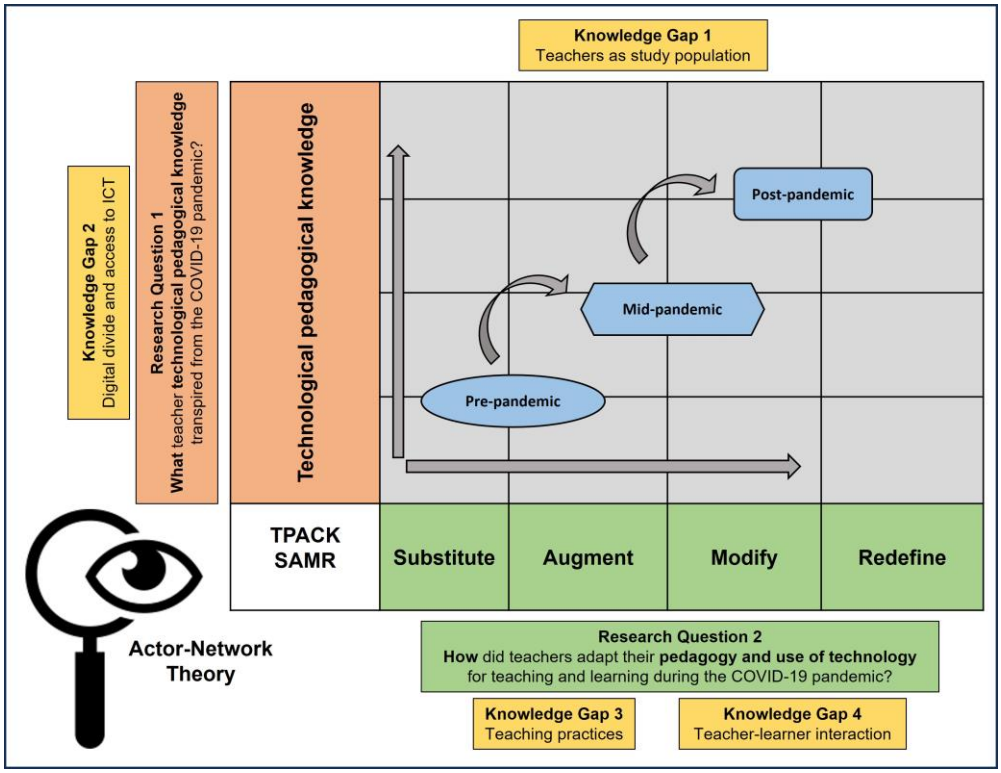


Figure 1.1: Theoretical and conceptual framework (Author's construct)

This integration allows the researcher to draw upon established theories to inform the design of the study while also providing a clear structure for collecting and interpreting data related to the research topic. This ensures that the study is theoretically grounded while addressing specific research questions within the chosen context.

1.7 Outline of the thesis

This section provides an overview of the thesis, drawing from the theoretical and conceptual framework as depicted in Figure 1.1.

Chapter 1 offers a summary of the research topic, emphasising its importance in the field. Moreover, it addresses the research issue, research objectives, and the research approach and methodology. The chapter ends by providing a well-organised overview of what to expect in the upcoming chapters, thus laying the foundation for a thorough exploration of the research domain.

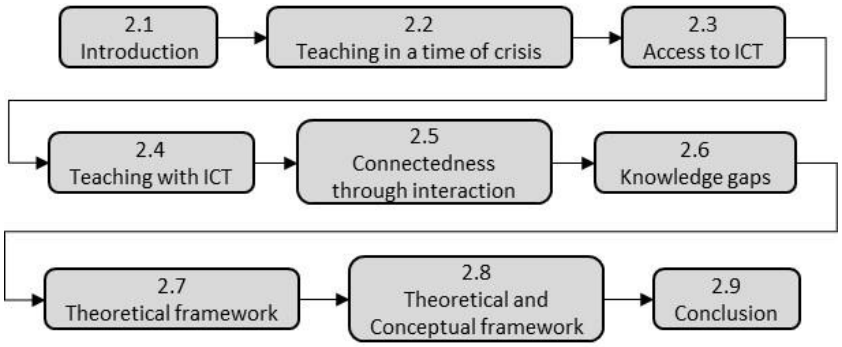
Chapter 2 presents an overview of relevant secondary scholarly knowledge that form the foundation of this study. The literature review establishes a framework for and contextualizes the study, emphasises its significance and originality and paves the way for further academic contributions in subsequent chapters.

Chapter 3 outlines the philosophical and methodological framework that guided the research. This chapter concludes by discussing the ethical principles that guided this study, actions taken to ensure the trustworthiness and usefulness of the data and the limitations of the study.

Chapter 4 marks the conclusion of the practical inquiry carried out to address the study's research questions and objectives. This chapter establishes the context for understanding how the ensuing findings enhance the established knowledge in the field.

Chapter 5 provides the final remarks for the research study. It offers a recap of the cause-and-effect reasoning applied in the study and evaluates the extent to which the problem statement, research questions, and research objectives have been effectively dealt with. Additionally, it addresses the unique contribution to the current body of knowledge, namely, the Context-Aware ICT Appropriation (CAIA) model, as well as acknowledging the study's limitations. The chapter closes with recommendations for enhancing ICT access and the technological pedagogical practices of teachers during crises.

CHAPTER 2
LITERATURE REVIEW



Structure of Chapter Two

A literature review in educational technology research illuminates the path forward, as we stand on the shoulders of past insights to shape the digital classrooms of tomorrow.

2.1 Introduction

In this chapter, a critical examination of pertinent academic literature is presented, serving as the cornerstone for this study. The objective of the review is to scrutinise and amalgamate the primary existing body of knowledge on the subject at hand, expound upon fundamental concepts, pinpoint areas lacking in information, frame research inquiries, and substantiate the rationale behind this study. This literature review positions the study within the broader global academic context, underscoring its significance.

Using a thematic approach, the review homes in on principal themes and related subtopics within the research field. By amalgamating insights from a variety of sources, this chapter offers a multifaceted comprehension of the subject, laying a sturdy foundation for the subsequent empirical examination and analysis. The literature review constructs a theoretical framework for the study and paves the way for the evaluation of empirical data in the forthcoming chapters.

2.2 Teaching in a time of crisis

Historically, educational activities have been disrupted by health hazards, natural disasters, armed conflicts, and other forms of political and social unrest (Czerniewicz et al., 2019; Barbour et al., 2020; Anthony Jnr & Noel, 2021). These unanticipated emergencies often disrupt traditional classroom activities for indefinite periods (Laprairie & Hinson, 2006) and create the need for alternative educational solutions to ensure continued teaching and learning.

2.2.1 Historical precedents

A pandemic is among the most devastating global challenges, and the literature documents the imperative need for education to heed the warnings of impending pandemics (Gonzales, 2020; Hall et al., 2020). While changes in educational practices prompted by pandemics are not unprecedented, references to pandemics and their potential ramifications on education are relatively scarce. Most empirical research on disruptions in education due to pandemics primarily focused on health-related rather than pedagogical aspects (Hall et al., 2020).

The outbreak of the Black Death in Europe between 1346 and 1353 marked the origin of crisis management for highly contagious diseases, now recognised as "quarantine." The term "quarantine" in the English language directly derives from "quaranta," the Italian word signifying a 40-day duration. The practice of enforcing 40 days of isolation was subsequently adopted during the three waves of the 1918 Spanish flu (Martini et al., 2019). This historical precedent offers a compelling rationale for reapplying this procedure as a definitive measure to contain the spread of future pandemics (Gonzales, 2020).

Internationally, the responses to and the effectiveness of the measures to contain the spread of the Spanish Flu varied widely. Some of the measures applied in schools were:

- Many schools were closed temporarily. The duration of closures varied depending on the severity of the outbreak in a particular area.
- Continued education through remote means, although the technology available at the time was limited. This often involved sending assignments home or conducting lessons via correspondence.
- Some schools implemented staggered schedules to reduce the number of students in the building at one time, which allowed for better social distancing.

- Schools that remained open or reopened often implemented strict hygiene measures, including the use of masks, frequent handwashing, and health screenings for learners and staff.
- Learners or staff members who were infected with the flu or had close contact with infected individuals were isolated or quarantined to prevent further spread.

In South Africa, efforts to contain the Spanish flu and polio epidemics of 1918 and 1944 were primarily guided by the quarantine measures of the 1916 epidemic in the USA, even though such quarantine measures had been declared insufficient (Wade, 2006). The decision to close schools during these epidemics was, however, not straightforward. Some argued that implementing widespread school closures without imposing limitations on other public and private gatherings involving both children and adults would not yield any meaningful benefits.

The closure of schools was, however, not enforced and was generally avoided. For instance, the Director of Education for the Transvaal province argued that shutting down schools without imposing restrictions on other public and private gatherings, would be ineffective (Wade, 2006).

Despite a rising number of school disruptions since the early 2000s (Kabaka & Stoltenkamp, 2013) and clear warnings that an entire academic year could be lost due to a "quarantine recess" in the event of a major pandemic (Laprairie & Hinson, 2006), the global COVID-19 crisis, in general, appears to have taken the educational (research) community by surprise (Hall et al., 2020).

Globally the ongoing impact of the pandemic-induced educational disruption is still being understood (Mseleku, 2020). It is thus imperative to pause, reflect on and learn from the present crisis (Bond, 2020; Hartshorne et al., 2020).

2.2.2 COVID-19 educational disruption

The COVID-19 pandemic, officially recognised as a global pandemic by the World Health Organization (WHO) in March 2020, represents the most extensive disruption to worldwide education ever documented (Santandreu Calonge et al., 2021; Dorfsman & Horenczyk, 2022; Crompton et al., 2023). In South Africa, President Cyril Ramaphosa declared a state of emergency, resulting in the closure of South African schools on March 18, 2020, which abruptly halted the classroom activities of approximately 17 million students (StatsSA, 2020).

As a result of the nationwide lockdown, schools remained closed from March to August 2020. Consequently, the 2020 academic year was reduced from 42 weeks to 37 weeks, resulting in a loss of 40 days of instructional time. Following the initial strict lockdown, most school learners adopted a rotational 'shift system,' with a significant portion of learning expected to take place at home. In response to these challenges, the South African government implemented various measures to ensure the continuity of teaching and learning.

2.2.3 COVID-19 educational response

The two major differences between COVID-19 and historical precedents were the scale of quarantine and the affordances of modern technology. While the COVID-19 pandemic globally forced educational institutions to halt traditional classroom-based education for an indefinite period, 21st-century technology provided a substantive way to remain operational (Arnett, 2021; Fuchs, 2022).

Different countries took different approaches based on factors such as the severity of the pandemic in a particular region, the available resources, technological infrastructure, and educational policies. Some common measures and approaches included:

- Temporary closure of schools.
- Remote teaching and learning using various educational technology platforms.
- Hybrid learning models, where learners attended school on alternating days or weeks to reduce the number of learners at school at one time.
- Providing devices and internet connectivity to teachers.
- Adapting assessment and grading systems.
- Training and professional development for teachers.
- Safety measures such as mask-wearing, social distancing, temperature checks, and frequent sanitation to protect teachers and learners in schools.

The approach to providing education in South Africa amid the COVID-19 pandemic was significantly shaped by the diverse socio-economic and educational contexts existing throughout the country. Various factors, such as whether schools were government-funded or private, their geographical location in urban or rural settings, and the socio-economic status of the communities they catered to, were instrumental in influencing the strategies adopted.

- Government vs. private schools:

Government schools in South Africa, which serve the majority of learners, faced significant challenges during the pandemic. Many of these schools are located in underserved communities and have limited access to technology and the internet. This made the transition to remote learning more challenging.

Private schools, on the other hand, generally have more resources and better technological infrastructure. They were often able to adapt to online learning more smoothly during the pandemic. However, the accessibility of private schools is limited to those who can afford tuition, creating disparities in educational access.

- Urban vs. rural schools:

Urban schools in South Africa's major cities faced unique challenges, including a higher population density, which increased the risk of virus transmission. However, they often had better access to technology and internet connectivity, making it somewhat easier to implement remote learning solutions.

Rural schools, especially those in remote and underserved areas, encountered more significant difficulties. These areas often had limited access to the internet, electricity, and technology devices. The geographic isolation of some schools made it challenging to distribute educational materials and maintain contact with learners during lockdowns.

- Wealthy vs. poor communities:

Schools located in more affluent communities often had greater financial resources, which allowed them to invest in technology, infrastructure, and additional support for students. This meant that learners in these areas had more access to digital devices and internet connectivity.

In poor communities, learners face a higher risk of falling behind in their education. The lack of access to technology and educational resources exacerbated existing inequalities, making it difficult for many learners to keep up with their studies during lockdowns.

In the best-case scenario, a very small number of well-resourced schools managed to transition smoothly to remote teaching (Dube, 2020; Landa et al., 2021; Mbhiza, 2021). In the worst-case situations, however, teaching and learning essentially came to a standstill due to the absence of the necessary digital infrastructure within schools and among teachers (Lie et al., 2020; Hennessy et al., 2021; Moyo et al., 2022). Consequently, most South African schools experienced little to no educational activity, placing numerous students at risk of falling behind (Dube, 2020).

In summary, the diverse socio-economic and educational contexts in South Africa exacerbated pre-existing educational inequalities and underscored the necessity for comprehensive strategies to ensure equitable access to quality education, particularly in times of crisis. The South African government introduced several measures, such as disseminating educational materials through printed media and broadcasting educational programmes on television and radio to cater to students lacking internet access. However, these endeavours only partially alleviated the inequalities and reduced the educational divide.

It is important to acknowledge that the educational response to the pandemic was dynamic and evolved as new information and challenges surfaced. Furthermore, the pandemic's impact on education remains an ongoing subject of research and analysis.

2.3 Access to ICT

Educational technology can enhance the adaptability of educational systems during crisis periods, as it enables remote teaching and learning capabilities (Tauson & Stannard, 2018). Nevertheless, technology-mediated teaching is only viable in educational settings where there is adequate access to digital technology and effective pedagogical methods (Padmanabhanunni & Pretorius, 2023). Considering the persisting disparities within the South African education system, a focus on ensuring access to ICT is both justifiable and necessary (Czerniewicz & Brown, 2005).

2.3.1 Educational technology

Educational technology refers to all digital technology (ICT) created or adopted for educational objectives (Hennessy et al., 2021). The impact of educational technology on education has been substantial and has brought about significant changes over the previous four decades (Burns, 2021). With the ongoing evolution of technology, its role in and influence on the educational landscape is expected to grow further.

Some key examples of how educational technology has influenced and shaped education are:

- The introduction of personal computers made it possible to store, access, and process vast amounts of information, leading to the development of educational software and interactive multimedia programs.
- The internet and the World Wide Web connected classrooms to a vast global repository of information and resources.
- Learning Management Systems (LMS) platforms like Moodle and Blackboard streamlined course management and online learning.
- Online Learning and Massive Open Online Courses (MOOCs) offer free or low-cost access to courses from top universities and institutions.
- The integration of e-learning tools and resources into traditional classrooms has given rise to blended learning models.
- The proliferation of smartphones and tablets has led to the development of educational applications that cover a wide range of subjects and age groups.
- Virtual Reality (VR) and Augmented Reality (AR) technologies immerse learners in virtual or augmented environments, offering immersive learning experiences.
- Artificial Intelligence (AI) powered tools, like chatbots and virtual tutors, assist students with questions, provide feedback, and offer personalized recommendations.

Although the COVID-19 pandemic underscored the significance of ICT access and use in education (Sahin & Shelley, 2020), discussions related to pandemics in the realm of educational technology remain scarce (Hall et al., 2020). Scholarship about educational technology in crisis scenarios, particularly the intersection of COVID-19, education, and technology, is nascent (Czerniewicz et al., 2019; Mailizar et al., 2020; Sukendro et al., 2020; Jelińska & Paradowski, 2021).

2.3.2 Dimensions of access

This research uses Van Dijk's (2002) cumulative model of access, which posits that various types of access occur sequentially and depend on each other. Figure 2.1 illustrates the interconnections among the dimensions of access, namely motivation, physical access, skills, and usage.

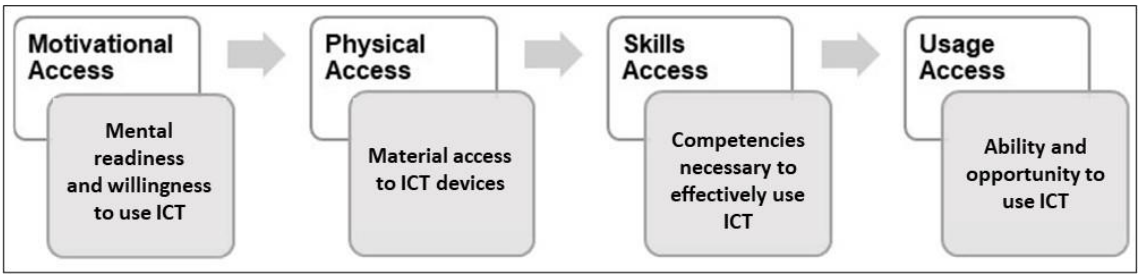


Figure 2.1: Access to ICT as a process of appropriation (Van Dijk, 2002)

Motivational access is required first. Once this has been achieved, material access can be mobilised. This will lead to skills access and only then is access to full usage obtained. The dimensions of access are discussed in more detail in the following sections.

2.3.2.1 Motivational access

Motivational access refers to the state of preparedness and eagerness to acquire and engage with digital technology. Despite its pivotal significance in the acceptance and use of ICT, motivation is often neglected or underestimated in real-world applications (Van Dijk 2012). Motivation can be classified into two categories: intrinsic motivation, which originates from within, and extrinsic motivation, which is externally driven (Soomro, 2018).

Before March 2020, most teachers perceived technology as an additional tool and a handy aid in the classroom (Giacosa, 2020). However, the outbreak of the COVID-19 pandemic necessitated teachers to employ technology as a coping mechanism and compelled schools and teachers to experiment with technology-mediated teaching approaches (Alhumaid et al., 2020; Bond, 2020; Demuyakor, 2020).

2.3.2.2 Physical access

Physical access to ICT encompasses the presence of the necessary devices and resources essential for the efficient use of ICT. Possessing physical access serves as a fundamental requirement for attaining digital skills and, in turn, using ICT effectively. Therefore, the existence of tangible ICT resources is a significant focal point in all conversations regarding access, as indicated in the current literature (Peters et al., 2020; Crompton et al., 2021).

In educational environments, having physical access to technology is a crucial requirement for eventually making use of it (Soomro, 2018). In practical terms, there is a prevalent belief that bridging digital disparities can be achieved by equipping teachers and learners with computers and internet connections. Consequently, the underlying rationale during the pandemic was that by ensuring physical access to ICT, teachers and learners could swiftly adopt technology for remote teaching and learning.

This approach was, however, problematic as obtaining physical access to ICT does not by default lead to the actual use of the technology (Chisango, 2021). Simply equipping schools, teachers, and learners with technology is not the solution.

Dimensions of digital inequality in South Africa

Jansen (2020) identified three aspects of digital inequality associated with physical or material access. These digital inequality facets, represented in Figure 2.2, include Google Classroom, WhatsApp, and Radio-Television groups. In this study, "Google Classroom" is replaced with "Virtual Classroom" to encompass the use of alternative communication platforms such as Moodle and Microsoft Teams.

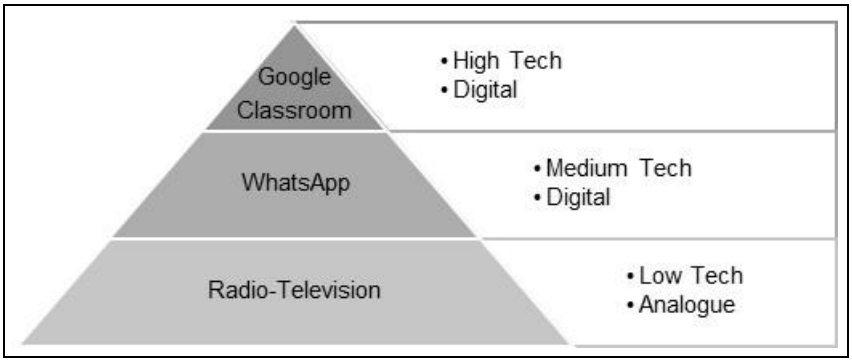


Figure 2.2: Dimensions of digital inequality (Authors' construct)

- **Virtual Classroom**

In well-equipped schools, the shift from in-person to remote teaching was a relatively seamless process for both teachers and learners. Some of these schools had already incorporated a blended learning approach into their teaching methods before the lockdown. This minority of schools swiftly adopted technology-mediated remote teaching and learning during the pandemic.

Regrettably, as depicted in Figure 2.3, it is worth noting that only around one in ten South African learners (approximately 11.7%) were provided with the option of remote learning, and only about 6% of learners engaged in remote learning during the pandemic (StatsSA, 2020).

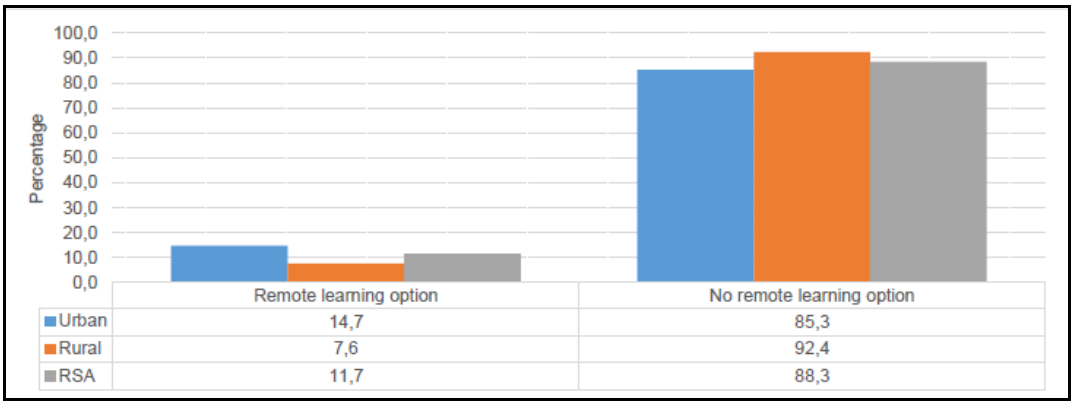
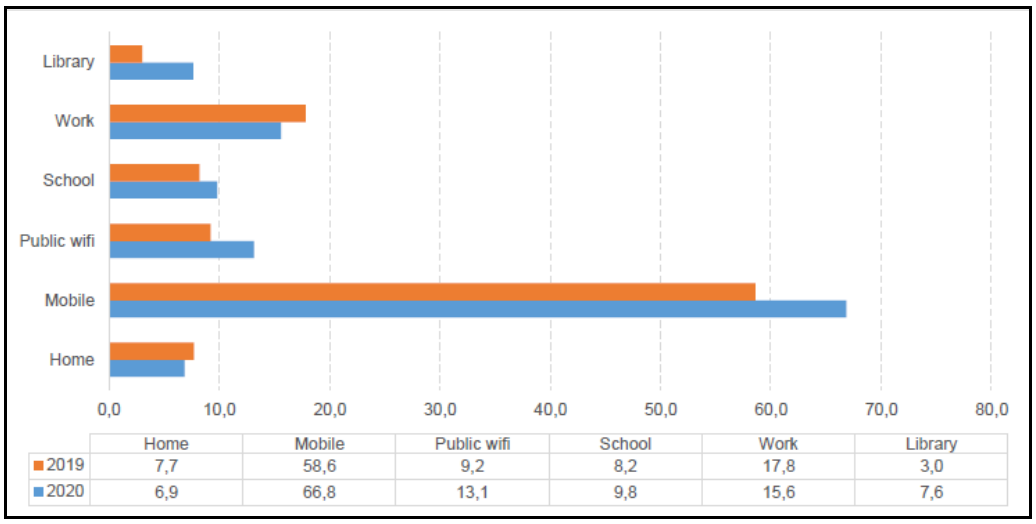


Figure 2.3: Percentage of individuals aged 5–24 years who attended an educational institution that offered a remote or home-schooling option by geography type, 2020 (StatsSA, 2020: 12)

- **WhatsApp**

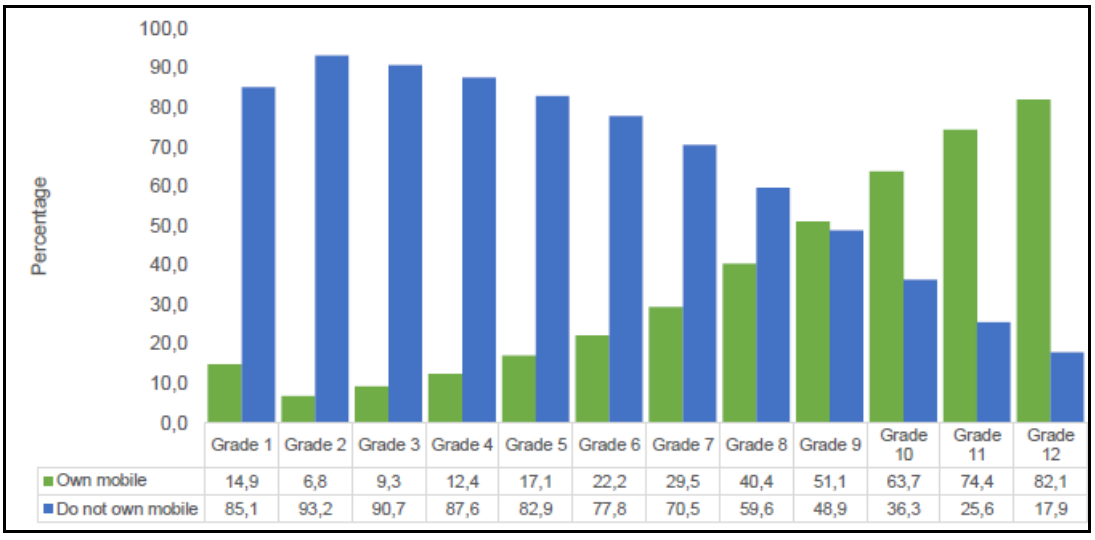
In practice, most teachers and learners made use of WhatsApp for educational communication. This preference is primarily due to a higher percentage of households with individuals between the ages of 5 and 24 using mobile phones to access the internet compared to other devices (as indicated in Figure 2.4).



	Home	Mobile	Public wifi	School	Work	Library
2019	7,7	58,6	9,2	8,2	17,8	3,0
2020	6,9	66,8	13,1	9,8	15,6	7,6

Figure 2.4: Percentage of households with individuals aged 5-24 years by internet access in South Africa, 2019-2020 (StatsSA, 2020: 28)

WhatsApp is a better-suited option for secondary schools because the percentage of mobile phone ownership increased significantly as learners progressed through each grade level. (Figure 2.5). Although WhatsApp enabled teachers and learners to engage in remote communication, the platform's educational functionality remained rudimentary, and the learning experience was adversely affected by challenges related to device availability, data costs, and inconsistent internet connections.



	Grade 1	Grade 2	Grade 3	Grade 4	Grade 5	Grade 6	Grade 7	Grade 8	Grade 9	Grade 10	Grade 11	Grade 12
Own mobile	14,9	6,8	9,3	12,4	17,1	22,2	29,5	40,4	51,1	63,7	74,4	82,1
Do not own mobile	85,1	93,2	90,7	87,6	82,9	77,8	70,5	59,6	48,9	36,3	25,6	17,9

Figure 2.5: Percentage of individuals aged 10-24 years who attended school and owned a functional mobile cellphone by grade, 2019 (StatsSA, 2020: 46)

- **Radio-Television**

The majority of South African learners had no alternative but to depend on educational radio and TV broadcasts for their remote learning needs. Because of the constraints of these broadcast platforms, the lockdown resulted in minimal, if any, educational advantages for most of these learners.

2.3.2.3 Skills access

Skills access, the ability to use technology, consists of three levels (Van Dijk, 2005).

Operational skills:

- These skills pertain to the basic, day-to-day use of digital technology and software applications.
- They include tasks like navigating computer interfaces, managing files and folders, using word processing and spreadsheet software, and sending emails.
- Operational skills are essential for performing routine tasks and efficiently using digital tools.

Informational skills:

- Informational ICT skills involve a higher level of competency in managing and manipulating digital information.
- This category includes skills related to data analysis, information retrieval, and the ability to critically evaluate online information.
- Informational skills are important for tasks like conducting research, data analysis, and making informed decisions based on digital data.

Strategic skills:

- Strategic ICT skills represent the highest level of digital competence and are often associated with leadership and decision-making roles.
- These skills encompass the ability to develop and implement technology-driven strategies and making informed decisions about technology investments and innovations.
- Strategic skills also involve understanding the broader impact of technology on an organization or society and aligning technology with long-term goals and objectives.

In summary, operational ICT skills are foundational, focusing on basic technology use, while informational ICT skills involve managing and analysing data and information. Strategic ICT skills encompass a deeper understanding of technology's strategic implications and the ability to make decisions that leverage technology for a competitive advantage.

Because teachers were mainly exposed to traditional classroom teaching before the pandemic, most teachers were unprepared for and lacked the skills required for technology-mediated remote teaching (Bozkurt & Sharma, 2020; Blaikie et al., 2020; Arnett, 2021).

2.3.2.4 Usage access

Usage access to ICT denotes the ability and opportunity to effectively employ ICT tools and resources across various domains like education, business, or personal use. It signifies the deliberate decision to engage with digital technology and assumes that individuals exercise this choice freely, influenced by factors such as need, opportunity, responsibility, availability, or effort.

Within an educational context, having usage access to ICT empowers teachers to integrate technology into their teaching practices, leading to improved teaching and learning experiences. It equips teachers with the capacity to use multimedia materials, interactive learning platforms, educational applications, and online resources to present information in engaging and interactive formats.

Before March 2020, teachers had the discretion to choose whether they would incorporate technology into their traditional, classroom-based teaching practices. However, with the onset of school closures, teachers were compelled to use whatever ICT resources were at their disposal to sustain educational activities (Ewing & Cooper, 2021). Although many teachers were new to teaching with technology (Sharin, 2021), it was no longer a matter of choice but a vital necessity.

2.3.2.5 Reflection

The successful incorporation and use of ICT in education are greatly dependent on the availability of ICT tools and resources. Regrettably, the current body of literature lacks a comprehensive grasp of teachers' access to and use of ICT (Soomro, 2018).

While Van Dijk's model has been instrumental in exploring and understanding the complexities of ICT access, it does present certain shortcomings and facets that necessitate scrutiny. One of the principal concerns relates to its limited focus on human agency, specifically how individual motivations, skills, and choices impact ICT access and usage.

In recent years, alternative theories of access to ICT have emerged, challenging the conventional hierarchical view of access. While these theories acknowledge that material access is a primary requirement, they view the appropriation of ICT as a complex and iterative process, encompassing multiple dimensions of access experienced simultaneously (Czerniewicz & Brown, 2005).

This study is unique in its examination of access to and use of ICT in secondary schools in South Africa, especially considering the scarcity of research in this domain. Existing studies have typically been localised case studies, primarily concentrating on technical aspects, overlooking the broader contextual factors of ICT integration.

2.3.3 e-Readiness

e-Readiness, or digital maturity, is a multifaceted concept denoting a school's capability to establish the necessary structures for delivering effective educational experiences through the use of ICT (Van Greunen et al., 2021). The importance of a school's e-readiness is growing in tandem with the increasing significance of technology. In practice, schools' e-readiness levels encompass a spectrum, ranging from having no access to ICT to being well-equipped with the capacity to effectively integrate ICT into teaching and learning.

While the sustainability of ICT implementation projects in schools hinges on the digital maturity of the school, the majority of South African schools have not yet reached a stage where ICT is deeply ingrained in their school leadership and vision (Policy Brief, 2018; Van Greunen et al., 2021). Consequently, educational policymakers often hold unrealistic expectations regarding the outcomes of ICT initiatives in schools.

The Department of Science and Innovation (DSI) recently developed a decision support tool that can be used to assess schools' e-readiness levels before any ICT-based intervention is deployed (Van Greunen et al., 2021). This tool evaluates e-readiness using indicators organised in five areas and five levels of maturity (Table 2.1).

Table 2.1: Digital maturity tool for schools (Van Greunen et al., 2021)

Assessment area	Digitally unaware	Digital beginner	Digitally competent	Digitally advanced	Digitally mature
Leadership and vision **ICT in the curriculum** **Development of digital competencies** **School ICT culture** **School and ICT infrastructure**	Limited, if any awareness of using ICT in teaching practices. ICT is used only in some classrooms.	Some awareness of using ICT in teaching, but not yet in practice. Limited staff use ICT in teaching and learning. ICT in some classrooms.	Use ICT in teaching practices. Staff develop their digital competencies and digital content. . ICT in most classrooms.	ICT integrated into teaching practices. Staff develop their own content and use ICT for advanced teaching styles. ICT in most classrooms.	ICT systems integrated to strategically position the school. ICT is used extensively in teaching and learning. Digital content repository. Access via own devices in all classrooms.

The DSI tasked the Nelson Mandela University's Centre for Community Technologies (CCT) in South Africa with the refinement, testing, and enhancement of the manual tool into a digital e-Readiness Tool (Van Greunen et al., 2021). Moving ahead, it is vital to consider the readiness of schools for digital engagement when planning for the long-term sustainability of ICT initiatives in educational institutions.

2.4 Teaching with ICT

The term "teaching with technology" refers to the use of technology by teachers to facilitate the acquisition of knowledge (Tunjera, 2019). The process of integrating ICT into teaching is intricate and encompasses several stages, beginning with the identification of the most suitable technologies, followed by experimentation, and culminating in the modelling of practices, which involves planning and implementing content, technology, and pedagogical strategies (Kihoza et al., 2016; Sadeck, 2016).

While ICT holds the potential to bring about positive transformations in traditional teaching approaches (Bishop, 2021), the existing literature fails to provide a comprehensive comprehension of the intricacies surrounding how and why teachers embrace and use technology (Padayachee, 2017). More extensive studies that explore teachers' technology-mediated teaching practices in diverse settings, such as the context of the COVID-19 pandemic, are warranted (Moorhouse & Kohnke, 2021).

2.4.1 e-Learning

e-Learning is a technology-mediated method for both teaching and learning, situated at the intersection of education, teaching, and learning with ICT. e-Learning is frequently employed as a comprehensive term encompassing various forms of digital teaching and learning, whether conducted in offline or online settings, in traditional in-person formats or through remote approaches (McCarty, 2021). e-Learning holds considerable promise within the realm of education and has constituted a prominent focus of research in educational technology over recent decades (Valverde-Berrocoso et al., 2020).

2.4.2 Emergency remote teaching

The COVID-19 school closures forced teachers to employ alternative approaches for engaging learners remotely (Bozkurt & Sharma, 2020; Anthony Jnr & Noel, 2021). The use of technology provided the most efficient and cost-effective method to continue teaching and learning (Alhumaid et al., 2020; Bond, 2020; Demuyakor, 2020). While it is not the first time that the use of technology has been considered an appropriate crisis-response measure (Affouneh et al., 2020), it has never been implemented globally on such an unprecedented scale within such as short time (Murphy, 2020).

The rapidly implemented technology-mediated practices not only differed from methodically implemented e-learning, but conventional terms such as distance education and online learning also did not quite capture what was being practiced during the imposed lockdown periods (Alhumaid et al., 2020).

Because of the swift implementation of technology, the process in which teachers have been involved since the beginning of the outbreak of the pandemic can more specifically be described as crisis or emergency teaching (Murphy, 2020; Tomczyk & Walker, 2021). “Emergency remote teaching” (ERT) emerged as a common alternative term as it more accurately reflects the urgency of surviving in a time of crisis (Barbour et al., 2020; Bozkurt & Sharma, 2020).

ERT, in contrast, to methodically implemented e-learning, is characterised by, inter alia, forced by external circumstances, absence of planning, and a lack of expertise in teaching with technology (Tomczyk & Walker, 2021). ERT is not grounded in sound theoretical and practical knowledge (Mailizar et al., 2020; Patwardharr et al., 2020). The nature, characteristics, and features of ERT (Tülübas et al., 2023) are summarised in Figure 2.6.

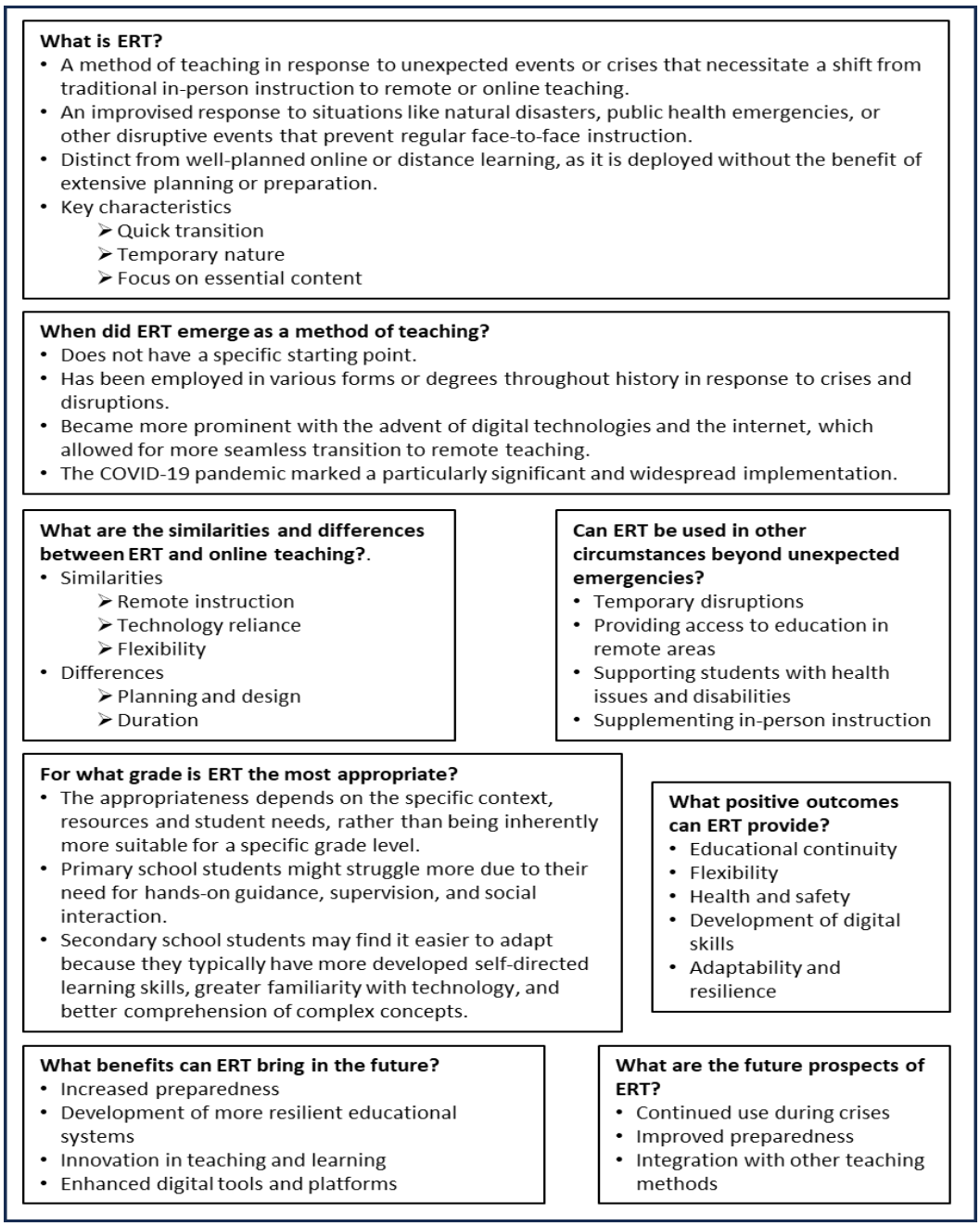


Figure 2.6: Features of ERT
(Tülübas et al., 2023)

2.5 Connectedness through interaction

The essence of any learning environment and experience is significantly reliant on connectedness achieved through interaction (Moore, 1989; Wolhuter & Jacobs, 2021). Fostering a sense of connection via interaction underscores the crucial role of effective communication in the process of teaching and learning (Almutairi et al., 2021).

While scholars and practitioners concur on the importance of interaction in learning, the terminology and discourse surrounding this concept vary in the fields of distance education and educational technology (Moore, 1989). Nevertheless, comprehensive reviews of the literature have revealed a substantial consensus regarding the fundamental components of the term (Selvaraju et al., 2012). The primary efforts to categorise the diverse forms or classes of interaction (Katsarou & Chatzipanagiotou, 2021) are condensed in Table 2.2.

Table 2.2: Summary of types of interaction

Moore (2007)	Jung et al. (2002)	Hirumi (2009)	Chou, Peng, Chang (2010)	Kang (2013)
Learner-teacher	Social	Learner-human	Learner-teacher	Guiding and facilitating learner Social intimacy Presence of the teacher
Learner-content	Academic	Learner-instruction	Learner-content	Instructional communication Instructional support
Learner-learner	Collaborative	Learner–self	Learner-learner Learner–self	
		Learner-non-human	Learner-interface	

The construct of connectedness is particularly crucial when teachers and learners are faced with the challenges of isolation and social distancing. Notably, the issue of **teacher-learner interaction** also emerged as a major pedagogical challenge in ERT during the COVID-19 pandemic (Katsarou & Chatzipanagiotou, 2021).

2.5.1 Teacher-learner interaction

Teacher-learner interaction is therefore at the heart of the (online) learning experience. Teacher-learner interaction is an essential requirement for a good relationship between teacher and learner and has been linked to greater commitment and effort on the part of the learners and improved learning outcomes (Woods & Baker, 2004; Ahmad et al., 2017; Hodgman et al., 2021; Katsarou & Chatzipanagiotou, 2021; Sason & Kellerman, 2021). Learners exchange information and knowledge with teachers through interaction and construct new knowledge from this process.

The various conceptual elements of teacher-learner interaction are summarised in Table 2.3. The table highlights the two essential dimensions of the teacher-learner interaction identified in studies into interaction (Kang & Im, 2013). The affective dimension pertains to the relationship formed between teachers and learners, while the support dimension relates to the assistance required to enable learners to achieve success.

Table 2.3: Conceptual elements of teacher-learner interaction (Author's construct)

<table>
<tr><th>Nature</th><th>Actors</th><th>Purpose</th><th>Dimensions</th></tr>
<tr><td rowspan="2">Learner-human</td><td>Teacher
Learner</td><td rowspan="4">Social
Academic
Collaborative</td><td rowspan="2">AFFECTIVE
Guiding and facilitating learner
Social intimacy
Presence of teacher</td></tr>
<tr><td>Learner(s)</td></tr>
<tr><td>Learner-instruction</td><td>Teacher
Learner
Content</td><td rowspan="2">SUPPORT
Instructional communication
Instructional support</td></tr>
<tr><td>Learner-non-human</td><td>Learner
Interface</td></tr>
</table>

While teacher-learner interaction is extensively studied in online education, creating and facilitating learning interactions that are truly captivating and intellectually stimulating remains a notable hurdle in modern online education. (Katsarou & Chatzipanagiotou, 2021). There is thus a need for more intensive research efforts in this area.

2.5.2 Technology-mediated interaction

The term "technology-mediated interaction" refers to situations in which teachers and learners are geographically separated, and all communication exclusively takes place through digital technology. The absence of digital technology would result in a complete lack of communication and any associated teaching and learning activities.

Over the past two decades, the extensive proliferation of digital devices has led to a considerable emphasis on research concerning online learning environments. This research has predominantly concentrated on two primary domains: the investigation of educational applications of ICT and the exploration of patterns of educational interaction. A comprehensive approach to these two domains, using the concept of technological educational affordances, serves as a research focus that enhances our understanding of the intricate connection between technology and educational interaction (Badia et al., 2011).

The idea of educational technology affordances concerns the qualities and functionalities of technology that make educational interactions between teachers and learners possible. These educational technology affordances are not a static collection of innate attributes within technological features; rather, they are inherently fluid and should be acknowledged and studied as an integral aspect of the educational interaction process.

ERT brought about a shift in the dynamics of teacher-learner interaction, as teachers and learners found themselves having to adapt to the unexpected realm of technology-mediated interaction within a virtual setting (Adnan & Anwar, 2020). It is crucial to take a moment to contemplate the technology-driven teaching practices employed by teachers amid the COVID-19 pandemic (Hartshorne et al., 2020; Bond et al., 2021). Delving deeper into the occurrences within technology-mediated teaching environments during this crisis presents a unique opportunity to gain insights into how to move forward (Charbonneau-Gowdy, 2023).

During the COVID-19 pandemic, the shift from classroom-based teaching to technology-mediated remote teaching had an impact on the interaction patterns between teachers and learners. Teachers faced numerous obstacles teachers in organising meaningful teacher-learner interactions (Le et al., 2022). Most teachers experienced insufficient technological literacy, confidence and readiness to teach online, pedagogical knowledge about online teaching and other communication barriers.

Most teachers employed passive teaching approaches, resulting in a notable decline in spontaneous interactions between teachers and learners within the online setting when compared to the traditional in-person classroom environment (Mehall, 2020; Le et al., 2022). Furthermore, lack of physical interaction led to feelings of being excluded and consequently, the most important requirement for teachers was to create opportunities for both synchronous and asynchronous interaction to promote learner engagement (Bond, 2020).

Although certain schools and teachers had the option to adopt a Learning Management System (LMS), Google Classroom emerged as the most commonly employed substitute platform. Google Classroom proved especially valuable because of its ease of access and the capacity to post assignments, distribute videos, and offer feedback. Additionally, teachers frequently resorted to social media platforms, such as WhatsApp, for communication with learners (Bond, 2020).

2.6 Knowledge gaps

Research on pandemic pedagogy is still relatively scarce, despite the call for more research into pandemic preparedness in the education sector (Laprairie & Hinson, 2006; Hall et al., 2020). The primary focus areas and topics of research in the field of educational technology during the COVID-19 pandemic, as identified during the literature review, are summarised in Table 2.4.

Table 2.4: Focus areas and aspects of research (Author's construct)

Focus areas	Aspects
Remote teaching and learning	▪ The difficulties and advantages of employing technology for distance education and learning amid the COVID-19 pandemic. ▪ Diverse software and platforms, including Zoom, Google Classroom, and Blackboard. ▪ The effects of using these tools on student involvement, active participation, and educational achievements.
Synchronous and asynchronous interaction	▪ Real-time and delayed interactions in technology-facilitated teaching and learning throughout the COVID-19 pandemic. ▪ Advantages and disadvantages of each form of interaction, and their impact on learners' learning experiences.
Learner and teacher well-being	▪ Influence of technology-facilitated communication on the mental and emotional health of teachers and learners amid the COVID-19 pandemic. ▪ Consequences of distance teaching and learning on the well-being of teachers and learners, including stress, anxiety, and burnout. ▪ Approaches to alleviate the adverse consequences.
Teacher professional development	▪ The educational requirements of teachers in the course of the COVID-19 pandemic. ▪ The influence of internet-based professional development initiatives on the knowledge, competencies, and self-assurance of teachers regarding the use of technology in teaching and learning.
Digital divide and Access	▪ Consequences of the COVID-19 pandemic on the digital gap. ▪ The way technology-facilitated communication influences fairness and educational access for underprivileged learners.
Pedagogical implications	▪ Educational consequences of technology-facilitated communication throughout the COVID-19 pandemic. ▪ Various instructional methods, like blended and flipped learning. ▪ The effects of these methods on learners' involvement and academic achievements.

There is a shortage of studies that methodically and empirically explore the connection between COVID-19, the field of education, and technology (Piyatamrong et al., 2021). There is a need to further explore the influence of the COVID-19 pandemic on the educational system and to collect real-world data on the effective actions taken by educational institutions in preparation for potential future pandemics (Haider & Al-Salman, 2020; Sharin, 2021).

This study addresses the following four knowledge gaps.

2.6.1 Gap 1: Teachers as study population

As a whole, there is a scarcity of empirical data in (South) Africa regarding the adoption of ICT for educational purposes in schools, particularly from the viewpoint of teachers (Mwapwele et al., 2019). Despite the critical significance of the ability to teach with technology during crises, there is a dearth of scholarly comprehension concerning teachers' technology usage in emergencies (Bishop, 2021; Crompton et al., 2021). Consequently, there is a requirement for more research focused on teachers and ERT during the COVID-19 pandemic (Crompton et al., 2023).

2.6.2 Gap 2: Digital divide and access to ICT

There is a notable gap in academic research concerning how teachers with limited access to and knowledge of ICT in teaching managed their virtual teaching practices during the COVID-19 pandemic. Most studies included in the literature review underscore the pressing necessity for improved ICT access to enhance teachers' competence in remote instruction.

2.6.3 Gap 3: Teaching practices

Teachers working in a crisis need to quickly adapt to new pedagogical approaches, routines, and technology. ERT, in contrast to methodically implemented e-learning, is an unplanned activity and its implementation is not grounded in sound theoretical and practical knowledge (Tomczyk & Walker, 2021).

There is a need for further studies that explore pedagogical strategies and teaching practices during the pandemic (Huck & Zhang, 2021; Le et al., 2022). It is thus imperative to pause and reflect on the technology-mediated teaching practices of teachers during the COVID-19 pandemic and to explore what educational practices worked and could be taken forward (Hartshorne et al., 2020; Bond, 2022).

2.6.4 Gap 4: Teacher-learner interaction

Interaction is a well-explored aspect of online education. Nonetheless, the challenge of creating learning interactions that are truly engaging and intellectually stimulating remains a major hurdle in contemporary online education. Therefore, there is an urgent requirement for more extensive research efforts in this field (Katsarou & Chatzipanagiotou, 2021).

The concept of connectedness is particularly important when teachers and learners confront challenges related to isolation and the need for social distancing (Almutairi et al., 2021). Specifically, the issue of teacher-learner interaction surfaced as a significant educational challenge during ERT during the COVID-19 pandemic (Ferri et al., 2020; Katsarou & Chatzipanagiotou, 2021).

Studies conducted during the COVID-19 era suggest that one of the most crucial factors contributing to learner satisfaction with ERT was the quality and timeliness of interactions between teachers and students (Sason & Kellerman, 2021). Ongoing research into methods to sustain learner engagement across various learning contexts remains imperative (Wolhuter & Jacobs, 2021).

2.7 Theoretical framework

Theoretical frameworks are imperative for guiding research. The field of educational technology is unfortunately still largely under-theorised, and few theoretical frameworks originate from the field of educational technology (Schad et al., 2021). The study of educational technology is challenging as it draws from two different disciplines i.e., education and technology. In practice, research into educational technology most often employs technology-driven theories and not theories in which education is prioritised (Sackstein, 2021).

In contrast to the presence of various theories related to educational technology, there is a noticeable absence of an educational theory specifically centred around technology. The key distinction lies in the fact that while theories of educational technology typically assume the fusion of education and technology, an educational theory of technology examines technology through the lens of educational values and objectives (Bozkurt, 2020).

The COVID-19 pandemic created an opportunity to critically reflect on and rethink the digital and pedagogical possibilities of education, but also the very essence of education (Blaikie et al., 2020; Mbhiza, 2021). To gain a deeper comprehension of how technology influences education, we must adopt an analytical perspective that accommodates the agency and actions of various participants, including both humans and non-human entities (Hicks et al., 2020).

Hence, a post-humanist philosophy (Blaikie et al., 2020) was deemed relevant and useful for this research because it recognises interdependence and provides fresh perspectives on viewing humans, including teachers and students, as not uniquely significant but interconnected with other entities and technology.

2.7.1 Posthumanism

The term "post-human" denotes an understanding of the interrelationship between humans and their technological surroundings, along with the ethical considerations that accompany it (Wolhuter & Jacobs, 2021). Posthumanism introduces fresh perspectives on perceiving humans, including teachers and learners, as not uniquely significant but interwoven with technology. Employing a post-humanist perspective in education prompts us to reevaluate teaching methods, the generation of knowledge, and its distribution, consequently introducing innovative teaching approaches that challenge traditional thinking and generate new knowledge (Blaikie et al., 2020).

e-Learning constitutes a socio-technical system involving an intricate interplay between human and technological elements (Mlitwa, 2007). Consequently, research in the field of educational technology should adopt a socio-technical approach to explore the activities and interactions among teachers, learners, and technology (Tatnall, 2019). This study employs posthumanism as a broad philosophical perspective and uses Actor-Network Theory (ANT) as its methodological approach to educational technology.

2.7.2 Actor-network theory

Actor-Network Theory (ANT) arose in the field of Science and Technology Studies (Rowan & Bigum, 2003; Latour, 2005; Law, 2009). ANT provides a useful framework for studying technology-mediated teaching practices because it emphasizes the role of both human (teachers and learners) and non-human actors (technology). For this reason, ANT can be applied as a theoretical lens to critically explore the dynamics of access to ICT and technology practices of teachers.

ANT maintains that social organisations are not made up solely of people and does not favour the human over material matters or technology (Rowan & Bigum, 2003; Tatnall, 2019). ANT says that the human is not at the centre and equal agency or explanatory status should be afforded to the device (Thomas & De Villiers, 2002; Matthews, 2021). ANT, therefore, allows a researcher to analyse a complex social setting in which both human and non-human are seen as a dynamically interacting network within which each part influences the other parts.

Although Actor-Network Theory (ANT) has seen an increase in its popularity in recent years, it has not been widely employed in the realm of educational technology research (Sackstein, 2021). ANT is not a research methodology as such – it is rather a way to intervene than a theory of what to think (Rowan & Bigum, 2003). The specific research strategies and techniques used to study technology-mediated teaching using ANT will thus depend on the specific research questions and goals.

The dimensions of ANT with specific reference to the approach to and application of ANT in this study are discussed in Table 2.5.

Table 2.5: Summary of dimensions of ANT (Author's construct)

Actor-Network Theory In the context of technology-mediated teaching			
Reasons for application	**Methods of application**	**Arguments for**	**Arguments against**
Focus on relations and networks • Investigate relationships between humans, technology, and other actors. • Gain a more nuanced understanding of how technology is used in education.	**Mapping the network** • Identify the actors involved in the teaching process. • Examine how actors interact with each other.	**De-centering human actors** • Emphasises the relationships between human and non-human actors. **Attention to Non-Human Actors** • Emphasis on the agency of non-human actors.	**Complexity** • A challenging theory to understand. • Requires a deep understanding of the complex and ever-changing relationships between entities.
Attention to materiality • Examine the ways that people interact with technology, but also the physical properties of the technology itself. • Explore how these properties influence teaching and learning.	**Examining the role of non-human actors** • Examine how technology is used in the classroom, how they are integrated into teaching practices, and how they shape the interactions between teachers and learners.	**Focus on process and change** • Emphasises the importance of process and change in social life. • Allows researchers to focus on the dynamic relationships and interactions that shape social phenomena.	**Lack of empirical support** • Has not been subjected to enough rigorous empirical testing to establish its validity. • Seen as an untested or unproven theory.
Non-human actors • Non-human actors are considered to have agency. • Allows researchers to consider the ways that technology and other non-human actors contribute to educational practices.	**Examining power relations** • Explore how power is distributed among different actors, such as teachers and learners, and how it influences the use and adoption of technology in the classroom.	**Methodological pluralism** • Encourages a diverse range of research methods. • Allows researchers to tailor their methods to the specific research questions they are exploring.	**Lack of political commitment** • Emphasis on network relations and the agency of non-human entities neglects the political dimensions of social life. • Does not offer a clear way to address issues of power and inequality.
Flexible and adaptable • Can be applied in a variety of educational contexts and different research projects. • Can be used to study a wide range of technology-mediated teaching practices.	**Exploring resistance and agency** • Investigate how teachers and students resist or challenge the use of technology, and how they exert agency in shaping the teaching and learning process.	**Relational ontology** • Entities do not exist independently of their relationships with other entities. • Allows researchers to focus on the complex, multi-faceted connections between entities.	**Criticisms of Relativism** • Seen as relativistic, in the sense that it does not offer a clear moral or ethical framework. • This can lead to a lack of accountability or responsibility.
Approach to and application of ANT in this study			
• Explore the relationships between teachers, learners, and technology during the COVID-19 pandemic. • Examine the properties of the technology – affordances and constraints. • Consider the ways that technology contributes to educational practices. • Investigate technology-mediated teaching practices of ERT.	• Identify the various actors involved in the ERT process and examine how they interact with each other. • Explore how technology is used, how they are integrated into teaching practices, and how they shape the interactions between teachers and learners. • Consider how power is distributed among teachers, learners, and technology and how it influences the use and adoption of technology. • Investigate how teachers and learners resist or challenge the use of technology.	• Emphasize the interdependent relationships between teachers, learners, and technology. • Recognise the agency of technology. • Focus on the dynamic relationships and interactions that shape social phenomena. • Tailor research methods to the research questions they are exploring. • Focus on the complex, multi-faceted connections between entities and how they shape each other.	• Complexity is not a weakness, but rather a strength as it allows for a nuanced understanding of social phenomena. • Provides insights that other theories may miss. • Has been successfully applied in educational technology studies. • A growing body of literature supports the theory's validity. • The lack of a clear moral or ethical framework is not a weakness, but rather a feature of the theory – not intended to prescribe moral or ethical norms.

In this study, ANT was employed to explore technology-mediated teaching practices and to analyse the interactions between teachers, learners, and technology in the context of the COVID-19 pandemic. ANT was used to identify the various actors involved in the ERT process, examine their interactions, understand technology usage, and assess its integration into teaching practices.

There is an expanding body of literature supporting the validity of ANT in various fields, including educational technology studies. ANT acknowledges the agency of technology and underscores the interdependent relationships among teachers, learners, and technology, but it also has certain perceived limitations.

ANT represents a departure from more traditional qualitative approaches like phenomenology, which aim to capture individuals' perceptions of their personal experiences in specific situations. ANT offers innovative methods for unpacking and describing the underlying assumptions about how ICT becomes integrated into teaching practices and classroom activities on a broader scale. It also enables us to explore questions without solely relying on explanations that either view such integration as a strength or a deficiency in teachers' knowledge and skills (Hicks et al., 2020).

In the domain of exploring innovation, especially in disciplines like Information Systems, there are two prevalent approaches. One approach primarily emphasises the technical facets of innovation, regarding 'the social' as simply the backdrop against which innovation takes shape and is embraced (Tatnall, 2019). On the other end of the spectrum, social determinism asserts that relatively unchanging social categories can be used to elucidate technological shifts, giving paramount importance to the scrutiny of social interactions while diminishing the significance of technology, often viewing it as a contextual element that might be bundled together and disregarded (Tatnall, 2019).

The investigation of information technology's role in education focuses on how individuals use technology-based systems to enhance the educational process. Researchers in this field must grapple with the challenges presented by the intricate web of interactions between individuals and technology. Thus, a simplistic categorisation that places the study of technology use in education solely under either Social Determinism or Technological Determinism cannot be considered accurate or valid (Tatnall, 2019). Both the posthuman and ANT perspectives agree.

Extending this perspective, Actor-Network Theory (ANT) offers a critique of both social determinism and technological determinism, asserting that they are flawed. ANT advocates for a socio-technical approach that does not favour either social or technical viewpoints. ANT positions itself toward the middle of a spectrum that spans from social constructivism to technological determinism. In this framework, both human and non-human elements are considered as mutually shaping entities within a dynamic and evolving network (Kipnis, 2015; Matthews, 2021). ANT terminology describes these interactions as socio-technical entanglements that resist neat separation into individual human and device components. It's this socio-constructivist perspective on the coexistence of individuals and objects that renders ANT a valuable tool for instructional technologists, enabling exploration of both how we influence our tools and how, in turn, our tools influence us (Culkin, 1967).

The principle of translation, the cornerstone of ANT, provides a point of departure for exploring how teachers make sense of and use information technology (Tatnall, 2019). ‘Teaching with technology’ involves a negotiating interplay between teachers and technology (Mlitwa, 2007), and the technology finally adopted by teachers is often not in its original form, but a modified version tailored to their specific needs (Hicks et al., 2020).

Although ANT is not widely used in education (Fenwick & Edwards, 2012) and has no methods specific to itself, it holds a lot of promise for educational technology, particularly from a posthuman perspective. Overall, using ANT and posthuman thinking can help researchers gain a deeper understanding by generating insights that may not be possible using other approaches.

2.7.3 Technology integration models

Academics have developed a variety of criteria, structures, models, and theories that can be utilized to provide direction for research and the practical use of technology in the field of education (Hamilton et al., 2016). Table 2.6 provides an overview of the frequently referenced theoretical models for studying and conceptualising the complex phenomenon of technology integration in education. (Kimmons et al., 2020; Sackstein, 2021; Schad et al., 2021).

Table 2.6: Theories to study technology integration (Sackstein, 2021)

Category	Theories	Comments
Technology Adoption Theories	Theory of Reasoned Action (TRA)	The focus is on technology-related factors.
	Theory of Planned Behaviour (TPB)	
	Technology Acceptance Model (TAM)	
	Unified Theory of Acceptance and Use of Technology (UTAUT)	
	Task Technology Fit (TTF)	
Social Theories	Activity Theory (AT)	Examine both personal and collectively created perceptions of reality and subjectively interpret observed human actions in connection with shared understandings, context, and historical factors.
	Diffusion of Innovation (DIT)	
	Technological Pedagogical Content Knowledge (TPACK)	
	Actor-Network Theory (ANT)	
	Pedagogical Beliefs-Technology (PBT)	
Structuration Theories	Structuration Theory (ST)	Aim to transcend the simplistic and linear model approach to elucidate the inherent intricacies within all social environments.
	Adaptive Structuration Theory (AST)	
	Strong Structuration Theory (SST)	
Educational Technology Models	Hierarchical Model of Technology Adoption (HMTA)	Offer a framework and organisation through which we can elucidate the various aspects of the process of integrating technology. Illustrate the levels at which teachers incorporate technology and the methods and tasks through which they apply technology.
	Apple Classroom of Tomorrow (ACT)	
	Substitution Augmentation Modification and Redefinition (SAMR)	

The TPACK model (Mishra & Koehler, 2006) and the SAMR model (Puentedura, 2009) stand out as the two most prominent models within the realm of educational technology. TPACK is primarily concerned with teachers' understanding of how to adeptly incorporate technology into teaching, while SAMR offers a framework for teachers to transform the learning process by harnessing ICT in innovative ways that extend beyond conventional methods (Lie et al., 2020).

2.7.3.1 TPACK

The TPACK (Technological Pedagogical Content Knowledge) framework (Mishra & Koehler, 2006) outlines the various forms of knowledge that teachers need to successfully integrate technology into their teaching practices. The most well-known aspect of this framework is its TPACK diagram, which illustrates three interconnected circles representing Technological Knowledge (TK), Pedagogical Knowledge (PK), and Content Knowledge (CK), all enclosed within an outer dashed circle representing the context.

This well-established TPACK framework has been recently enhanced by introducing a fourth knowledge domain, with the outer dotted circle now labelled Contextual Knowledge (XK). As depicted in Figure 2.7 (Mishra, 2019), Contextual Knowledge pertains to a teacher's understanding and awareness of available technology as well as the broader context within which they operate, such as the school, district, provincial, or national level.

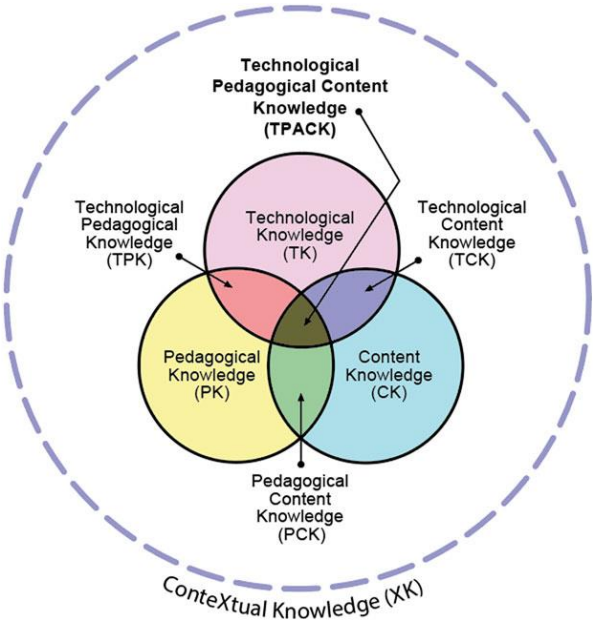


Figure 2.7: Revised version of the TPACK image (Mishra, 2019)

The adapted framework highlights the critical importance of organisational, situational, and broader contextual constraints. The success of teachers' ICT integration efforts depends not as much on their technological, pedagogical, and content knowledge, but rather on their knowledge of the context (Mishra, 2019).

2.7.3.2 SAMR

The SAMR (Substitution, Augmentation, Modification, and Redefinition) model (Figure 2.8) is a tool to describe and categorise teachers' use of educational technology (Puentedura, 2009). Compared to TPACK, the SAMR model is a relatively recent addition to research into teachers' appropriation of educational technology (Hamilton et al., 2016).

The SAMR model (Puentedura, 2013) categorises teachers' ICT integration into four levels:

- Substitution – Replacing traditional materials with digital equivalents, such as using digital handouts instead of printed ones.
- Augmentation – Enhancing teaching by incorporating technology, such as using video demonstrations instead of textual representations for certain topics.
- Modification – Going beyond augmentation by integrating computer simulations to facilitate specific conversations, as opposed to using digital or printed representations.

- Redefinition – The highest level, where technology enables students to create their interactive simulations to model phenomena, rather than relying on pre-existing simulations.

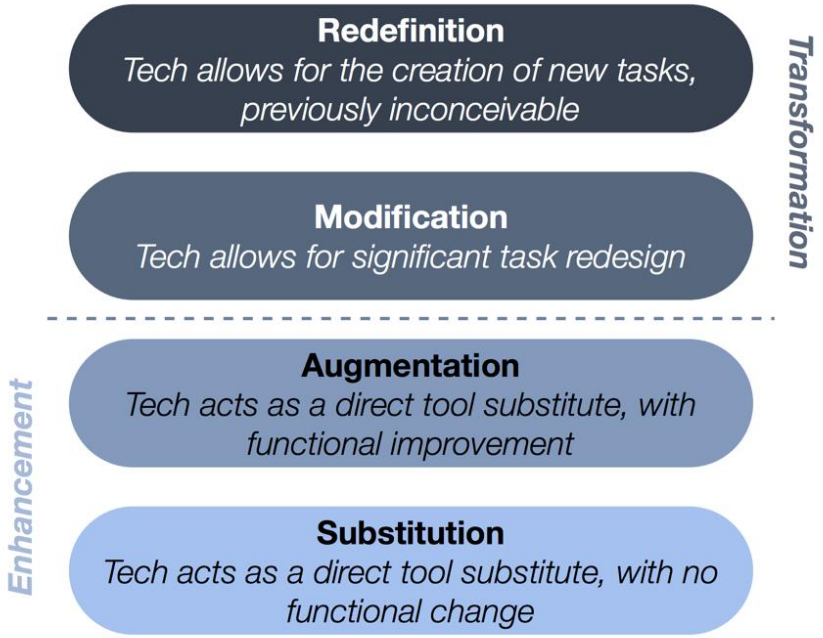


Figure 2.8: Substitution, Augmentation, Modification, and Redefinition (SAMR) model (Puentedura,2009)

Even though the SAMR model is gaining increasing recognition, there is a shortage of comprehensive guidance on how to understand and implement this model effectively (Hamilton et al., 2016).

2.7.3.3 Summary of TPACK and SAMR

The TPACK and SAMR models hold pivotal significance in the field of education, furnishing teachers with valuable insights for adeptly merging technology into their teaching approaches and reshaping the learning journey for learners. As outlined in Table 2.7, these two models are widely acknowledged and recommended for their exceptional capacity to support teachers in the endeavour of integrating technology into their teaching practices (Kihoza et al., 2016; Cherner & Mitchell, 2021).

Table 2.7: Summary of TPACK and SAMR (Tunjera, 2019)

	TPACK The knowledge required by teachers for using technology in teaching.	**SAMR** A framework for assessing how teachers use technology in teaching.	**TPACK & SAMR affordances** Technology integration systems.
Focus	Emphasises the integration of technology into teaching practices.	Categorises the levels of technology integration in education, ranging from basic substitution to transformative redefinition of teaching and learning.	Enhancing the integration of technology in education
Underlying assumption	Effective teaching involves a combination of technological knowledge, pedagogical skills, and content knowledge.	Technology can be used to progressively enhance and transform educational practices.	Technology can be leveraged to enhance teaching and learning
Theoretical links	Behaviourist	Constructivist	Grounded in educational theory
Target	Teachers	Learning activities	Teachers and instructional designers
Tool	For planning technology integration	For planning learning activities	To assess and enhance technology integration in teaching practices
Contributes to	Teacher competencies for effective teaching	Encouraging teachers to move from lower-level substitutions to higher-level transformations of teaching and learning.	Guide teachers to use technology more effectively, leading to increased engagement, innovation, and improved educational outcomes
Benefits	Helps teachers make better use of technology for teaching and learning	Helps teachers make informed decisions about how to use technology effectively, leading to innovation in teaching and learning.	Improved teaching practices, better alignment of technology with learning objectives, increased student engagement, and enhanced collaboration and innovation
Drawbacks	The framework may require additional training for teachers to fully understand and implement, and some teachers may find it challenging to integrate all elements effectively into their teaching practices.	May be seen as somewhat linear and prescriptive, and there is some debate over its practicality and application in real-world educational settings.	Challenging to implement fully

Given the unprecedented nature of the COVID-19 pandemic, which differs significantly from recent historical events, locating previous research studies with similar contexts has posed a considerable challenge. Nonetheless, concerning the amalgamation of the TPACK and SAMR models, the literature review did identify the following recent studies:

- an investigation of the ICT readiness of teacher trainees (Kihoza et al., 2016)
- a study of how language teachers adopt technology (Alivi, 2019)
- a case study on pre-service teachers (Tunjera, 2019)
- research into the extent of the teachers' online engagement during the pandemic (Lie et al., 2023).

2.7.4 ConTIS model

While the aforementioned technology integration models offer a foundational understanding of the process, the field of educational technology calls for more explicit models that prioritise technology integration as a means to an end and place learners at the forefront (Kimmons et al., 2020; Schad et al., 2021).

To address this need, the present study will also adopt the Constructivist Technological Instructional Strategies (ConTIS) model (Tunjera, 2019), incorporating the SAMR and TPACK constructs, as its theoretical foundation. As depicted in Table 2.8, the ConTIS model functions as a self-assessment tool, enabling teachers to assess their current level of technology integration in teaching and plot a course toward more advanced stages of technology incorporation.

.

Table 2.8: The Constructivist Technological Instructional Strategies model (Tunjera, 2019)

	TK Knowledge of technology and what it can do for teaching and learning	**TPK** Knowledge of technology that enriches teaching	**TCK** Knowledge of content specific technology that supports constructive content delivery	**TPACK** Knowledge of technology, what it can do and how to use it to teach specific content	
Redefine	Teacher's knowledge of technology that creates innovative ideas to teaching and learning	Teacher's knowledge of technology that produces innovative constructivist teaching and learning methods	Teachers knowledge of content specific technology that reconceptualises learners' comprehension of learning concepts	Teachers' knowledge to design innovative and appropriate 21st century activities that transform content learning	Supports student-centered strategies Transforms instruction
Modify	Teacher's knowledge of technology that goes beyond traditional linear teaching into flexible learning	Teacher's knowledge of technology affordances that offer effective ways to reach diverse learners	Teacher's knowledge of content-specific technology that can help accomplish content / concept understanding	Teacher designs appropriate teaching activities supported with technology resulting in constructivist enriched quality and relevance for deeper content learning	
Augment	Teacher's knowledge of what technology can do to assist in captivating learning activities that result in improved engagement	Teacher's knowledge of how technology works to complement strategies in achieving stimulating learning activities	Teacher's knowledge of content-specific technology that can be used to support illustrative content delivery	Teacher's knowledge of complementary technology and teaching strategies that ease comprehension of concepts in a teaching and learning activity	Supports teacher-centered strategies Enhances instruction
Substitute	Teacher's basic technology knowledge for convenient use	Teacher uses basic technology knowledge to support traditional teaching methods	Teacher's fundamental knowledge of content-specific technology that enhances proficiency	Teacher's basic technology knowledge that complements teaching strategy in facilitating content presentation	

The ConTIS model is a relatively recent addition to the educational technology field and remains largely unexplored and undocumented in research. Although this model was formulated based on a thorough review of existing literature, there is still a requirement for empirical scrutiny to assess its practical efficacy (Tunjera, 2019). The present study seeks to subject the ConTIS model to examination, evaluating its real-world effectiveness within a different context.

2.8 Theoretical and conceptual framework

To explore how teachers accessed and used ICT during the COVID-19 pandemic, a hybrid rubric was developed for this study, incorporating elements from the ConTIS model. The theoretical and conceptual framework for this research was constructed by plotting the underpinning theories of technology integration, namely TPACK (specifically Technological Pedagogical Knowledge) and SAMR, and the research questions on the axes of the rubric.

The theoretical and conceptual framework is illustrated in Figure 2.9.

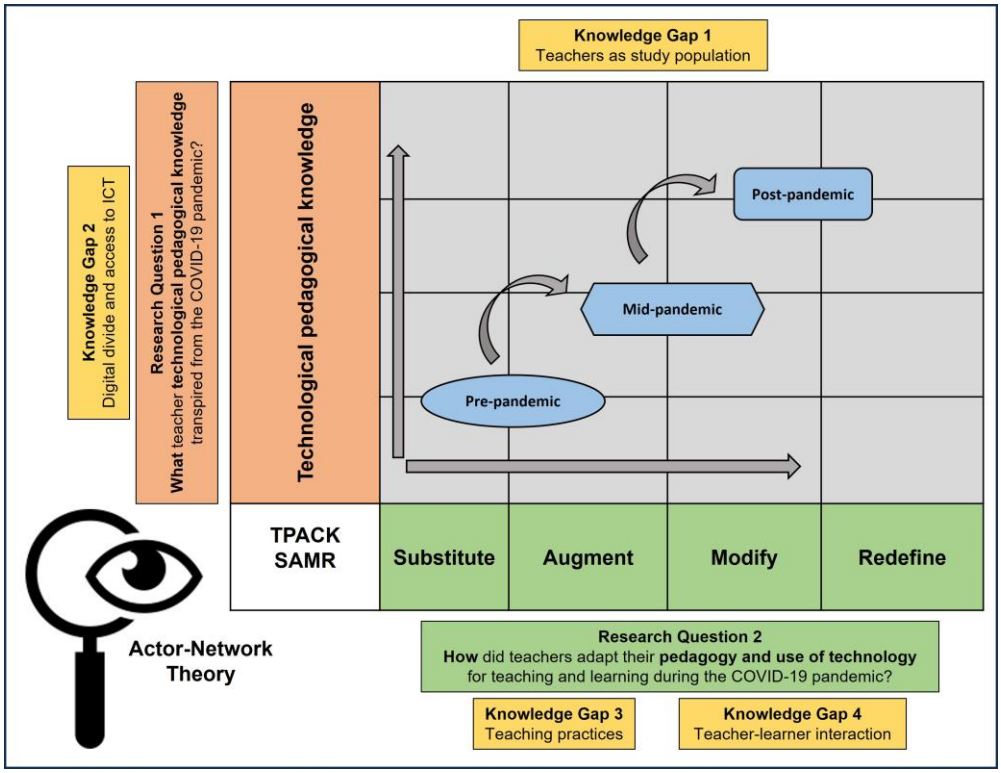


Figure 2.9: Theoretical and conceptual framework (Author's construct)

The theoretical and conceptual framework, not only graphically illustrates key factors, constructs or variables of the study and the relationships between them, but also:

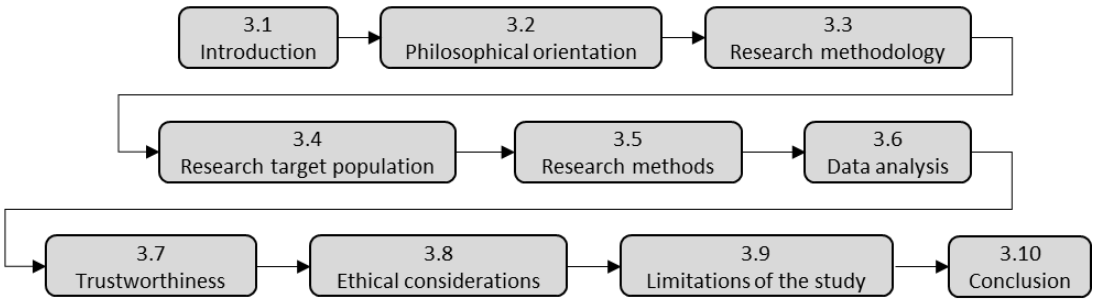
- establishes the boundaries within which to explore the phenomenon being studied;
- assists in organising the questions employed for data gathering; and
- provides the backdrop against which the collected data can be comprehended and interpreted.

2.9 Conclusion

Utilising the insights gathered from various sources, the literature review serves as a crucial guide for future research, policy formulation, and practical implementation. In the scope of this review, it is apparent that the global impact of the COVID-19 pandemic has sparked increased attention from researchers, leading to numerous studies on the use of ICT to support remote teaching and learning during crises. The objective of this review is to connect the fields of education and technology, with the expectation of providing valuable insights to researchers, policymakers, and educational practitioners in future emergencies necessitating ERT.

The next chapter outlines the philosophical and methodological framework that guided the research.

CHAPTER 3
RESEARCH DESIGN AND METHODOLOGY



Structure of Chapter Three

In educational technology research, the design and methodology are the compass and map, guiding us through uncharted digital landscapes to discover innovative learning horizons.

3.1 Introduction

Chapter 3 begins by describing the overall research approach, including the foundational philosophical principles that influenced the study. This sets the stage for understanding how data is interpreted, and knowledge is derived.

The study used a qualitative phenomenological design to explore teachers' access to ICT and technology practices during the COVID-19 pandemic. The interpretivist, posthumanist stance allowed the researcher to explore the subjective experiences and interpretations of the participants. The research adopted an inductive approach to derive meaning from the gathered data, uncovering patterns and connections.

The selection of participants used targeted purposive sampling, choosing individuals who aligned with the research objectives. The study primarily employed an online survey to reach a diverse audience, supplemented by a focus group interview for data triangulation. The data was organized and analysed using Atlas.ti.

The chapter also addresses strategies to mitigate biases, manage limitations, and enhance research validity and reliability. Ethical considerations are prominently featured, covering informed consent, confidentiality, data protection, and potential conflicts of interest.

3.2 Philosophical orientation

The research employed a phenomenological approach guided by an interpretivist and posthumanist philosophical framework to explore the interplay between access to ICT and teachers' technology practices. A phenomenological approach was selected because it allows for an in-depth understanding of the phenomenon by delving into the firsthand experiences and perceptions of a specific group of knowledgeable participants (Pietkiewicz & Smith, 2012).

Within this study, an interpretivist paradigm was used to explore and elucidate the participants' subjectively lived experiences and personal interpretations of the phenomenon (Cohen et al., 2007). The choice of an interpretivist paradigm was further influenced by the research context, utilization of theory, and the researcher's worldview and role, as detailed in Table 3.1.

Ontologically, the study subscribes to the notion that reality is subjective, multifaceted, and socially constructed. This approach acknowledges that individuals have their own thoughts, interpretations, and meanings, shaping their unique realities. Consequently, the study employed research methods and techniques within the interpretive framework to explore and interpret participants' feelings and inner thoughts.

Epistemologically, interpretivism posits that knowledge is constructed through interaction and communication among individuals and rejects the idea that objective knowledge exists independently of human perspectives (Nguyen, 2015; Ryan, 2018). It emphasises that meaning is not something to be discovered but rather something constructed, and there is no single valid interpretation. This study, therefore, encourages multiple interpretations.

Regarding axiology, this research acknowledges the inherent value-laden nature of the study. It recognises that the researcher is an integral part of the research process and that their worldview and values can potentially influence the research findings.

Table 3.1: Alignment of interpretivist paradigm with current study (Aliyu et al., 2015; Neuman, 2017)

Interpretivist Research Paradigm		
Perspectives	**Beliefs**	**Current study**
Ontological	• The world is intricate and ever-changing, and individuals perceive and construe it through their interactions with one another. • Reality is subject to varying interpretations and can only be understood imperfectly.	This study seeks to achieve the following objectives: • Develop a comprehensive comprehension of the intricacies in teachers' practices of integrating technology. • Uncover the inherent connections within the social context under examination. • Comprehend and delineate the subjective perspectives of teachers regarding technology integration.
Epistemological	• Understanding is shaped by what can be seen, individual beliefs, values, and interpretations. • Research is influenced by contributors and examined and validated by external parties.	This study: • Uses the ConTIS framework to enable a fresh approach to comprehending the particular context. • Recognises the pivotal role of teachers in technology integration efforts. • Respects the subjective viewpoints of teachers. • Seeks to understand the subjective social significances shaped by teachers.
Axiological	• The researcher actively contributes to the construction of meaning and incorporates their own subjective experience into the research. • Values form an essential component of societal existence. • Surveys and interviews are employed to capture the knowledge held by individuals intimately familiar with the subject.	• The researcher will personally collect and analyse the data. • The interpretation will be influenced by the researcher's own knowledge, background, values, and experiences. • The phenomenon will be examined with both an exploratory and explanatory perspective. • The research primarily adopts a qualitative approach.

In this study, a posthumanist philosophical perspective (Blaikie et al., 2020) was considered appropriate because it recognises interconnectedness and provides fresh perspectives on the concept of humans, encompassing teachers and learners, as not inherently exceptional but rather intertwined with other entities and technology.

3.3 Research methodology

The choice of a research methodology was primarily guided by the objectives and research inquiries of this study. This research employed qualitative research methods that are in harmony with the interpretivist paradigm and are well-suited for investigating human or social activities as they naturally unfold in the real world (Creswell, 2007).

3.3.1 Research design

This study used a qualitative approach to explore the WHAT and HOW of access to ICT and technology-mediated teaching practices amid the COVID-19 pandemic. A qualitative research methodology enabled the researcher to gain a thorough and in-depth comprehension of a complex phenomenon by uncovering concealed experiences within a specific social context (Merriam, 1998; Denzin & Lincoln, 2011). It is important to note that qualitative findings are not easily generalisable due to the absence of statistical analysis (Hammersley 2013); therefore, this study aims to uncover recurring patterns instead.

3.3.2 Inductive approach

The study applied an inductive methodology to delve into the real-life experiences of teachers regarding the subject of investigation (Maxwell, 2008). The inductive approach entails gathering pertinent data related to the research topic and subsequently taking a holistic perspective on the collected information. The researcher uses inductive reasoning to derive insights from the dataset, identifying recurring patterns within those observations and formulating explanations for these patterns. In essence, the researcher progresses from data to theory, or from specific instances to broader generalisations.

3.4 Research target population

This study explored the dynamics of access to ICT and technology practices of secondary school teachers.

3.4.1 Sampling method

The researcher applied purposive sampling, a form of non-probability sampling. This technique allowed the researcher to choose participants who best suited the objectives of the research (Saunders et al., 2003; Korstjens, & Moser, 2018; Taherdoost, 2018).

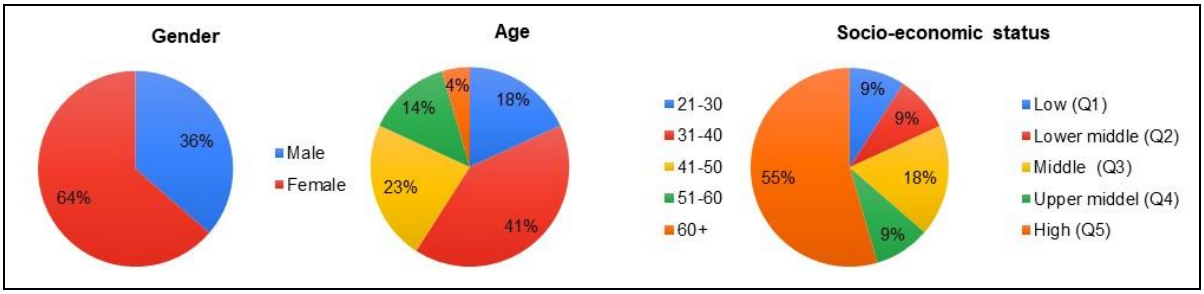
The selection of sampling methods was driven by the study's requirement to gather comprehensive data regarding the phenomenon under investigation. The research focused on technology-mediated teaching practices, with the individual teacher as the primary unit of analysis. The adoption of purposive sampling was instrumental in enhancing the research study, as it enabled the selection of participants who could provide firsthand insights based on their direct experience with technology-mediated teaching. Consequently, this approach bolstered the credibility and reliability of the data collection and subsequent analysis.

3.4.2 Participant selection

Online questionnaire participants

The participants were identified in consultation with the principals of the participating schools. An email request for participation was sent to principals of private and government secondary schools in the Western Cape Province. Seven principals of government schools confirmed participation in the study and provided the contact details of appropriate participants. Invitations, explaining the purpose of the research and the estimated amount of time the questionnaire would take, were sent to the potential participants by email.

The online questionnaire was completed by 22 teachers, encompassing diversity in terms of gender, age, years of experience, and socio-economic status of the schools (Figure 3.1). The small sample size was not a matter of concern because, in cases of similar participant characteristics, a sample ranging from 4 to 12 individuals is typically considered sufficient, while a sample of 12 to 30 is appropriate for populations with more heterogeneity (Creswell & Creswell, 2018). This demonstrates the potential to gather diverse perspectives on the subject of study even when working with a relatively small group of participants.



The quintile system in South African public schools classifies schools into five groups, from the poorest (Quintile 1) to the least poor (Quintile 5).

Figure 3.1: Respondent demographics

Focus group interview participants

Invitations for participation in the FGI were extended to all participants at the Learning LandSCAPE 2022 Symposium. As the symposium was primarily attended by representatives of the tertiary education sector, only two secondary school teachers agreed to participate in the FGI. The demographics of the participants are summarised in Table 3.2.

Table 3.2: Demographics of FGI participants

Type of school	Geographical context	Socio-economic status	Province
Private	Rural	Middle (Q3)	Northern Cape
Public	Rural	Low (Q1)	North West

3.5 Research methods

The methods and instruments used to solicit data from the participants are set out in Table 3.3.

Table 3.3: Research questions

Research Questions	Objectives	Instruments
What teacher technological pedagogical knowledge transpired from the COVID-19 pandemic?	To reveal the 'what' of teachers' 'teaching with technology' knowledge ➢ by exploring the influence of the COVID-19 pandemic on the technological and pedagogical knowledge of teachers.	Secondary literature review Individual online questionnaire Focus group interview
How did teachers adapt their use of technology for teaching and learning during the COVID-19 pandemic?	To clarify the 'how' of innovative technology practices used by teachers ➢ by exploring the extent to which teachers substitute, augment, modify, or redefine their existing practices using available technology.	

3.5.1 Online questionnaire

In this study, a survey methodology was employed to explore the technology practices of secondary school teachers who transitioned from traditional classroom settings to online remote teaching during the COVID-19 pandemic. An online questionnaire (Appendix C) was chosen as the most suitable instrument due to its ability to easily reach a widely dispersed target audience (Alahmari & Kyei-Blankson, 2016).

The questionnaire was generated using Google Forms, an online tool equipped with an integrated database for storing respondents' answers and offering fundamental analytical functionalities. The questionnaire's inquiries were crafted to align with the conceptual framework of the research study. To ensure the clarity and comprehensibility of the questions, a preliminary version of the questionnaire was shared and deliberated with fellow postgraduate peers. It is imperative to clarify that this process did not constitute a pilot study, and no data collection or analysis occurred during this stage (Ryan et al., 2014).

The opening page of the questionnaire included an informative document providing a pertinent overview of the study, outlining the research methodology and ethical considerations, and supplying the researcher's contact details. Participants received assurances that the data gathered would be exclusively employed for the specified research investigation. The questionnaire also featured a consent statement and guaranteed the preservation of respondents' anonymity. Furthermore, survey participants had the option to terminate their participation at any juncture, and their consent for engagement was confirmed on the final submission page of the questionnaire.

The questionnaire consisted of the following five sections:

Section A: Personal and school was an introductory section in which respondents rated their access to and proficiency in using ICT.

Section B: Emergency remote teaching (ERT) focused on the participants' experience of digital remote teaching during the crisis.

Section C: Technological pedagogical knowledge explored the respondents' understanding of how ICT can be used in teaching practices.

Section D: Use of information technology explored how participating teachers use ICT in their teaching practices.

Section E: Demographic information of respondents and schools.

The questionnaire included six questions related to participant demographics, twelve open-ended questions, ten items using a Likert scale, one question allowing for multiple responses, and three multiple-choice questions. The Likert-scale items used a 4-point scale, ranging from 0 (Low) to 3 (High).

3.5.2 Focus group interview

The researcher also used a focus group interview (FGI), a data-gathering technique commonly employed in qualitative research, to delve deeper into, expand upon, and cross-verify the information gathered from the online questionnaire. This was achieved by adopting a semi-structured approach within an interactive interview setting that encouraged participants to openly share their thoughts while maintaining a focus on the pertinent topics (Ryan et al., 2014). This dynamic social exchange facilitated a more profound and comprehensive comprehension of the teaching practices as observed and interpreted by the teachers (Eatough & Smith, 2007).

The FGI was held via Zoom and was recorded. The recordings were transcribed for data analysis purposes. The following questions were posed to participants during the FGI:

- How did you experience the swift transition to ERT?
- How did you manage and experience teacher-learner interaction?
- How did COVID-19 impact your technological pedagogical knowledge?
- How did you adapt your teaching practices?
- How will you be integrating information technology in your teaching practices in future?

The next section offers a summary of how the researcher organised, analysed, and detected patterns in the data based on the research questions.

3.6 Data analysis

Data analysis is an indispensable yet time-intensive process that brings order, structure, and significance to the gathered data (Biggerstaff & Thompson, 2008). To accomplish this, the researcher employed the qualitative research tool Atlas.ti to collate, categorise, scrutinise, and archive the data materials, online questionnaire and FGI responses, within a single repository.

Precisely defining the units of research and analysis in this study is paramount, as it delineates the extent of data analysis and sets the parameters for organising and interpreting the data (Clarke, 2013). The researcher established categories (referred to as codes) based on the research questions and the conceptual framework to provide a framework for analysing the online questionnaire responses. These codes were subsequently employed to query the data, detect patterns, and visually depict the concepts that emerged from the data, thereby assigning its significance.

The data analysis process for the focus group interviews encompassed the following steps:

- Verbatim transcription of the interviews.
- Repeated reading and re-reading of the transcripts.
- Initial notetaking.
- Identification and development of emerging themes.
- Exploration of connections among these emerging themes.
- Interpretation of the data.
- To ensure anonymity, the transcribed recordings had any personal names or location references removed.

The interviews, which were recorded, underwent transcription using verbatim transcription techniques, aided by available software. This transcription process presented the researcher with an opportunity for in-depth engagement with the data, involving the act of listening to the audio recordings and revisiting them. During this process, while reviewing the audio recordings and transcripts, the researcher summarised key points before moving on to the coding phase (Jori, 2014; Callary et al., 2015).

The Atlas.ti computer software was employed for analysing the online questionnaire and FGI data, simplifying various tasks such as selecting text, applying codes, making annotations, and comparing significant segments of text. Within the Atlas.ti software, the researcher established codes, collected pertinent quotes, and maintained memos to document the nature and source of emerging interpretations.

This method allowed for a meticulous examination and annotation of insights into participants' experiences and perspectives. It also involved the inclusion of descriptive comments and memos. The responses of each participant were scrutinized meticulously, examining each word and sentence, to attain a comprehensive understanding of the overt and covert messages conveyed by the participants (Eatough & Smith, 2007).

The next section details actions taken by the researcher to maintain the trustworthiness and usefulness of the data.

3.7 Trustworthiness

The researcher is a dynamic and active part of the qualitative research process and can potentially impact the study's outcomes. To ensure the trustworthiness of the findings, encompassing their credibility, transferability, confirmability, and dependability, the researcher engaged in reflexivity.

The researcher consistently questioned personal assumptions, judgments, practices, and belief systems that might influence the research throughout the data collection and analysis phases. Additionally, the researcher employed appropriate data collection, analysis, and reporting tools and methodologies (Creswell & Miller, 2000; Flyvberg, 2006; Leung, 2015).

3.7.1 Credibility

The researcher established data credibility by deeply immersing himself in the subjects under observation and analysis, aiming to gain a profound understanding of the phenomena. This method aided the researcher in comprehending and elucidating the phenomenon, ensuring an accurate and faithful representation of the data (Korstjens & Moser, 2018)

3.7.2 Positionality and Bias

The researcher, with over two decades of experience in the field of educational technology, was acutely aware of his positionality and took deliberate measures to mitigate any potential bias or subjectivity when examining the phenomenon (Jackson, 2013). Within an interpretive framework, the researcher plays a pivotal role in the study, serving as one of the research instruments responsible for interpreting the data (Merriam, 2002). Given that personal beliefs, attitudes, and the researcher's comprehension could introduce subjectivity, precautions were taken. To address this, the researcher engaged peers and other researchers to conduct verification and credibility checks.

3.7.3 Confirmability

The researcher validated assertions by supporting them with evidence obtained from the collected data. Additionally, these claims were bolstered by establishing clear connections between theoretical frameworks, existing literature, and the interpretation and explanation of the data or findings.

3.7.4 Dependability

The researcher justified the choice of research methodology, data collection procedures, and instruments by elucidating how each of these components contributed to the study. This transparency allows other researchers to potentially replicate data collection in comparable conditions or contexts.

3.7.5 Transferability

The researcher furnished a precise and comprehensive explanation of the extent of this qualitative study, making sure that it can be readily understood for its pertinence and adaptability across different settings (Given & Saumure, 2008).

3.7.6 Peer review

During the research journey, the researcher actively solicited input from other postgraduate students, faculty members, and the supervisor, all of whom offered valuable feedback on both the research process and its substance. These insightful viewpoints were instrumental in subjecting the study to a thorough evaluation and ensuring its thoroughness (Korstjens & Moser, 2018).

3.8 Ethical considerations

The researcher meticulously followed established ethical principles to govern his conduct and address the inherent challenges associated with qualitative research (Maxwell, 2013). Ethical clearance for this study was secured from the Faculty of Informatics and Design Research Ethics Committee of the Cape Peninsula University of Technology (CPUT). Furthermore, formal permission was obtained from the Western Cape Education Department (WCED) to include the intended participants in the study.

Informed consent was obtained from the school principals and teachers who willingly agreed to participate. The questionnaire explained the study's objectives and scope, ensuring that participants were fully aware of their rights as autonomous individuals to make a voluntary choice to participate or decline (Anney, 2014). Participants confirmed their willingness to engage in the study before submitting their responses. Throughout the reporting of findings, the confidentiality, privacy, and anonymity of the schools and teachers were rigorously preserved by using pseudonyms instead of actual names.

Upholding human dignity and protecting intellectual property were of paramount importance in this research. The study exhibited a strong sense of social responsibility by safeguarding the rights and well-being of all participants and institutions, ensuring that no harm, whether in terms of their reputation or any other aspect, befell them.

Ethical standards were followed to prevent any form of data fabrication or falsification, with the primary goal of advancing knowledge and uncovering the truth, which lies at the core of all research endeavours (Bulmer, 2008). The researcher maintained a commitment to integrity and objectivity, consistently avoiding bias throughout the research process, spanning experimental design, data analysis, data interpretation, and data reporting.

Additionally, the utmost care was exercised to prevent negligence and inadvertent errors. To further enhance the security of the raw data, which encompassed notes, recordings, and transcriptions, these materials were stored in password-protected folders, ensuring that exclusive access was granted solely to the researcher (Eynden & Brett, 2010).

3.9 Limitations of the study

In qualitative interpretive studies, the primary objective is to attain a thorough understanding of a phenomenon. While the focus is not on generalising the findings, it is crucial to acknowledge the aspects of the research design or methodology that can impact the interpretation of the results (Lynch, 2013).

This research delves deeply into the complexities surrounding ICT access and technology-mediated teaching practices during the COVID-19 pandemic. It is important to note that the study's focus, which specifically targets secondary school teachers, may have limitations when it comes to its applicability to other contexts. Nevertheless, the study can serve as a foundational basis for generating hypotheses. Consequently, researchers exploring similar phenomena and contexts might find the study's findings valuable and could use them as a starting point for future investigations.

It is worth noting that purposive samples are not intended to represent the entire population. The relatively small sample size of 22 teachers from mainly well-resourced schools in the Western Cape might not be considered representative of the broader population of teachers. Nevertheless, this sample encompassed diversity in gender, age, teaching experience, and the socio-economic backgrounds of the schools, thereby enhancing the richness of the study's findings.

Furthermore, the research was conducted within a relatively brief timeframe, which may restrict the capacity to draw inferences about potential changes over an extended period. As a result, the findings may not offer a wholly precise portrayal of the larger population.

3.10 Conclusion

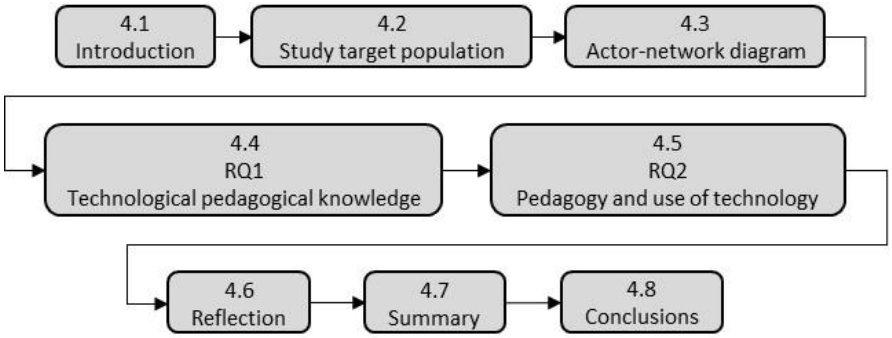
The study was underpinned by an interpretivist philosophy and employed a qualitative research design to explore the lived experiences of secondary school teachers during the COVID-19 pandemic. The researcher applied inductive reasoning to generate meanings from the data set collected to search for causal patterns from those observations and develop explanations for those patterns.

The unit of research was teaching practices that involve the use of ICT, and the unit of analysis was the actions and opinions of individual teachers. Purposive sampling enabled the researcher to carefully select specific participants known for their use of educational technology and their potential to offer valuable and dependable data.

The study was confined to practising secondary school teachers. Data was collected through an online questionnaire, focus group interview, and literature searches. The data was subjected to content analysis. Chapter 4 presents the data and findings of the study.

CHAPTER 4

DISCUSSION OF FINDINGS



Structure of Chapter Four

Discussing findings in educational technology research is where data transforms into insights, shaping the future of digital learning.

4.1 Introduction

This chapter serves as the culmination of the empirical inquiry carried out to address the research aim and objectives of the study. To begin, the chapter restates the two research questions, underlining their importance and their connection to the four knowledge gaps identified in Chapter 2. This lays the foundation for comprehending how the forthcoming findings offer a novel contribution to the current body of knowledge in the field.

RQ1: What teacher technological pedagogical knowledge transpired from the COVID-19 pandemic?

- Knowledge gap 1: Teachers as study population
- Knowledge gap 2: Digital divide and access to ICT

RQ2: How did teachers adapt their use of technology for teaching and learning during the COVID-19 pandemic?

- Knowledge gap 3: Teaching practices
- Knowledge gap 4: Teacher-learner interaction

The interpretation and presentation of the findings are grounded in the theoretical and conceptual framework established in Chapter 2 and guided by the research design established in Chapter 3. The data is systematically organised to unveil patterns, relationships, and novel insights. Visual aids are employed as tools for conveying complex information succinctly and facilitating the readers' comprehension of the research outcomes.

By drawing connections between the research findings and relevant theoretical concepts, this chapter contributes to the ongoing dialogue within the academic field, paving the way for further research and discussion.

4.2 Study target population

The study population was informed by Knowledge Gap 1, namely a paucity of systematic reviews on school education during emergencies.

Knowledge Gap 1: Teachers as study population.

This study addressed this gap by exploring the technology practices of secondary school teachers during the COVID-19 pandemic. The investigative questions, the interpretation and the discussion of the findings are grounded in and guided by the theoretical and conceptual framework as illustrated in Figure 4.1.

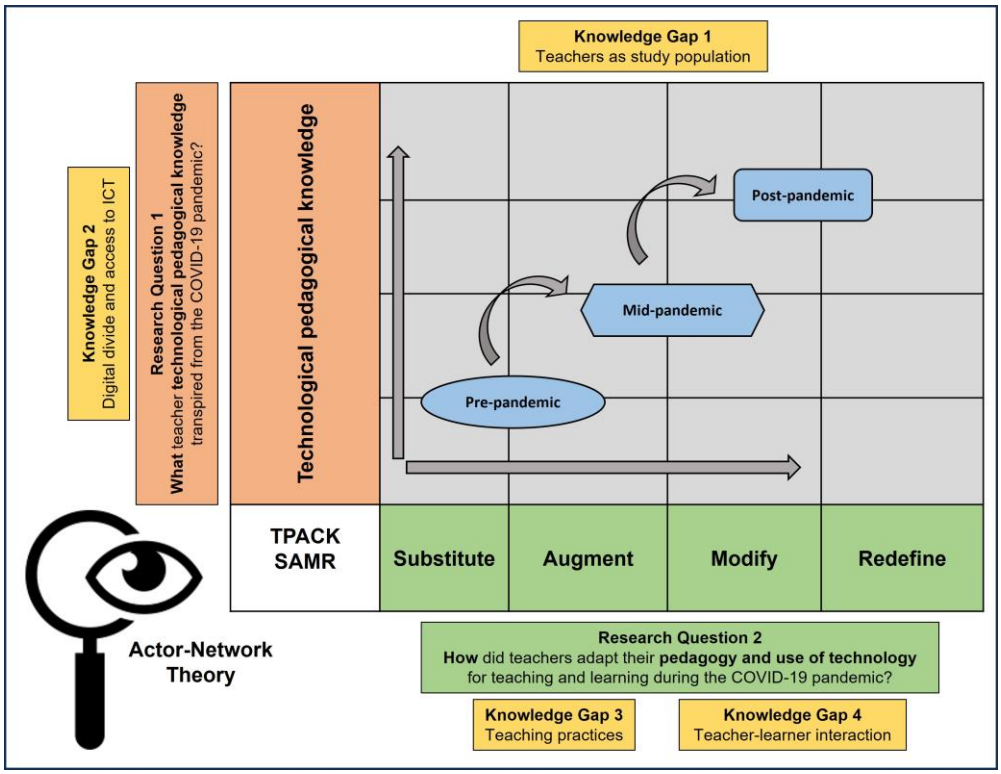


Figure 4.1: Theoretical and conceptual framework (Author's construct)

4.3 Actor-network diagram

Many stakeholders in the education sector believed that the COVID-19 pandemic would trigger large-scale educational technology innovation. Various inter-related factors, however, promoted, or hindered teachers' appropriation of ICT.

As indicated in Chapter 2, this study applied Actor-Network Theory (ANT) as a theoretical lens to explore the complex relationships between human and non-human actors and how they shaped the technology practices of teachers. While ANT offers a unique perspective on the interplay between human and non-human elements in social processes, it can be complex and challenging to apply. The following steps (Table 4.1) were followed in applying ANT to this study.

Table 4.1: Steps in applying Actor-Network Theory (Author's construct)

1. Data collection and mapping	
• Collect data relevant to your research question to understand teachers' experiences with technology-mediated interaction during the crisis. • Create a diagram that identifies the different actors in the network.	
2. Identify actors	
Recognise both human and non-human actors.	
3. Tracing associations	
Identify the relationships and interactions between human and non-human actors.	
4. Analyse actor agency	
Analyse the power dynamics and influence each actor exerts in shaping the network and its outcomes.	
5. Consider translation	
Explore how actors negotiate and align their interests through translation processes to ensure effective technology-mediated interactions.	
6. Interpret the network	
• Look for patterns, power dynamics, and instances of agency and translation in technology-mediated interactions between teachers and learners. • Look for common challenges, successful strategies, and any disparities in access and engagement.	
7. Report	
Introduction	Introduce the research topic and context, explain the significance of studying technology-mediated interactions during a crisis, and outline the application of Actor-Network Theory in the study.
Methodology	Describe the data collection methods and how the actors were identified and mapped in the network.
Findings	Present the network diagram illustrating the technology-mediated interactions between teachers and learners. Discuss the agency of different actors and how they influence the patterns of interactions during the crisis.
Analysis	Interpret the data using ANT concepts, such as translation and power dynamics. Discuss how technological affordances and constraints impacted the interactions.
Conclusion	Summarize the main findings, highlighting the key patterns and challenges in technology-mediated interactions between teachers and learners during the crisis. Discuss the implications for education policies and practices in times of crisis and propose future research directions in this area.

The analysis, interpretation, and reporting of the findings were guided by the Actor-Network Diagram as illustrated in Figure 4.2. The diagram was designed to identify the main actors in the network (Table 4.2), trace how each actor is linked to other actors, and illustrate the relationships and interactions between the human and non-human actors.

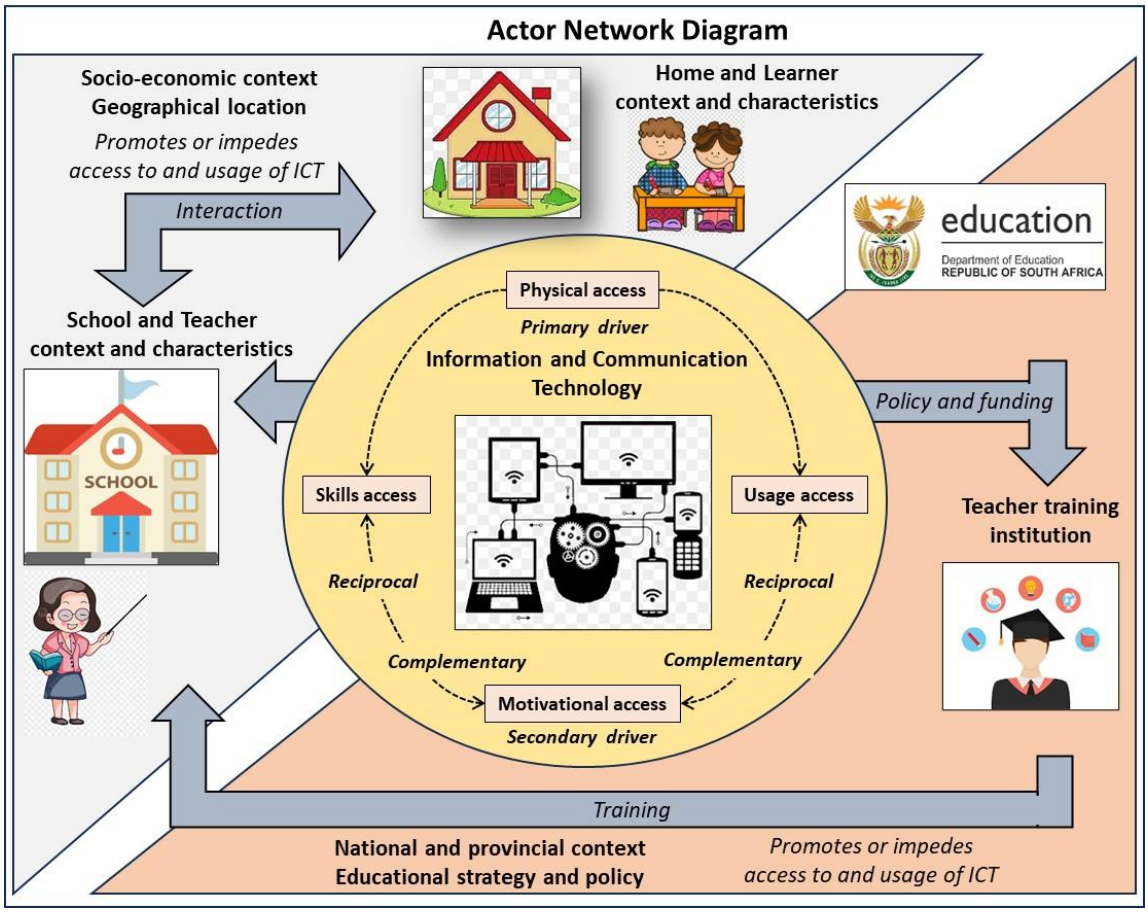


Figure 4.2: Actor-network diagram
(Author's construct)

Table 4.2: Actors in the network

Human actors	Non-human actors
School management Technical support staff Teachers	School environment
Parents Learners	Home environment
	Education department Teacher training institutions Information and Communication Technology Socio-economic context Geographical location

4.4 RQ1: Technological pedagogical knowledge

Research Question 1 explores the impact of the pandemic on the technological pedagogical knowledge of teachers. This topic is explored by investigating access to ICT with a specific focus on teachers' acquisition of digital skills and competencies to effectively use ICT in their teaching practices.

RQ1: What teacher technological pedagogical knowledge transpired from the COVID-19 pandemic?

4.4.1 Access to ICT

The literature review highlighted the pressing requirement to enhance ICT access for efficient teaching and learning. The research addresses Knowledge Gap 2, which pertains to the digital divide and ICT accessibility, by exploring the idea of access as a process of appropriation of ICT with the purpose of actual usage.

Knowledge Gap 2: Digital divide and access to ICT.

Van Dijk's cumulative ICT access model, when combined with Jansen's digital inequality dimensions, offers a valuable framework (as illustrated in Figure 4.3) for delving into how ICT access influences teachers' technology practices.

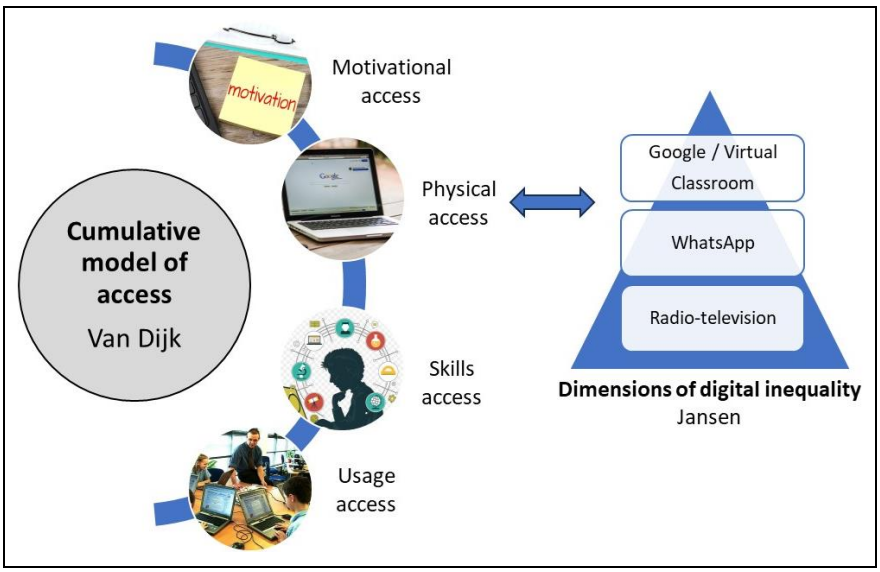


Figure 4.3: Van Dijk in conjunction with Jansen (Author's construct)

4.4.1.1 Motivational access

The motivation to engage with and use technology is a pivotal determinant. While the teachers in this study possessed a reasonable level of operational ICT skills, most had minimal to no prior familiarity with "teaching with technology" before March 2020. The responses to the query "B1: Rate your exposure to the following learning environments before the COVID-19 pandemic" confirm their limited exposure to online and/or blended learning. (Figure 4.4).

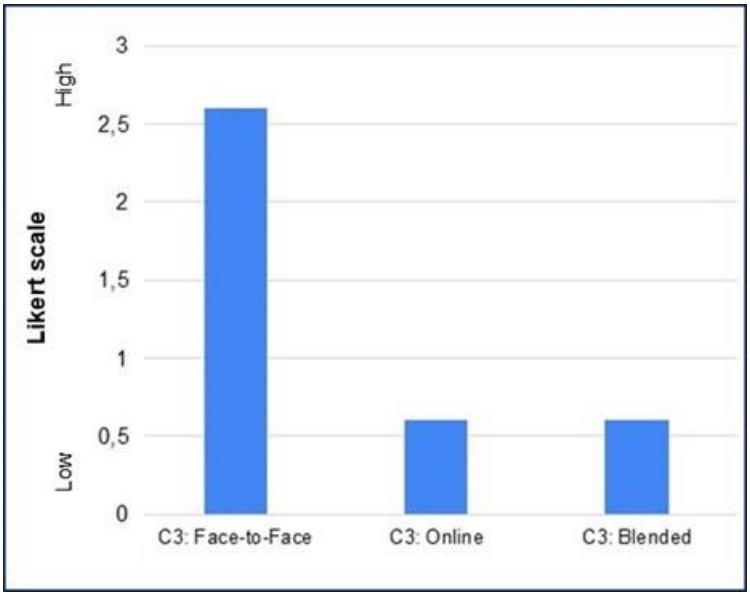


Figure 4.4: Exposure to learning environments before the COVID-19 pandemic

The limited exposure to "teaching with technology" can predominantly be attributed to a deficiency of enthusiasm for adopting and implementing ICT in teaching practices. The subsequent statement aptly encapsulates teachers' inherent disinterest in and apprehension of technology:

Lillibet: *A lot of teachers are creatures of habit and don't like to try new technology – it scares them.*

Amid the pandemic, schools and teachers found themselves compelled to function remotely. Teachers were obliged to use technology to ensure continued teaching and learning. Consequently, the use of ICT was not a matter of preference but rather externally imposed. The subsequent comment from a participant underscores the necessity of adapting to ERT:

Yvette: *During the pandemic, we had to 'survive' so a lot of what was created was very experimental, and since then we have learned a lot …*

In general, respondents had a more positive perception of "teaching with technology" after the pandemic as indicated by the following responses to "C4: What is your current perception and understanding of the benefits of teaching with technology?".

Anne: *Technology is the way forward and incorporating it into the classroom is a step in the right direction.*

David: *Technology can be a wonderful tool to be used for educative purposes.*

The pandemic-induced increase in motivational access, however, did not automatically translate into increased adoption and use of ICT in teaching practices.

4.4.1.2 Physical access

While most respondents had some level of access to ICT before the pandemic, their schools implemented additional initiatives to improve access to ICT. The following respondent statements provide examples of how the schools supported teachers in transitioning to remote online teaching.

Celeste: *I made use of the school laptop to teach my classes.*
The school assisted learners with data so they may have assisted teachers if they asked for it.

Yvette: *Additional allowances were paid to assist with the costs of data/internet.*
. In cases where teachers did not have access to personal computers/laptops, it was provided.

Lyndon: *Offer to help pay for data if a teacher did not have sufficient access to wifi at home.*

The transition to ERT highlighted the importance of having access to a functional Learning Management System (LMS) for the administration and delivery of educational programmes. Unfortunately, most of the schools in this study did not have an operational LMS in place. As depicted in Figure 4.5, only two participants mentioned using a recognised LMS, specifically Moodle and Blackboard. In the absence of a functional LMS, the respondents predominantly relied on Google Classroom as the most practical alternative to facilitate the delivery of educational programmes.

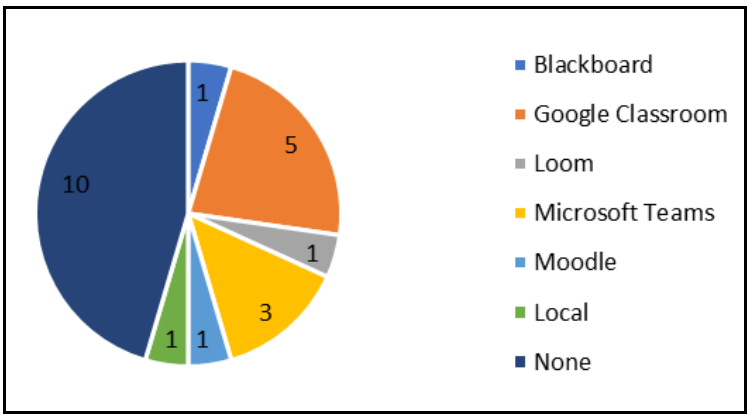


Figure 4.5: Learning Management System (LMS)

While most respondents did not use an LMS, they were aware of the potential benefits of using an LMS. Example of responses to "D5: What are the benefits of using a learning management system (LMS) for teachers and learners?".

Anne: *Saves time, promotes communication, and eases the workload for teachers.*

David: *Eases teacher workload*

Che: *Easy access to work. Less administrative load.*

Amy: *Learners have better access to information on each of their subjects anywhere and anytime. Saves time and paper. The teacher's workload is less.*

4.4.1.3 Skills access

Before March 2020 basic operational and informational skills were sufficient for elementary use of ICT in teaching practices. The following responses to “D1: How do you use ICT in your teaching practice? [Prior to the COVID-19 pandemic.]” illustrate the rudimentary use of ICT.

Anne: *I made use of Google classroom on a regular basis to upload content taught in class (pdf of worksheets and powerpoints).*

Lourens: *Interactive whiteboards, you tube videos, projectors in class with internet and Powerpoint presentations*

Mark: *Smart board in the classroom, use of science simulations (PhET), video material from YouTube, limited use of Google Classroom, all off a PC in the classroom*

Susan: *I used it occasionally in my lesson and only when needed.*

The pandemic created a need for teachers to develop the strategic or technological and pedagogical skills required for more advanced use of technology in their teaching practices.

NOTE: Skills access is discussed in more detail in paragraph 4.4.2 Technological pedagogical knowledge.

4.4.1.4 Usage access

As discussed above, teachers predominantly viewed ICT as an additional or supplementary tool for enhancing or replicating traditional classroom practices before the pandemic. Nonetheless, the pandemic created a necessity, an opportunity, a duty, available time, and the effort required to integrate ICT into teaching approaches. The use of ICT in teaching ceased to be a choice but rather became a requirement.

The following comment illustrates the novel usage opportunity created by the pandemic:

Lyndon: *Being forced to make radical changes to how we do things was what we needed. It is very easy to have good intentions about using more or unfamiliar technology, but the pandemic made it essential.*

4.4.1.5 Dynamics of access

This section discusses the influence of the dimensions of access to ICT on teachers' appropriation of ICT in their teaching practices during the pre-, mid-, and post-pandemic stages as summarised in Table 4.3.

Table 4.3: The dynamics of the dimensions of access to ICT

Stages	Promoted use of ICT	Hindered use of ICT
Pre-pandemic	Physical access (Operational) Skills access	(Intrinsic) Motivational access Usage access
Mid-pandemic	Physical access (Operational) Skills access (Extrinsic) Motivational access (Forced) Usage access	(Strategic) Skills access
Post-pandemic	Physical access (Operational and strategic) Skills access	(Intrinsic) Motivational access Usage access

Physical access serves as a crucial element for teachers to incorporate technology into their teaching practices. Most of the participants had access to devices and internet connectivity, both at their schools and residences, before and during the pandemic. This categorises the schools and teachers involved in this study as part of Jansen's minority group referred to as the "Virtual Classroom." These schools and teachers were therefore well-prepared to switch from traditional in-person teaching to technology-mediated remote teaching and learning when the lockdown was announced.

These findings indicate that, despite having physical access to ICT, most respondents lacked the inherent motivation to embrace and use ICT before the pandemic. This lack of motivation impeded the integration of ICT into their teaching practices. However, the shift to technology-mediated teaching necessitated a shift in teaching methodologies. A respondent remarks on this enforced change as follows:

Lynette: (The pandemic) took teachers out of their comfort zone.

As a result, the pandemic acted as an external catalyst. This external stimulus, coupled with their pre-existing operational skills and physical access, enabled the participants to incorporate ICT into teaching and learning. However, this short-term external incentive did not lead to a sustained increase in intrinsic motivation post-pandemic. Consequently, most respondents reverted to traditional teaching methods, with only a minor uptick in their use of ICT in teaching practices.

Competence in using ICT plays a crucial role in the adoption of ICT. Most of the respondents reported reasonably high levels of operational and informational ICT skills before the pandemic. Due to limited motivation and a lack of knowledge regarding "teaching with technology," the use of ICT in teaching practices was minimal and basic before the pandemic. ICT was primarily used as a substitution for or enhancement of conventional classroom methods, such as replacing traditional activities and materials with digital alternatives like PowerPoint presentations and YouTube videos.

The pandemic necessitated that teachers rapidly acquire or enhance their strategic ICT skills and technological pedagogical knowledge. Despite training initiatives during the pandemic, most respondents still rated their understanding of "teaching with technology" lower than their operational ICT proficiency post-pandemic.

Since the participants were not previously compelled to employ ICT in their teaching practices, their exposure to online and/or blended learning before the pandemic was limited. Teachers' prior experiences and the frequency of ICT use also influenced their adoption of ICT during the pandemic. Respondents with previous experience using ICT were more likely to adapt to the technology-mediated remote teaching environment.

Unfortunately, the pandemic-induced necessity, opportunity, and requirement to use ICT in teaching practices were transient. Despite improved access to, proficiency in, and motivation for using ICT, the respondents rated their schools' use of ICT for teaching and learning significantly lower than their individual use of ICT. Nevertheless, the participants noted an increased implementation of technology in a more blended approach to teaching.

4.4.1.6 Access to ICT in a time of crisis

The concept of access refers to the process of appropriation of technology with the purpose of actual usage. The COVID-19 pandemic compelled teachers to transition to ERT. This educational crisis or emergency thus presented a novel opportunity or obligation to use ICT.

An analysis of the relationship and interactions between the dimensions of access, as illustrated in Figure 4.6, provides a deeper understanding of the appropriation of ICT for educational purposes.

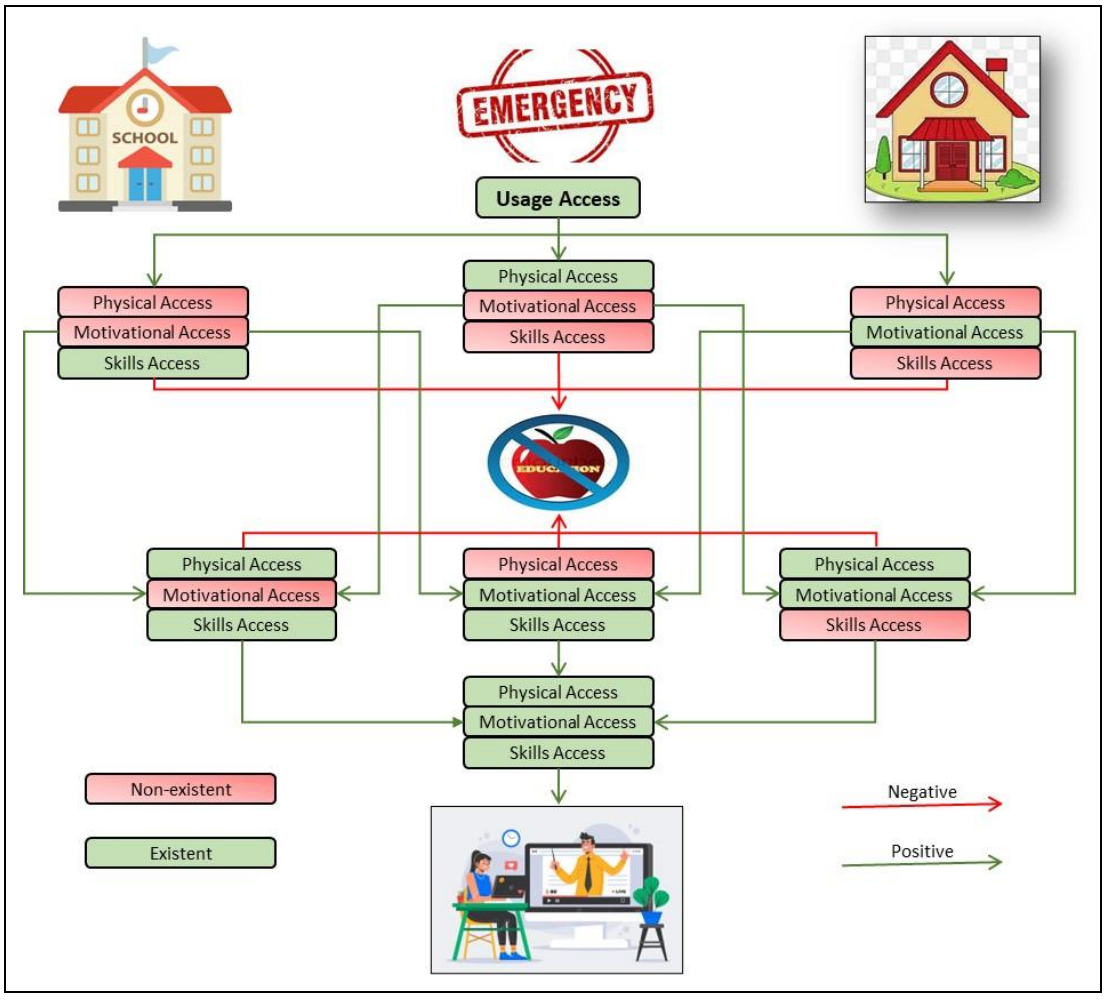


Figure 4.6: Dynamics of access to ICT in a time of crisis (Author's construct)

With the closure of schools in March 2020, only a very small number of schools and teachers possessed the physical, motivational, and skills access required to exploit the novel opportunity to use ICT.

Most schools and teachers, however, found themselves in one of the following scenarios:

Physical access, but not skilled and motivated to use digital devices.
Skills access, but no physical access to and not motivated to use digital devices.
Motivational access, but no physical access to and not skilled in using digital devices.

The three scenarios presented different challenges and required distinct approaches to empower teachers and ensure the sustained use of ICT in teaching practices. The options available in the three scenarios are discussed in Table 4.4.

Table 4.4: Scenarios and options to ensure access to ICT in a time of crisis

Scenario	Option 1 – preferred	Option 2
Physical access	1. Train teachers to use ICT in teaching practices. 2. Enhance confidence and motivational levels to use ICT.	1. Enhance confidence and motivational levels to use ICT. 2. Train teachers to use ICT in teaching practices.
Skills access	1. Provide teachers with digital devices. 2. Enhance confidence and motivational levels to use ICT.	1. Enhance confidence and motivational levels to use ICT. 2. Provide teachers with digital devices.
Motivational access	1. Provide teachers with digital devices. 2. Train teachers to use ICT in teaching practices.	1. Train teachers to ICT in teaching practices. 2. Provide teachers with digital devices.

Physical access in educational settings is essential for teachers to incorporate technology into their teaching practices. It is also widely believed that digital inequality can be overcome by providing teachers with a computer and internet connection.

It is, however, important to recognise that merely providing schools and teachers with physical access to technology is not the solution. Physical access requires an educational environment that requires the use of ICT in teaching practices. Only when “teaching with technology” becomes the benchmark for best practices, teachers will be driven to develop the skills required to optimally use the digital devices available to them.

In summary, the findings suggest that the appropriation of ICT is a complex process, rather than a simplistic linear progression of successive stages that automatically lead to usage. Therefore, adopting a more interconnected and relational view of access would be more fitting and beneficial for creating supportive and enabling educational environments that promote the effective use of ICT.

4.4.2 “Teaching with technology” knowledge

Most schools implemented various initiatives to enhance the “teaching with technology” knowledge and skills of their teachers. Training encompassed various aspects such as Google Meet, Google Classroom, Microsoft Teams, and creating WhatsApp groups to communicate with learners.

The sources of and duration of training are illustrated in Figure 4.7. During the lockdown, schools provided part-time online training programmes, and when they reopened, they offered in-school programmes. However, respondents considered "self-directed learning" to be the most significant source of training.

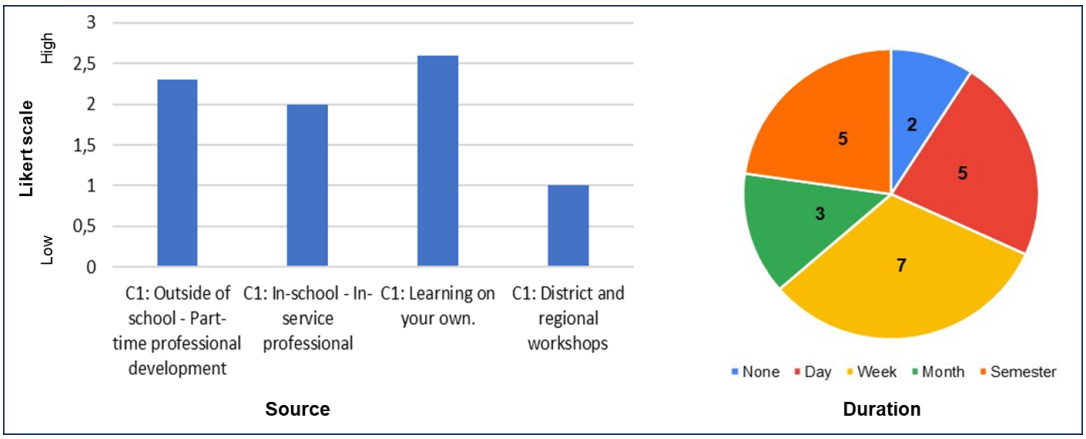


Figure 4.7: Sources and duration of ICT training

The impact of the pandemic on teachers’ technological pedagogical knowledge is illustrated in the theoretical and conceptual framework (Figure 4.8) by plotting the responses to the following questionnaire items:

A1: How would you rate: [Your proficiency with ICT?]
C3: Indicate your level of "teaching with technology" knowledge. [Before the COVID-19 pandemic.]
C3: Indicate your level of "teaching with technology" knowledge. [Current]

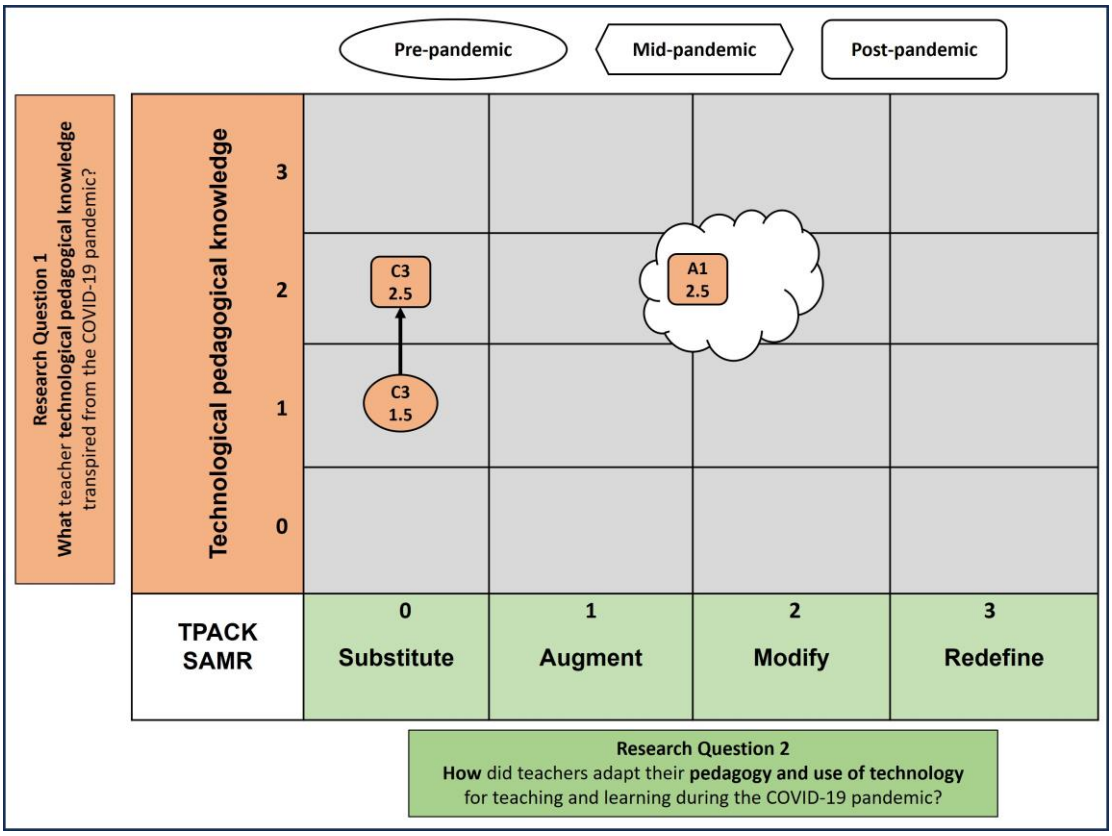


Figure 4.8: RQ1 - Theoretical and conceptual framework (Author's construct)

The purpose of Item A1, the first question in the questionnaire, was to establish the respondents' perceived post-pandemic level of ICT proficiency. The rating of 2.5 is therefore indicated in a cloud bubble.

Item C3 consisted of two components to measure and compare the pre-pandemic and post-pandemic ratings of "teaching with technology" knowledge. As illustrated in Figure 4.9, most respondents rated their post-pandemic level of knowledge (RED line) higher than their pre-pandemic level of knowledge (BLUE line).

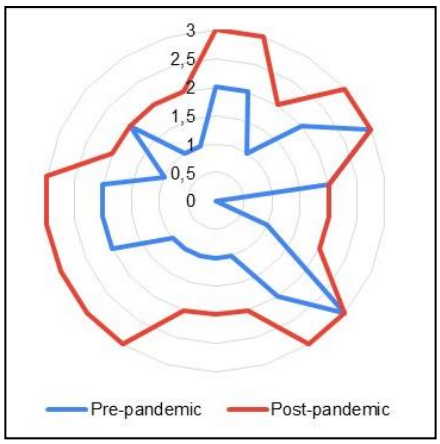


Figure 4.9: "Teaching with technology" knowledge

The increase in the average rating from 1.5 to 2.5 indicates a noteworthy enhancement in the respondents' understanding of "teaching with technology." The post-pandemic rating for "teaching with technology" knowledge (C3=2.5) is in alignment with the rating for the perceived level of ICT proficiency (A1=2.5). However, regrettably, as depicted in Figure 5, most respondents still rated their "teaching with technology" knowledge considerably lower compared to their operational ICT proficiency following the pandemic.

4.5 RQ2: Pedagogy and use of technology

RQ2 addresses Knowledge Gap 3 by exploring the impact of the COVID-19 pandemic on teachers' technology practices.

RQ2: How did teachers adapt their pedagogy and use of technology for teaching and learning during the COVID-19 pandemic?

Knowledge Gap 3: Teaching practices.

4.5.1 Preparedness for ERT

The respondents reported that even though they had adequate physical access to and competency in ICT, their prior exposure to "teaching with technology" was quite limited before March 2020. The majority of respondents were predominantly accustomed to traditional in-person teaching, with limited involvement in "teaching with technology" in online or blended teaching and learning settings.

Overall, the preparedness for online remote teaching varied among respondents. Some teachers felt very comfortable and confident in using platforms like Google Classroom, Meet, and Docs, while others felt less prepared and had to learn new technology. Some teachers found that their previous exposure to online teaching, for example during their teacher training, helped them navigate the transition to remote teaching with ease.

Examples of responses to item B3: To what extent did your prior experience with ICT in teaching and learning prepare you for emergency remote teaching during the COVID-19 pandemic? are summarised in Table 4.5.

Table 4.5: Preparedness for ERT

Name*	Response
Anne	It helped … however not a lot.
Che	Gained this experience during my teaching practical in 2020. It helped a GREAT extent.
Clair	It did not help.
David	Not fully prepared.
Lillibet	I am computer literate and a fast learner. I was able to adapt easily.
Lyndon	I completed Google Educator Level 1. I was very comfortable using all the Google products.
Martin	I studied online … this helped me with working with online platforms. My previous employer implemented technology-based learning which was also a great help.
Nyanda	I was used to online content delivery via UNISA** and TUKS**.
Rossouw	I was already familiar with online teaching due to teaching assistant work … it assisted me greatly.
Yvette	Previous experience prepared me to be willing to experiment and not be too afraid of trying new things.

* As established in Chapter 3, pseudonyms are used to ensure confidentiality and anonymity.
** Reference to universities using online teaching.

Despite not being fully prepared for the swift transition to online remote teaching, most respondents showed a willingness to learn and adapt to ensure continued teaching and learning during the pandemic.

4.5.2 Transition to ERT

In March 2020, teachers were suddenly compelled to adjust to delivering instruction via technology in a virtual setting. Many teachers encountered difficulties, primarily stemming from inadequate infrastructure and teaching methods that did not meet the necessary standards for incorporating ICT into the educational process.

The following examples illustrate the measures that schools in this investigation implemented to assist teachers in the transition to remote online teaching during the COVID-19 pandemic:

- During lockdown, teachers received training in online teaching methods and tools.
- Additional support was provided in the form of troubleshooting help and relevant online courses.
- Some teachers received training in Microsoft Office and other technology tools.

4.5.3 Teaching with technology

The responses to the following questionnaire items were plotted on the theoretical and conceptual framework (Figure 4.10) to illustrate how teachers adapted their pedagogy and use of technology for teaching during the pandemic:

A1: How would you rate: [Your use of ICT for teaching and learning?]
D1: How do you use ICT in your teaching practice? [Before the COVID-19 pandemic.]
D1: How do you use ICT in your teaching practice? [Current]

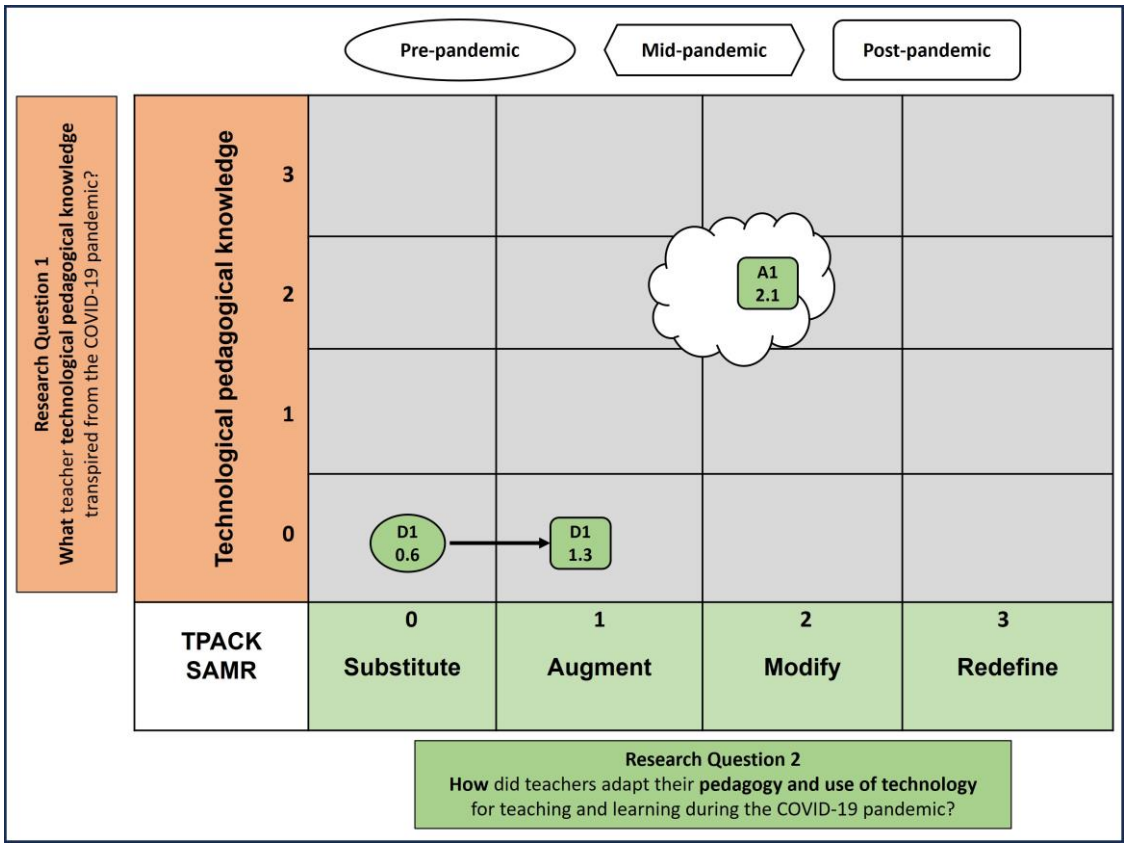


Figure 4.10: RQ2 - Theoretical and conceptual framework (Author's construct)

The purpose of Item A1, the first question in the questionnaire, was to establish the respondents' perceived post-pandemic level of ICT usage in teaching and learning. The rating of 2.1 is therefore indicated in a cloud bubble.

The following statements by respondents reflect the perception that "teaching with technology" during the COVID-19 pandemic had supported or transformed their teaching practice.

Anne: *It changed the way I approach teaching.*

Lyndon: *Technology certainly supported traditional teaching methods.*
Technology enhanced the way of teaching and really raised the bar.

Susan: *Technology is used to design innovative learning experiences.*

Item D1 consisted of two components to measure and compare the pre-pandemic and post-pandemic ratings of ICT usage in teaching practices. The improvement in the rating from 0.6 to 1.3 implies a minor change in "teaching with technology" practices. The post-pandemic rating of "teaching with technology" practices (D1=1.3) is also substantially lower than that of the "perceived" level of "teaching with technology" practices (A1=2.1).

The findings suggest that there was not a substantial shift in the way respondents applied ICT in their teaching methods after the pandemic (Figure 4.11). ICT is still predominantly employed to enhance teaching practices by substituting traditional activities and materials with digital alternatives, such as PowerPoint presentations, or by integrating interactive digital elements, like YouTube videos.

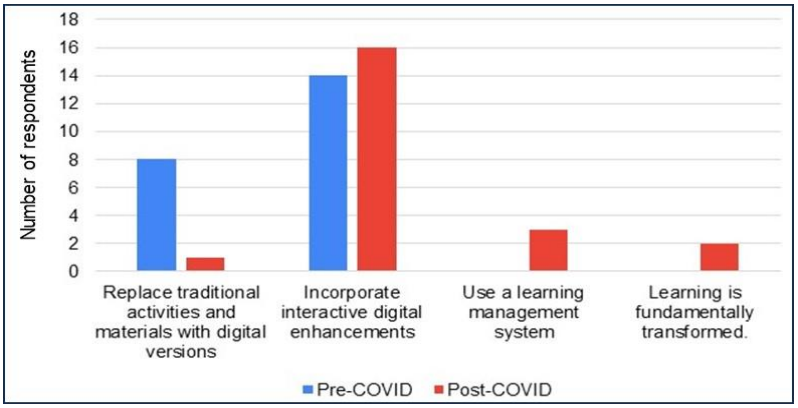


Figure 4.11: Use of ICT in teaching practice

In summary, the findings of this study suggest that because teachers are under no obligation to use ICT, they do not create or use opportunities to apply their increased technological pedagogical knowledge to transform their teaching practices.

4.5.4 Technology-mediated interaction

Interaction was a major pedagogical challenge in ERT due to isolation and social distancing. The study addresses Knowledge Gap 4, namely technology-mediated teacher-learner interaction, by exploring the modes, platforms, and dimensions of interaction during the pandemic.

Knowledge Gap 4: Technology-mediated teacher-learner interaction.

4.5.4.1 Modes of interaction

During the pandemic, most respondents primarily engaged with learners asynchronously due to various technological limitations (Figure 4.12). Teachers, for example, provided learning material by posting notes on Google Drive and uploading assignments on Google Classroom.

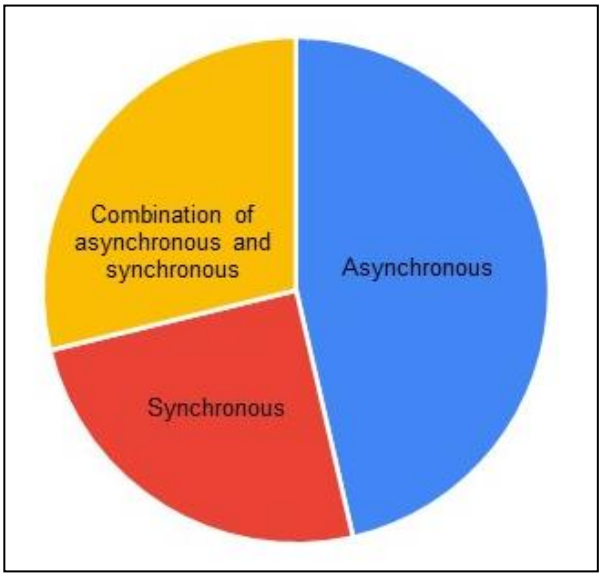


Figure 4.12: Modes of interaction during the COVID-19 pandemic

Asynchronous communication was convenient and flexible, with the advantage that learners could access learning material from different locations during different hours and work at their own pace. The disadvantage of asynchronous interaction is that it may be less engaging and effective as it does not promote collaboration and does not allow for instant feedback and clarification.

4.5.4.2 Platforms for interaction

Google Classroom and WhatsApp were the most highly rated and widely used platforms for teacher-learner interaction during the pandemic (Figure 4.13).

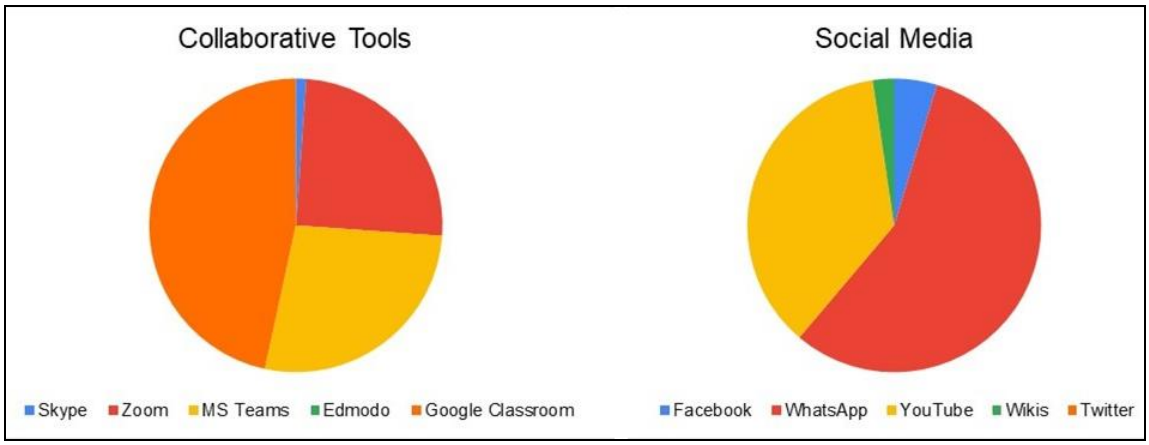


Figure 4.13: Platforms for interaction during the COVID-19 pandemic

Given the absence of a fully operational Learning Management System (LMS), the teachers in this study resorted to Google Classroom as the best alternative for engaging with their learners. Despite lacking certain features when compared to a traditional LMS, participants regarded it as the most effective and efficient online platform for interaction during the pandemic.

WhatsApp emerged as the predominant social media platform for teacher-learner interaction, primarily because a significant majority of learners had access to and were already using this platform. As detailed in Chapter 2, WhatsApp was found to be more suitable at the secondary school level, where the percentage of learners owning cell phones increased notably with grade levels.

Using Jansen's dimensions of digital inequality (Chapter 2) most of the schools in this study can be classified as high-tech "Google Classroom" and/or the medium tech "WhatsApp" schools.

4.5.4.3 Dimensions of interaction

The shift from classroom-based teaching to technology-mediated remote teaching had a major impact on the interaction patterns between teachers and learners. Interaction was challenging during the initial lockdown as teachers and learners were completely cut off from each other and many learners just "disappeared". Engagement with learners who did not have access to computers and/or the internet was a major problem.

Responses to an item on the **affective dimension** of teacher-learner interaction during the COVID-19 pandemic confirm that there was a lack of direct interaction between teachers and learners. As a result, learners were anxious and quiet during this period, and teachers struggled to provide support for emotional and non-academic needs.

Teachers, however, devised and implemented various strategies to enhance teacher-learner interaction during the pandemic. For example, some teachers had daily check-ins with learners and used video recordings and messages from alumni to create a familiar and positive atmosphere.

Most respondents also indicated that providing **academic support** during the pandemic was problematic. The major challenge was learner access to devices and internet connectivity. As a result, teachers had to be creative in designing and implementing strategies that enabled them to provide meaningful support to learners. The following are examples of the temporary measures implemented by teachers:

- Focused on the important concepts needed for learners to be successful.
- Videos explaining the content and additional resources. quizzes and worksheets.
- Homework is given over WhatsApp and assessments are through Google Forms.
- Shared the Western Cape Education Department online resources with the learners.
- YouTube video links that further explained the work covered.

4.6 Reflection

This section outlines the results derived from the FGI, which served to complement and triangulate the data obtained from the questionnaire. The interactive nature of the FGI allowed for a more profound and more comprehensive comprehension of the real-life experiences of the two participants. The demographic details of the schools participating in the FGI are provided in Table 4.6.

Table 4.6: Demographics of FGI schools

Name*	School type	Province	Location
Santi	Private	Northern Cape	Rural
Sipho	Public	North West	Rural

* Pseudonyms are used to ensure confidentiality and anonymity.

The analysis of the data revealed distinct differences between the lived experiences of the two teachers.

4.6.1 Preparedness for ERT

The characteristics of the schools determined the participants' preparedness for ERT. Santi's school had a significant advantage in this regard.

Santi: The school has been operating as a distance learning institution for approximately 25 years. This experience enabled a seamless transition into ERT. The school already possessed a functional communication and interaction platform, which contributed to enhanced learner engagement during ERT. Santi managed to sustain uninterrupted teaching throughout the crisis, maintaining their regular planning and daily communication with students.

Sipho: The school faced challenges in terms of preparedness for ERT. They lacked devices, had limited experience in online remote teaching, struggled with data availability, and suffered from poor connectivity. WhatsApp was the sole communication platform available to interact with learners. The issues with connectivity and intermittent data availability further exacerbated the hurdles faced during the teaching and learning process.

4.6.2 Transition to ERT

The different levels of preparedness and planning promoted or hindered the transition to ERT. Santi's school benefited from experienced teachers and well-established online platforms.

Santi: The school's transition involved leveraging an already-established distance learning system, which offered a seamless shift to ensure continued teaching and learning. Preparation through term plans, underpinned by confidence derived from prior experience with distance learning, facilitated a smoother transition to ERT. Learners did, however, initially struggle to maintain routine and engagement due to the presence of distractions in their home environments. Over time, learners adapted, and a sense of normalcy was established.

Sipho: The school faced challenges stemming from a lack of preparedness and planning. Most teachers were reluctant towards and unfamiliar with technology. The pandemic acted as a catalyst for change, prompting colleagues to recognise the value of technology in bridging the gaps left by traditional methods. Despite this recognition, challenges persisted limiting the full potential of technology integration.

4.6.3 Teacher-learner interaction

Due to the different levels of preparedness, the two teachers adopted different approaches to engage or interact with learners.

Santi: The school already had an established platform for communication and interaction, fostering engagement with learners. Familiarity with this platform allowed learners to access learning materials and instructions consistently. Santi's approach highlighted a more interactive and engaging method of teacher-learner interaction. She employed synchronous communication with learners eagerly participating in the sessions. Visual and verbal interaction was valued, with learners encouraged to keep their videos on and engage actively in conversations, mimicking in-person classroom dynamics. Rules and structure were established to maintain discipline and facilitate effective communication, while group engagement and support were fostered through their LMS.

Sipho: Sipho faced challenges in learner interaction due to limited access to devices and connectivity issues. Interaction was primarily possible with Grade 12 learners who had access to tablets. Other learners encountered difficulties in accessing learning materials due to data limitations, hampering engagement efforts. Adjusting to remote learning proved challenging, leading to difficulties in learner engagement and commitment to academics. Managing large groups and mitigating technical difficulties posed hurdles, occasionally disrupting the flow of lessons.

4.6.4 Themes and patterns

Santi and Sipho provided valuable insights into the realities of teaching and learning during the COVID-19 pandemic. While both teachers were tasked with adapting their teaching practices and transitioning to ERT, their experiences differed based on their school's preparedness and available resources.

The pandemic did not have a significant impact on Santi's school, and she did not face major disruptions in her teaching practices or require extensive adaptation. Sipho's school, on the other hand, faced serious challenges due to a lack of devices and poor internet connectivity in their school and community.

A thorough analysis and interpretation of the data revealed distinct themes and patterns in the lived experiences of Santi and Sipho.

Planning and Preparedness: Santi emphasises the importance of planning and having a structured curriculum in place. Their school had already prepared a term ahead, allowing them to continue teaching seamlessly during the COVID-19 crisis. In contrast, Sipho mentions that they did not have the same level of preparedness, facing difficulties in providing teaching materials and accessing learners due to the lack of devices and poor internet connection.

Transition to online platforms: Santi states that their school quickly adapted to the new teaching scenario, and after an initial adjustment period, the learners resumed a sense of normalcy in their routine. In contrast, Sipho mentions the difficulties faced during the transition, with learners struggling to adjust to the new learning environment, and teachers facing challenges in utilising ICT tools effectively.

Challenges with technology access and proficiency: The digital divide created inequities in the learning experience of the two participants. Santi mentions that their school had a well-established LMS platform and technology infrastructure in place even before the pandemic. They were able to continue teaching and provide assignments to students effectively. In contrast, Sipho highlights the lack of devices and internet connectivity in their school, limiting the use of ICT tools for teaching and learning. Many learners lacked suitable devices and reliable internet access to effectively participate in online interactions.

Teacher-learner interaction: Santi was able to use synchronous communication involving real-time interactions through video conferencing, where she could deliver live lectures, answer questions, and facilitate discussions. Santi also encouraged active participation by requesting learners to keep their videos on, use hand gestures, and engage in immediate communication during lessons. This approach aimed to create a classroom-like environment and foster engagement.

In comparison, Sipho acknowledges the challenges in teacher-learner interaction during the pandemic, with difficulties in accessing students and limited options for communication. He primarily used asynchronous communication through emails, discussion boards, or messaging platforms.

Learner support: Santi indicated that technology-mediated interactions allowed for more individualised learner support. She could provide personalized feedback, address specific learner needs, and track individual progress through online assessments and assignments. Learners could also reach out to her more easily for one-on-one virtual consultations or support. Santi further noted that she had to be mindful of learners' emotional states, as the absence of face-to-face interactions and the challenges posed by the pandemic could affect their mental health. She used video conferences, chats, or discussion forums to maintain a sense of community, share experiences, and provide emotional support. In contrast, Sipho struggled to provide meaningful academic and emotional support during the pandemic.

These patterns demonstrate the complex nature of technology-mediated interactions between teachers and learners during the COVID-19 pandemic. They highlight the importance of adaptability, resourcefulness, and creativity in leveraging technology to facilitate effective teaching and learning experiences in challenging circumstances.

4.7 Summary

This section provides a summary of the findings concerning access to ICT, teaching with technology, and the actor-network.

4.7.1 Access to ICT

This paragraph outlines the impact of the pandemic on teacher access to ICT with a specific focus on the “teaching with technology” knowledge of teachers.

In general, the findings of this research indicate that the pandemic had a favourable effect on teachers' physical access to ICT, motivation, and skills. Most of the respondents claimed to possess a better grasp of how ICT can be integrated into teaching. However, it is regrettable that teachers still rated their competence in "teaching with technology" as considerably lower than their operational ICT proficiency post-pandemic.

Although it is often argued that shifting attitudes and intentions can predict the overall adoption and use of technology, this study highlights that enhanced motivation and improved skills do not necessarily lead to increased use and implementation of ICT in teaching practices.

In-class use of mobile devices

Before the pandemic, the in-class use of mobile devices by learners was banned or discouraged in most participating schools (Figure 4.14). The following comment reflects the negative perception of mobile devices.

David: Extensive studies have been done on the negative impact it has on our youth and their development, so if technology means mobile devices, then we need to work against the increase in our schools and society.

The findings, however, indicate that more schools allow, encourage, and even require the in-class use of mobile devices by learners after the pandemic. Unfortunately, the number of schools that discourage use also increased. While most respondents believe that the in-class use of mobile devices by learners can enhance learning, they find this practice distracting and have concerns about security and privacy.

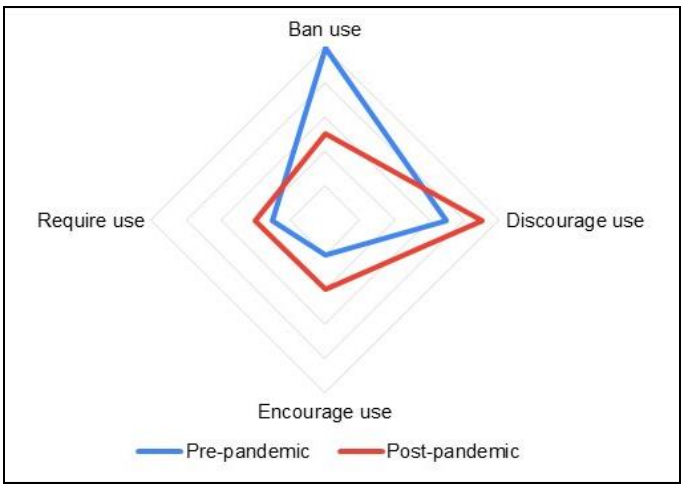


Figure 4.14: In-class use of mobile devices

4.7.2 Technology practices

This section summarises the impact of the pandemic on the technology practices of teachers, in other words how teachers used ICT to support, enhance, or transform their teaching practices.

4.7.2.1 Blended learning

The pandemic impact on teaching practices is illustrated by mapping the pre-, mid-, and post-pandemic teaching practices on the theoretical and conceptual framework (Figure 4.15). The responses to the following questionnaire items were analysed and interpreted for this purpose.

B1: Rate your exposure to the following learning environments before the COVID-19 pandemic. [Face-to-face (Classroom)]
B1: Rate your exposure to the following learning environments before the COVID-19 pandemic. [Online (Remote)]
B1: Rate your exposure to the following learning environments before the COVID-19 pandemic. [Blended learning – a combination of face-to-face and online]

B2: How did you use ICT in teaching and learning before the COVID-19 pandemic?
B5: To what extent did you use the following options to engage with learners remotely during the COVID-19 pandemic? [Asynchronous: Uploaded content for the course for learners to view at any time.]

B5: To what extent did you use the following options to engage with learners remotely during the COVID-19 pandemic? [Synchronous: Met with learners online using virtual meeting software.]
B5: To what extent did you use the following options to engage with learners remotely during the COVID-19 pandemic? [Combination of asynchronous and synchronous.]

D7: To what degree did you continue "teaching with technology" when you returned to face-to-face classes?

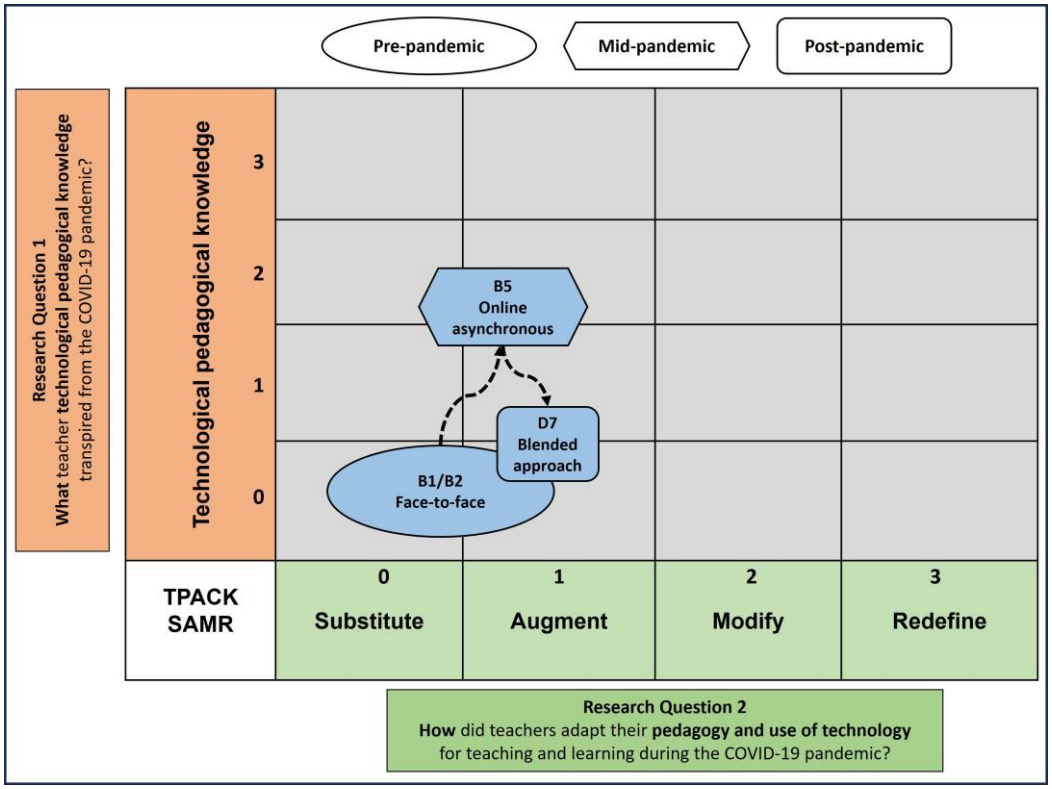


Figure 4.15: Pandemic phases - Theoretical and conceptual framework (Author's construct)

Items B1 and B2 confirm the face-to-face classroom-based nature of pre-pandemic teaching practices. An analysis of Item B5 indicates the transition to primarily using asynchronous technology-mediated teaching practices during the pandemic. Lastly, Item D7 reveals that the respondents largely returned to traditional teaching practices with increased implementation of technology after the pandemic. The following word cloud (Figure 4.16) illustrates the word frequency in the responses to Item D7.

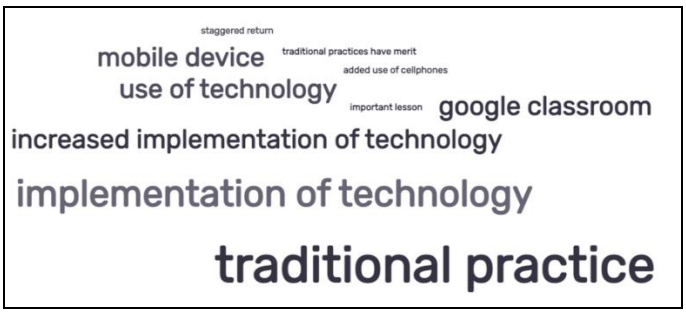


Figure 4.16: Post-pandemic teaching practices

Overall, the findings reveal the blended character of post-pandemic teaching practices in which ICT is used to **change**, rather than fundamentally **transform** traditional teaching practices.

4.7.2.2 Successes in “teaching with technology”

Despite many challenges, respondents also experienced successes in their transition to and application of ERT. Respondents reported that they improved their online remote teaching skills during the pandemic. They paid more attention to and documented what and how they were teaching. As a result, they learned to provide clearer instructions and guidance to learners. Some teachers recorded lessons that allowed learners to go back and review the material at any time, making exam preparation easier and helping absent learners keep up with work. Overall, using ICT in teaching helped teachers improve their use of technology, improve access to lesson content, and enhance the quality of learner support.

4.7.2.3 Benefits of “teaching with technology”

Respondents identified various advantages of ICT in teaching practices, for example, increased learner engagement, accessibility for absent learners, accommodation of different learning styles, and the ability to pace learning individually. They, however, emphasised that technology should be used alongside traditional teaching methods and take into consideration factors such as access to devices and stable internet connection.
In conclusion, the following statements articulate the overwhelming positive perception of “teaching with technology”, while highlighting a few cautionary issues.

Teaching with technology

Lyndon: *Being forced to "teach with technology" is one of the very few positives to come out of the pandemic.*

Anne: *Technology is the way forward and incorporating it into the classroom is a step in the right direction.*

Technology in education

Amy: *Technology definitely improves the quality of learning, and we should be incorporate it more in the classroom.*

David: *Technology or digital tools used to strengthen working educative strategies should be encouraged and funded.*

Teachers and teaching practice

Lyndon: *The pandemic forced us to make radical changes to how we teach, but it was necessary.*

Lillibet: *A lot of teachers are creatures of habit and don't like to try new technology.*

Learners

Clair: *Not all learners have access to devices for online teaching.*

Lynette: *Better understanding of the learners' needs and trying to support them.*

4.7.3 Actor-network analysis

The application of ANT allowed the researcher to explore and better understand the role of human (teachers and learners) and non-human (ICT) agency in the phenomenon under investigation. A step-by-step analysis of the Actor-network diagram was performed to identify and interpret the relationships and interactions between the key human and non-human actors in the network.

Step 1: Trace Associations by identifying the relationships and interactions between the human and non-human actors.

- Teachers and learners ***interact*** through technology-mediated modes of communication.
- The Department of Education ***provides*** the policy framework and funding for ICT appropriation in schools.
- The characteristics and context of the school ***impact*** teachers' appropriation of ICT.
- Teacher training institutions ***provide*** teachers with training for ICT appropriation.
- The socio-economic context and geographical location ***impact*** on access to ICT in schools and homes.
- The dimensions of access to ICT ***impact*** the appropriation of ICT by teachers and learners.

Step 2: Analyse Actor Agency by exploring the power dynamics and influence each actor exerts in shaping the network and its outcomes.

- Teachers and learners may face challenges if they lack appropriate access to ICT.
- Inappropriate policies and insufficient funding by the Department of Education may hinder ICT appropriation in schools.
- Inappropriate curriculum content of teacher training institutions may hamper ICT appropriation by teachers.
- The socio-economic context and geographical location of schools and homes may limit access to and appropriation of ICT.
- The various dimensions of access to ICT may hinder the appropriation of ICT by teachers and learners.

Step 3: Consider Translation by exploring how actors negotiate and align their interests through translation processes to ensure effective technology-mediated interactions.

- Teachers modified their lesson plans to better engage learners through technology-mediated modes of interaction.
- The Department of Education provided online resources to assist teachers and learners in the appropriation of ICT to ensure continued teaching and learning.
- Schools invested in providing teachers with improved physical and skills access to ICT.
- Teachers and learners, specifically those from schools in poorer remote communities, used the social media platform WhatsApp for educational purposes.

Step 4: Interpret the Network by looking for patterns, power dynamics, and instances of agency and translation.

- **Preparedness and transition:**
  - Schools played a critical role by implementing initiatives to provide teachers and learners with increased physical and skills access to ICT.
  - The compulsory usage opportunity, supported by increased physical and skills access, motivated teachers to implement innovative means of technology-mediated interaction with learners.

- **Disparities in access:**
  - A small minority of schools had a well-established LMS platform and technology infrastructure in place even before the pandemic.
  - Teachers and learners in poor and remote communities lacked suitable devices and reliable internet access to effectively participate in online interactions.

- **Teacher-learner interaction:**
  - Very few teachers were able to use synchronous methods to interact with learners.
  - Most teachers primarily used asynchronous communication to interact with learners.
  - Most participating teachers devised creative ways to interact with learners.

- **Learner support:**
  - Teachers noted that they were mindful of learners' emotional states as the challenges posed by the pandemic could affect their mental health.
  - Most teachers struggled to provide meaningful academic and emotional support during the pandemic.

4.8 Conclusions

This section summarises the major findings of this study.

4.8.1 Summary of findings

Many stakeholders in the field of education had anticipated that the technological advancements brought about by the COVID-19 pandemic would persist into the period after the pandemic. Yet, the outcomes of this investigation, as depicted in Figure 4.17, suggest that the connection between teachers' accessibility to ICT and their actual use of it is more complex than initially presumed.

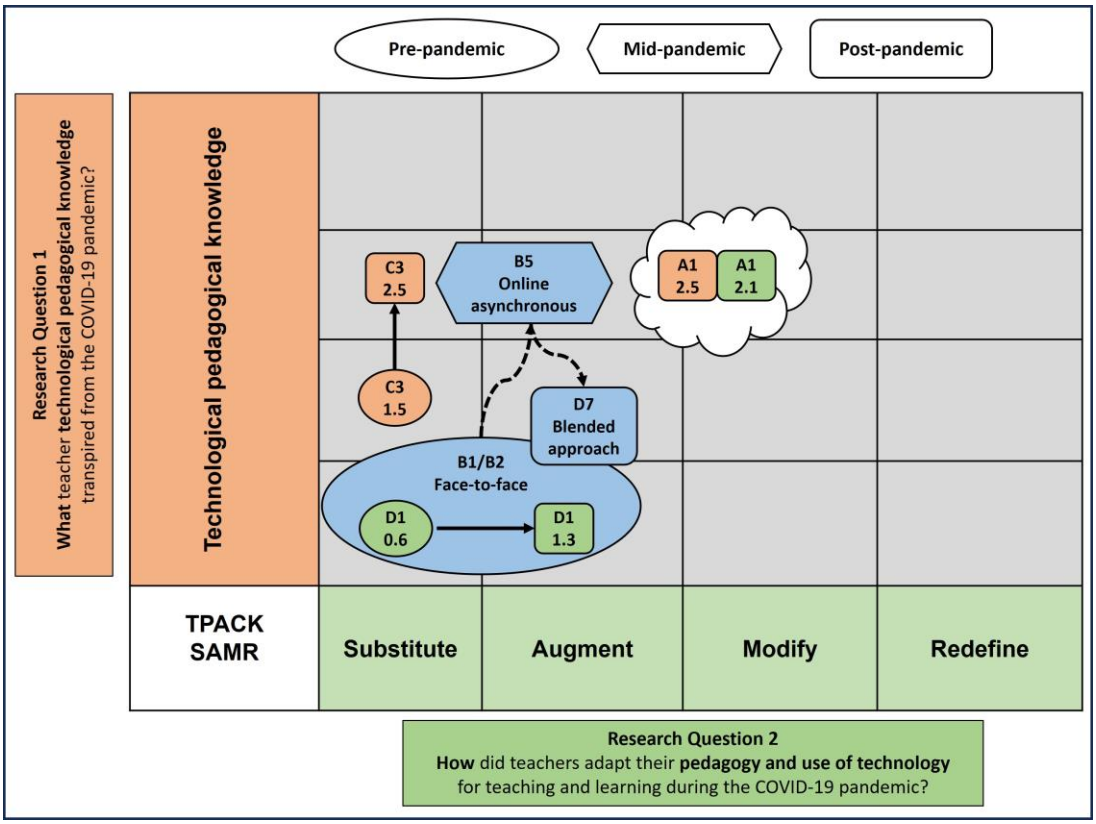


Figure 4.17: Overall findings - Theoretical and conceptual framework (Author's construct)

Before the pandemic, the use of ICT was optional, and teachers mainly used it to assist in or mimic conventional classroom methods. Nevertheless, the COVID-19 pandemic mandated that teachers use ICT for remote instruction, primarily driven by the need to adhere to social distancing measures.

The findings suggest that during the pandemic, teachers experienced enhanced physical access to ICT and developed a more favourable view and deeper comprehension of the advantages of ICT in education. Consequently, some teachers began to incorporate innovative technology-driven teaching methods. Regrettably, when schools resumed their standard operations, most of the participants in this study predominantly reverted to conventional teaching approaches.

The findings suggest that the boost in intrinsic motivation to use ICT was a transitory phenomenon. This suggests that motivation is not an inherent outcome of having physical access or skills but is a separate element that inspires teachers to actively explore and employ ICT. Motivational access to ICT signifies that teachers recognise its advantages and possess the necessary pedagogical knowledge and opportunities to integrate it into their teaching practices effectively.

In summary, the findings from this study propose that access does not follow a simple linear progression of consecutive stages. Physical access may serve as a fundamental requirement, but it does not inherently result in the sustained use of technology. The integration of technology into teaching and learning represents a multifaceted process that necessitates a more interconnected, relational perspective of access within educational settings, one that motivates and empowers teachers to use ICT in their teaching methods.

4.8.2 Recommendations

In closing, this chapter offers the following recommendations for educational policy and practice based on the findings of this study.

4.8.2.1 Educational policy

Currently, South African education policymakers narrowly focus on physical access to ICT. For example, President Cyril Ramaphosa stated in his State of the Nation address in 2019 that the government would provide every school child in South Africa with digital workbooks and textbooks on a tablet device.

Unfortunately, policymakers often have unrealistic expectations about their ICT initiatives. The following are examples of challenges recently reported in the press:

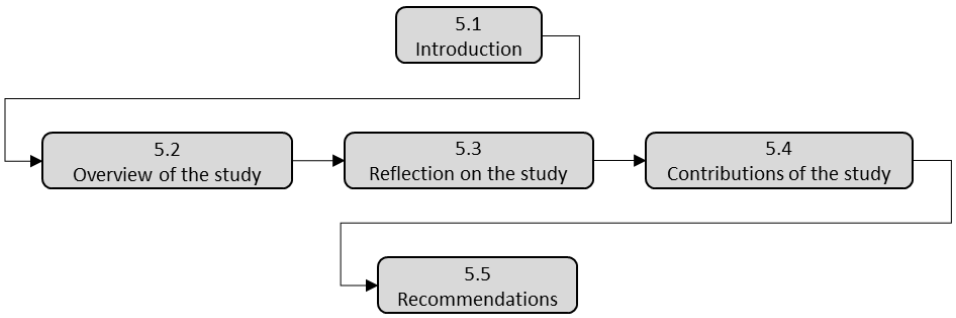
- In Gauteng, approximately R5.5 million worth of smartboards and R42.9 million worth of tablets went missing or were stolen during the last three fiscal years.
- In Mpumalanga, parents who are worried about the misuse of tablets for Grade 12 students have urged the Education Department to reclaim them, as they are being used to access inappropriate websites, including pornography.
- The Eastern Cape's education department is facing challenges in retrieving 55,000 tablets that were distributed to the Class of 2020's matriculants.

Access to ICT does not follow a straightforward, step-by-step path that automatically leads to its use. Just providing digital devices to schools, teachers, and learners is not the complete solution. Policymakers should adopt a more comprehensive and context-aware approach that considers all the factors and actors influencing ICT access and their interconnectedness.

4.8.2.2 Educational practice

Firstly, schools must develop a comprehensive ICT strategy, setting out the aims, principles, and strategies for the adoption and use of ICT, with the input of all stakeholders. The ICT strategy must guide teachers and learners in navigating through the ICT environment and enable the integration of ICT in teaching and learning. Secondly, schools must continuously monitor and improve their e-readiness, in other words, the school’s capacity and capability to provide appropriate structures to deliver effective educational experiences using ICT.

CHAPTER 5
CONCLUSIONS



Structure of Chapter Five

In the realm of educational technology research, conclusions are the stepping stones that bridge knowledge to action, propelling us toward a brighter future of learning.

5.1 Introduction

Chapter 5 brings the thesis to a close by assessing the findings in addressing the research questions and outlining the implications, constraints, and suggestions for future research.

5.2 Overview of the study

The study is motivated by the absence of a thorough comprehension regarding how teachers access and use ICT in varying scenarios. The primary objective of this research was to explore the nuances of ICT access and technology practices among secondary school teachers, with a particular focus on the context of the COVID-19 pandemic. In pursuit of this goal, the following research questions were developed:

RQ1: What teacher technological pedagogical knowledge transpired from the COVID-19 pandemic?

RQ2: How did teachers adapt their use of technology for teaching and learning during the COVID-19 pandemic?

The study **commenced** by exploring relevant national and global academic resources concerning teaching and learning in crises, with a particular focus on the COVID-19 pandemic. This review was structured per the research questions, and the findings were presented in Chapter 2.

The COVID-19 pandemic emphasised the importance of teachers' access to ICT. Access pertains to the process of obtaining technology to use it effectively. Van Dijk's model, which proposes a cumulative approach to access, delineates various access types that occur in sequential stages, each reliant on the others. While Van Dijk's model has been influential in understanding the complexities of ICT access, it has certain limitations and aspects that warrant critical examination, particularly its limited focus on human agency.

In summary, the findings of this study suggest that the relationship between teachers' access to ICT and their actual use of it is not straightforward. While physical access is a fundamental requirement, it does not automatically translate into effective technology use. This research asserts the need for a more intricate and nuanced understanding of the multifaceted concept of ICT access, one that more accurately reflects how teachers actively interact with ICT in an increasingly technology-driven society.

Moreover, in South Africa, diverse social and educational contexts significantly influenced access to and use of ICT during the pandemic. Despite government-imposed emergency measures, most schools and teachers lacked sufficient ICT access and were ill-prepared for technology-mediated remote teaching. Consequently, due to these digital inequalities, very little or no teaching occurred in most South African schools.

The COVID-19 pandemic compelled teachers to implement technology as a mitigating strategy in their teaching practices. The technology-mediated practices implemented during the pandemic, however, differed from methodically implemented e-learning. “Emergency remote teaching” (ERT) emerged as a common alternative term to describe the teaching practices during the pandemic. ERT is an unplanned activity and is not grounded in sound theoretical and practical knowledge.

Teacher-learner interaction is at the heart of the learning experience. It is through interaction that teachers build a bond with learners and facilitate learners’ success. ERT, however, changed the nature of teacher-learner interaction. Connectedness through interaction is particularly problematic when teachers and learners are faced with the challenges of isolation and social distancing. As a result, the issue of teacher-learner interaction emerged as a major pedagogical challenge during the COVID-19 pandemic.

Theoretical frameworks are imperative to the field of educational technology. The literature review, however, revealed that the field of educational technology is largely under-theorised. While the popular technology integration models provide researchers with a basic understanding of the technology integration process, the field of educational technology needs more explicit models that emphasise technology integration as a means to an end and focus on learners.

This study employed the ConTIS framework as its theoretical foundation. The ConTIS model is relatively new in the field of educational technology and has not been extensively examined or documented in previous research. It encompasses the two widely recognised constructs for investigating technology integration in education: TPACK and SAMR. TPACK focuses on teachers' technology integration knowledge, while SAMR offers a framework for teachers to enhance teaching and learning methods. This conceptual framework guided the research questions and influenced the research design, the data collection tools, the data collection procedures, and the subsequent analysis.

Research on pandemic pedagogy is still relatively scarce and studies that systematically explored the relationship between COVID-19, education, and technology are also limited. The literature review revealed the following gaps in scholarship directly related to the aim and purpose of this study.

Gap 1: Teachers as study population

This study addresses the lack of scholarly understanding of how teachers use technology during emergencies. Hence, the overarching question driving this study is:

How did access to ICT impact secondary school teachers' knowledge and use of technology during the COVID-19 pandemic?

Gap 2: Digital divide and Access to ICT

This research addresses the need for a deeper understanding of how teachers with limited access to and knowledge of ICT in teaching conducted their teaching practices virtually during the COVID-19 pandemic.

Gap 3: Teaching practices

This study reflects on the pedagogical strategies and practices of teachers during the COVID-19 pandemic to explore what educational practices worked and could be taken forward.

Gap 4: Teacher-learner interaction

This study addresses the need for more research into engaging and stimulating interactions to keep learners involved and engaged in differing learning contexts.

The **second step** in the research process was to design the research. The research design, outlining the philosophical and methodological framework that guided this study, was presented in Chapter 3.

A qualitative phenomenological design was employed to explore how teachers accessed ICT and their technology practices during the COVID-19 pandemic. The study adopted an interpretivist, posthumanist philosophy to delve into the subjective experiences and interpretations of teachers. An inductive approach was used to extract meaning from the data collected, identifying patterns and relationships.

The research employed targeted purposive sampling to identify and select participants whose characteristics aligned with the study's research aim and objectives. Data was gathered through an online questionnaire and further enriched by a focus group interview for data triangulation. A total of 22 teachers, representing diversity in terms of gender, age, years of teaching experience, and the socio-economic status of their schools, participated in the questionnaire. Additionally, two teachers from different socio-economic and geographical contexts took part in the FGI.

Thirdly, the main findings of this study are presented in Chapter 4.

What teacher **technological pedagogical knowledge** transpired from the COVID-19 pandemic?

In general, the findings of this study reveal that the pandemic had a beneficial effect on teachers' ICT skills and access. The majority of participants indicated an improved understanding of how ICT can be employed in teaching. However, it is unfortunate that these teachers still assessed their knowledge of "teaching with technology" as notably lower than their operational proficiency in ICT following the pandemic.

How did teachers **adapt their use of technology** for teaching and learning during the COVID-19 pandemic?

The key findings of the study were mapped onto the theoretical and conceptual framework (Figure 4.17). These findings indicate that amid the pandemic, teachers shifted from traditional classroom-based instruction to predominantly asynchronous technology-mediated remote teaching. Nevertheless, a significant number of teachers reverted to conventional teaching methods while integrating more technology into their practices after the pandemic. Consequently, the findings highlight the blended nature of post-pandemic teaching practices. In summary, the COVID-19 pandemic resulted in a **change** in traditional teaching practices rather than a fundamental **transformation**.

5.3 Reflection on the study

This section reflects on the lessons that can be learned from this study.

5.3.1 Methodological reflection

This study employed a qualitative survey design to explore the lived experiences of secondary school teachers during the COVID-19 pandemic. The use of questionnaires is firmly rooted in the phenomenological tradition and offers the researcher an efficient means of collecting data from a widely dispersed group of participants.

The questionnaire was created using Google Forms, with careful consideration of the study's conceptual framework and research inquiries when formulating the questions. Before its implementation, the questionnaire underwent a review process by postgraduate peers to enhance its clarity and comprehensibility. It incorporated a consent statement, ensured anonymous submission, and allowed respondents the option to exit the questionnaire at any point.

The researcher also used a focus group interview (FGI) to reflect on and triangulate the data collected from the online questionnaires. This FGI was accomplished by employing a semi-structured approach in an interactive interview environment. The dynamic social interaction allowed participants to freely express themselves and provided a deeper understanding of teaching practices as experienced by the teachers. The FGI was held via Zoom and was recorded. The recordings were transcribed for data analysis purposes.

Online questionnaires and focus group interviews are both valuable research methods, but they come with shared strengths and weaknesses that should be considered when selecting the most appropriate method for the study. The methods selected to use a structured approach, efficiently collect qualitative data from multiple respondents in a short amount of time, are relatively easy to administer, and provide a degree of anonymity that can encourage honest responses.

Both methods, however, rely on the skills of the researcher and require careful planning and a flexible approach. In addition, they may suffer from sampling bias and limited generalisability to larger populations, especially when the sample is not representative. While both methods can collect rich data, the depth of responses may be limited, and analysing data can be complex.

The researcher addressed the potential limitations by carefully planning the process and pilot-testing the methods with a diverse group of individuals to ensure they are clear and unbiased. The researcher reached out to potential participants through multiple channels to ensure diversity in terms of demographics and characteristics to reduce bias. A comfortable and nonjudgmental environment was also established to encourage participants to openly share their opinions. Lastly, the limitations of the sample and potential biases in the findings were recognised and reported.

Applying online questionnaires and focus group interviews, yielded valuable methodological lessons that can inform future research endeavours. The use of these methods taught the researcher the importance of understanding the context in which data is collected and how to integrate and triangulate data from both methods to provide a more comprehensive view of the research topic. The researcher also discovered the importance of adapting research methods based on the challenges encountered during data collection and pivoting and adjusting the approach to optimise data collection and analysis. Another important lesson was understanding the trade-off between obtaining comprehensive data from a large sample and collecting in-depth data from a smaller sample.

Reflecting on the strengths and weaknesses of research methods can lead to continuous improvement in research design, data collection, and analysis in future studies. Incorporating these methodological lessons into future research endeavours can enhance the rigor, validity, and effectiveness of research projects, allowing researchers to navigate challenges more effectively and produce valuable insights.

Table 5.1 summarises the research choices employed and the implications that these had for this study.

Table 5.1: Summary of research choices employed

Research choice	Advantages	Disadvantages	Implications
Online questionnaire	Cost-effective Geographic reach Time efficiency Ease of use Anonymity Confidentiality	Sampling bias Self-selection bias Response rates Lack of control Limited in-depth responses Limited non-verbal cues	• Pretest the questionnaire and refine the questionnaire. • Be cautious when generalising findings to broader populations. • Clearly define the limitations of the sample. • Combine the questionnaire with other methods to provide a more comprehensive understanding of the research topic. • Report clearly to enhance the credibility and replicability of the research.
Focus group interview	Rich qualitative data Group dynamics Social context Comparative analysis Efficient data collection	Conformity Peer pressure Time-consuming Facilitator bias Difficulty in analysis Data transcription	• Carefully plan the composition of focus group. • Guide discussions toward the research objectives while remaining neutral. • Ask open-ended questions to encourage meaningful discussions. • Learn from participants' perspectives and experiences.

5.3.2 Substantive reflection

This section reflects on the substantive contribution of this study to the current body of knowledge on the topic. In 2023, UNESCO published the comprehensive "Global Education Monitoring Report 2023: Technology in Education – A tool on whose terms?" This report largely confirms this study in the following ways (UNESCO, 2023).

Although there is a substantial body of research on educational technology, there is a notable lack of research that delves into specific contexts. Therefore, studies in various educational settings, such as the one conducted in this research, are necessary. It is important to acknowledge that research on technology in education is intricate, and findings that are applicable in one context might not necessarily be transferable to others. This research project sought to bridge this gap by making an original contribution to the field.

A systematic review of empirical research from 2020 and 2021 identified two challenges directly related to the research questions of this study (Mazrooei et al., 2023), namely:

RQ1: Insufficient readiness in terms of **limited accessibility to technological resources** as well as **inadequate technological pedagogical skills**.

RQ2: The **struggle of transforming traditional teaching practices** and adapting to online teaching and learning.

This inquiry explored, summarised and assessed the lived experiences of teachers during the pandemic and, with the understanding gained, opened a dialogue on ways to move forward in the post-pandemic era.

5.3.2.1 Teachers as study population

Increasingly sophisticated ICTs are bound to become increasingly integrated into all facets of life, including education. Research in the field of educational technology operates under the fundamental premise that technology can never supplant the essential human element embodied by teachers. Teachers assume a pivotal role in knowledge dissemination, fostering learning, and nurturing the social development of learners, functions that technology alone cannot accomplish. While there is an increasing expectation for teachers to integrate ICT into their teaching practices, it is crucial to establish a relationship between teachers and technology that emphasises complementarity rather than substitutability.

In practical terms, many teachers harbour reservations about technology, and numerous obstacles impede them from fully harnessing the potential of technological tools. Teachers often encounter hindrances in their use of technology, primarily stemming from a lack of proficiency and confidence in its application. Additional barriers encompass concerns that technology may divert learners' attention from the learning process and a dearth of support to enhance their ICT skills and employ them effectively in teaching.

In general, a significant proportion of teachers are ill-prepared for "teaching with technology." Going forward, it is imperative to develop educational environments that necessitate, motivate, enable and induce (even compel) teachers to use ICT to create more engaging and relevant learning environments.

5.3.2.2 Access to ICT

Historically ICT has been employed to address various challenges in education, including issues related to remote locations and situations such as civil unrest or natural disasters. The global disruption caused by the COVID-19 pandemic not only disrupted education globally but also demonstrated how 21st-century digital technology can offer innovative educational platforms.

While digital technology holds the potential to revolutionize education and narrow the disparities in access, the COVID-19 pandemic underscored the significant challenge of unequal access to ICT. Achieving equitable access to ICT remains an elusive goal, placing many teachers and learners at risk of falling behind. In general, teachers in low- and middle-income settings encounter greater limitations in accessing ICT resources.

Obstacles related to infrastructure and device availability loom large as a major impediment. To compensate for the lack of school resources, many teachers resort to using their personal digital devices. Another substantial challenge lies in the deficiency of ICT skills, prompting teachers to rely on their resourcefulness during ERT.

Addressing these issues necessitates the formulation of comprehensive, long-term strategies aimed at enhancing teacher access to ICT, bolstering the resilience of the education system, and ensuring the sustainability of ICT initiatives in education. Beyond merely training teachers to use technology, it is imperative to incorporate technology as a means of teacher training, thereby transforming the way teachers acquire new skills and knowledge.

5.3.2.3 Teaching practices

Overall, ICT has **changed** but not **transformed** education. While innovations in technology create new opportunities, it is often the pedagogical practices that offer the most potential as transformation drivers. Research on ICT in education must thus include both technology and teaching practices.

The global pandemic forced a paradigm shift and reconfiguration of teaching and learning through LMS (Ndou et al., 2021). While the most widely used LMS, Moodle, is free and open source, most schools were not prepared for the implementation of an LMS. In South Africa, the use of LMS is challenged by the lack of reliable ICT infrastructure, specifically in rural areas, and poor Internet connectivity (Ndou et al., 2021).

Due to widespread ownership, even among individuals with limited resources, the mobile phone emerges as the most widely accessible device that holds potential for educational applications during emergencies. Teachers predominantly employ mobile phones for basic functions like the asynchronous sharing of educational materials and interaction with students. Unfortunately, existing research on educational technology primarily concentrates on smartphones, which are essentially advanced, internet-enabled mobile phones.

The use of mobile devices, such as smartphones, is a highly contentious and debated topic and many countries are considering limiting or banning the in-school use of mobile devices. The main reason for banning mobile devices is that mobile devices disrupt classroom activity and distract learners from learning. Shielding learners from ICT by merely banning mobile devices from schools, may however put learners at a disadvantage.

There is a need for policies that enable schools to provide safe online environments. Enforceable policies can regulate the in-school use of mobile devices. These policies should be clear on the role of mobile technology in schools, what use is and is not permitted, and educate teachers and learners about the risks and opportunities that come with technology.

The Western Cape Education Department, for example, recently published comprehensive guidelines on mobile technology, including cellular phones, in public schools (WCED, 2021). These guidelines aim to create awareness about the opportunities and risks presented by mobile devices within the learning environment and assist public schools in developing their policies to regulate the use of cellular phones and mobile devices at their schools.

.

5.3.2.4 Teacher-learner interaction

Research in the field of educational technology recognises the essential human and social aspects that constitute the core of the educational process. Digital technology is seen not as a replacement but as a complementary tool that enhances in-person interactions between teachers and learners.

The teacher-learner interaction faced significant challenges during the COVID-19 pandemic. Teachers resorted to various applications and platforms to engage with their students. In the absence of an LMS, most teachers turned to free platforms like Google Classroom and WhatsApp to facilitate their teaching and learning activities.

5.3.3 Major findings and implications of the study

The major findings and implications of the study are summarised in Table 5.2.

Table 5.2: Major findings and implications of the study

Problems / Answers from the literature		My findings/answers	Implications
RQ1: What teacher technological pedagogical knowledge transpired from the COVID-19 pandemic? *Knowledge gap: Teachers as study population* *Knowledge gap: Access to ICT – Skills access*			
1.	Teachers are not prepared to teach with ICT.	• ICT access does not follow a simple step-by-step process that automatically results in usage. • To create educational environments that facilitate ICT use, we require a more interconnected and relational approach to access.	• Policymakers must follow a more holistic contextualised approach that considers all the dimensions of access to ICT. • Teacher training institutions must focus on developing teachers' ICT competence.
2.	Lack of knowledge and confidence in using ICT.		
3.	Increase teachers' access to digital devices.		
4.	Develop ICT skills of teachers.		
RQ2: How did teachers adapt their use of technology for teaching and learning during the COVID-19 pandemic? *Knowledge gap: Teaching practices* *Knowledge gap: Teacher-learner interaction*			
1.	ICT changed, not transformed, teaching practices.	• Blended character of post-pandemic teaching practices. • ICT is used to enhance, rather than fundamentally transform traditional teaching practices. • Need for a functional LMS for the administration and delivery of educational programmes.	• A school's maturity and readiness level for ICT must inform its ICT integration strategy. • Schools must develop a comprehensive ICT strategy for the adoption and use of ICT. • School contexts must motivate and empower teachers to use ICT in their teaching practices.
2.	Limited access to and use of LMS.		
3.	Social media platforms, e.g. WhatsApp, are used to interact with learners,		
4.	Ban on in-school use of mobile devices.		
5.	Need for policy for use of mobile devices.		

5.4 Contributions of the study

This research project offers the following contributions to the current body of knowledge on educational technology:

5.4.1 General theoretical and practical insights

- The study addressed and partially filled the **paucity of scholarship** on school education during emergencies, by exploring and assessing the technology practices of secondary school teachers during the COVID-19 pandemic and the implications of these experiences for the future.

- The application of **ANT as a theoretical lens** offers a unique perspective on the interplay between human and non-human actors in the socio-technical process of ICT appropriation in schools. This study shows that while ANT is complex, it allows for a more nuanced understanding of social phenomena.

- The design, development and application of a **hybrid rubric based on the ConTIS model**, including both the TPACK and SAMR models, to locate teachers' 'teaching with technology' knowledge and practices.

- The findings emphasise the importance of considering the **e-readiness of schools** when designing for the sustainability of ICT interventions.

- The study highlights the **critical importance of CONTEXT** in the dynamics of access to and use of ICT in schools (Figure 5.1).

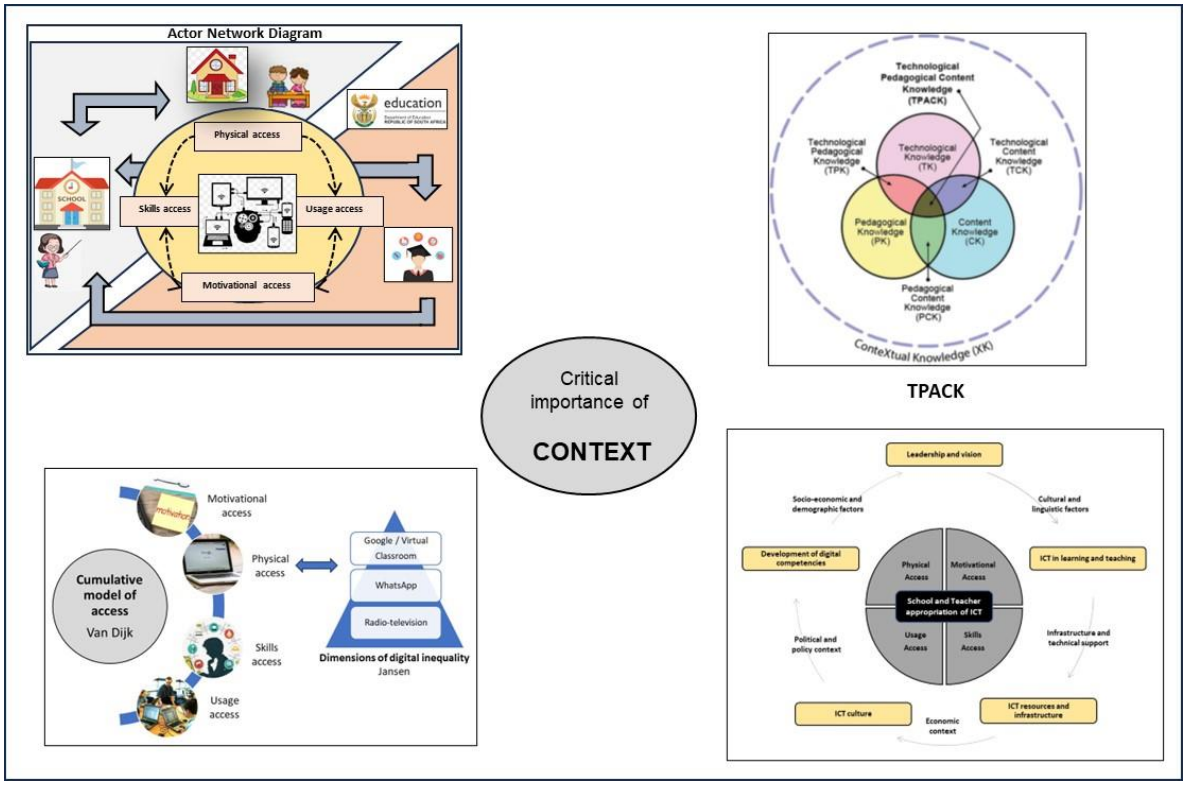


Figure 5.1: The critical importance of CONTEXT

The following constructs employed in or developed during the study all recognise and incorporate **CONTEXT** as a key variable:

- Jansen's dimensions of digital inequality add a South African **contextual element** to Van Dijk's cumulative model of access.
- The ANT diagram includes **various contexts** that impact access to and use of ICT.
- The revised TPACK model provides for **Contextual Knowledge (XK).**
- The ContextAware ICT Appropriation model (CAIA) expands on Van Dijk's cumulative model of access by incorporating **various contextual elements**.

5.4.2 Original contribution

Building on Van Dijk's cumulative model of access, this study proposes an ICT appropriation model that considers and incorporates broader contextual factors and indicators of school readiness for ICT integration. The **ContextAware ICT Appropriation model (CAIA)** is illustrated in Figure 5.2.

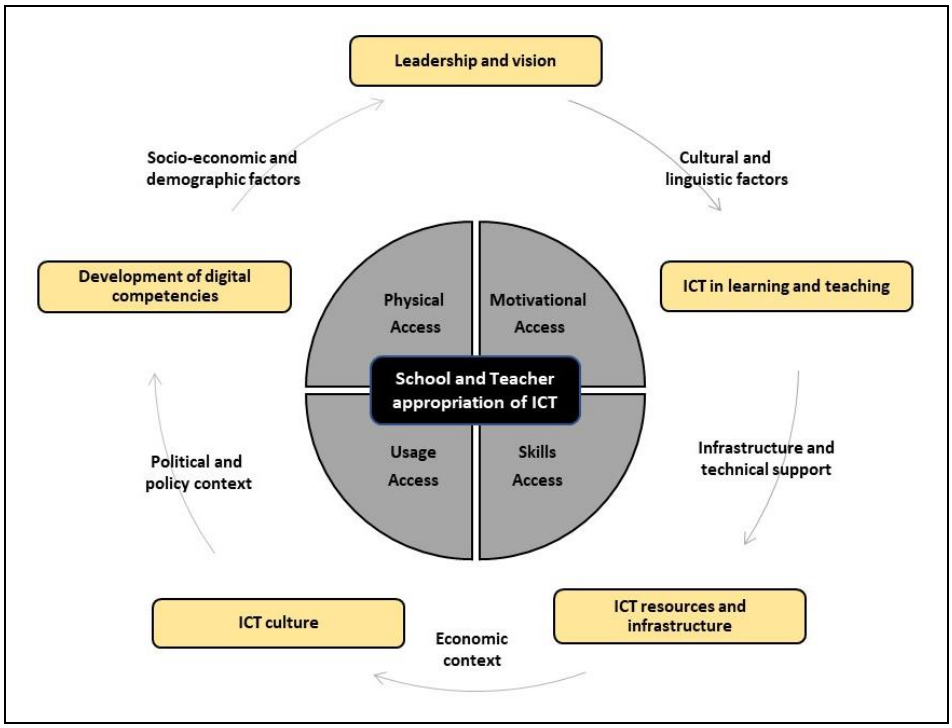


Figure 5.2: ContextAware ICT Appropriation model (CAIA) (Author's construct)

The model's name effectively conveys its emphasis on context awareness within ICT access. It underscores the importance of adapting to various contextual factors when dealing with ICT, and its acronym, CAIA, offers a succinct reference for discussions and documentation. This suggests that the model is attuned to users' specific needs and circumstances, a valuable feature in the domain of ICT accessibility and use. Overall, CAIA is a robust choice for a model emphasising context awareness in ICT access.

The researcher believes that this study has enriched the theoretical and practical aspects of the field, laying a foundation for future research. Evaluating the CAIA model's practical effectiveness and its ability to overcome the limitations of isolated technology interventions is essential. The researcher advocates for future studies to assess the practicality and effectiveness of the proposed CAIA model. This encourages further examination of the model's real-world applicability and efficiency.

Applying the model will provide a comprehensive understanding of a school's strengths and weaknesses in terms of technology integration. This knowledge should guide the school's ICT integration strategy and plans, ensuring the sustainability of ICT implementation projects within educational institutions.

5.5 Recommendations

The findings of this study revealed the incremental increase in the technological pedagogical knowledge of teachers and the **change**, rather than **transformation**, of teaching practices as a result of the COVID-19 pandemic. Following from these findings, the following recommendations are suggested for the improvement of policy, practice, and further research on these and related issues.

5.5.1 Policy

Educational (technology) policy guides and facilitates access to, adoption and use of ICT in the education system (Mwapwele et al., 2019). Unfortunately, South African education policymakers narrowly focus on physical access to ICT. Policymakers should follow a more holistic approach that considers the broader contextual factors, including human and non-human actors, that influence access to and use of ICT and how they are interconnected.

5.5.2 Practice

Firstly, schools should develop a comprehensive ICT strategy, setting out the aims, principles, and strategies for the adoption and use of ICT, with the input of all stakeholders. This strategy should reflect the beliefs, attitudes, and practices associated with ICT, assist teachers and learners in navigating through the ICT environment, and facilitate the integration of ICT in teaching and learning.

Secondly, schools should continuously monitor and improve their e-readiness, in other words, the school's capacity and capability to provide appropriate structures to deliver effective educational experiences using ICT. This ICT strategy and e-readiness level should inform the school's ICT integration strategy and plans. Schools and teachers should also continue experimenting with new technologies and new applications of existing technologies to improve the sustainability of the quality and quantity of teaching and learning inputs, processes, support, outputs, outcomes, and impacts.

5.5.3 Further development

The paper-based e-Readiness Assessment Tool for Schools of the DSI must be further refined as proposed for the development of a better digital e-Readiness Tool that can be implemented by national and provincial departments of education and schools.

5.5.4 Further research

The need for incorporating technology in education is expected to persist, making ICT access increasingly vital. There is a growing requirement for more comprehensive research focusing on schools and teachers who have chosen not to return to conventional classroom-based teaching. What measures should these schools take to establish a more supportive context for ICT use and empower teachers to integrate ICT into their teaching practices?

Considering the findings of this study, the following avenues for future research are suggested:

- **Impact of crisis on education:** Scholarship may examine how crises influenced education systems to reveal challenges and opportunities for technology integration during emergencies. Such studies can shed light on how teachers and learners adopt and integrate technology during crises or other disruptive events. It may explore the challenges faced during technology adoption and strategies for overcoming them.

- **Equity and access:** Scholarship may address issues of equity and access in technology-mediated interactions, highlighting disparities in digital access and the implications for learners from different socio-economic backgrounds. Studies can explore the importance of a robust technological infrastructure and technical support systems to ensure smooth technology-mediated interactions.

- **Pedagogical innovation:** Research can provide insights into different pedagogical approaches used in online or virtual learning environments, focusing on how teachers design and deliver their lessons, and how learners engage with the material. Researchers may explore innovative pedagogical practices made possible through technology, such as blended learning and personalised learning experiences.

By drawing connections between the research findings and relevant theoretical concepts, this study contributes to the ongoing dialogue within the academic field, paving the way for further research and discussion.

Final thoughts

My PhD journey has been a transformative experience that has not only expanded my knowledge within my research field but has also cultivated critical thinking, resilience, and adaptability. Through countless hours of research, experimentation, and collaboration, I have learned the value of persistence and the ability to navigate the complexities of academia. This journey has not only shaped me as a researcher but has also provided me with invaluable life skills and a profound sense of accomplishment.

REFERENCES

Adnan, M. & Anwar, K. 2020. Online learning amid the COVID-19 pandemic: students' perspectives. *Journal of Pedagogical Research*, 2:45-51.

Affouneh, S., Salha, S. & Khlaif, Z. 2020.'Designing quality e-learning environments for emergency remote teaching in Coronavirus crisis*, Interdisciplinary Journal of Virtual Learning in Medical Sciences*, 11(2):135-137.

Ahmad, C.N., Shaharim, S.A. & Abdullah, M.F.N.L. 2017. Teacher-student interactions, learning commitment, learning environment and their relationship with student learning comfort. *Journal of Turkish Science Education*, 14(1):57–72.

Alahmari, A. & Kyei-Blankson, L. 2016. Adopting and implementing an e-learning system for teaching and learning in Saudi public K-12 schools: The benefits, challenges, and concerns. *World Journal on Educational Research*, 3(1):11–32.

Alhumaid, K., Ali, S., Waheed, A., Zahid, E. & Habes, M. 2020. COVID-19 & e-learning: perceptions & attitudes of teachers towards e-learning acceptance in the developing countries. *Multicultural Education*, 6(2):100-115.

Alivi, S.J. 2019. A review of TPACK and SAMR models: How should language teachers adopt technology? *Journal of English for Academic and Specific Purposes*, 2(2):1–11.

Aliyu, A.A., Singhry, I.M., Adamu, H. & Abubakar, M.M. 2015. Ontology, epistemology and axiology in quantitative and qualitative research: Elucidation of the research philosophical misconception*. Proceedings of the Academic Conference: Mediterranean Publications & Research International on New Direction and Uncommon Vol. 2 No. 1. 22nd December 2015*. University of Agriculture, Abeokuta, Abeokuta, Ogun State, Nigeria.

Almutairi, F.M., Ali, N.G.H. & Ghuloum, H.F. 2021. A novel framework for facilitating emergency remote learning during the COVID-19 pandemic. *International Education Studies*, 14(5):121.

Anney, B. 2014. Ensuring the quality of the finds of qualitative research: Looking at the trustworthiness criteria. *Journal of Emerging Trend in Educational Research and the Policy Studies*, 5:272-281.

Anthony Jnr, B. & Noel, S. 2021. Examining the adoption of emergency remote teaching and virtual learning during and after COVID-19 pandemic. *International Journal of Educational Management*, 35(6):1136–1150.

Arnett, T. 2021. Breaking the mold: How a global pandemic unlocks innovation in K-12 instruction. *Clayton Christensen Institute for Disruptive Innovation.*

Badia, A., Barberà, E., Guasch, T. & Espasa, A. 2011. Technology educational affordance: Bridging the gap between patterns of interaction and technology usage. *Digital Education Review,* 19(1):20–35.

Barbour, M.K., LaBonte, R., Hodges, C. & Moore, S. 2020. *Understanding pandemic pedagogy: differences between emergency remote, remote, and online teaching. State of the Nation: K-12 e-Learning in Canada*, December: 1–24.

Biggerstaff, D.L. & Thompson, A.R. 2008. *Interpretative phenomenological analysis.*

Bishop, P.A. 2021. Middle grades teacher practices during the COVID-19 pandemic. *RMLE Online*, 44(7):1–18.

Blaikie, F., Daigle, C. & Vasseur, L. 2020. *New pathways for teaching and learning: the posthumanist approach*. Canadian Commission for UNESCO.

Bond, M. 2020. Schools and emergency remote education during the covid-19 pandemic: A living rapid systematic review. *Asian Journal of Distance Education*, 15(2):191–247.

Bond, M. 2022. Global emergency remote teaching during the COVID-19 pandemic: *Thoughts and findings of online learning during COVID*.

Bond, M., Bergdahl, N., Mendizabal-Espinosa, R.M., Kneale, D., Bolan, F., Hull, P. & Ramadani, F. 2021. *Global emergency remote education in secondary schools during the COVID-19 pandemic: A systematic review*. London.

Bozkurt, A. & Sharma, R.C. 2020. *Emergency remote teaching in a time of global crisis due to Corona virus pandemic.* Contemporary teaching and learning techniques for distance education view project virtual reality view project. 15(1):1–6.

Bozkurt, A. 2020. Educational Technology Research Patterns in the Realm of the Digital Knowledge Age. *Journal of Interactive Media in Education*, 2020(1):18.

Bozkurt A., Karakaya K., Turk M., Karakaya Ö. & Castellanos-Reyes D. 2022. The Impact of COVID-19 on Education: A Meta-Narrative Review. *TechTrends*, 66(5):883-896

Bulmer, M. 2008. The Ethics of Social Research. In N. Gilbert, ed. *Researching social life*. London: SAGE Publications: 59–89.

Burns, M. 2021. *Technology in education: Background paper prepared for the 2023 Global Education Monitoring Report.* https://unesdoc.unesco.org/ark:/48223/pf0000378951.

Callary, B., Rathwell, S. & Young, B.W. 2015. Insights on the Process of Using Interpretive Phenomenological Analysis in a Sport Coaching Research Project. *The Qualitative Report*, 20(1):63–75.

Charbonneau-Gowdy, P. 2023. *Designing the 'new normal': Key insights from the pandemic for transforming online learning going forward*. 15(3).

Cherner, T. & Mitchell, C. 2021. Deconstructing EdTech frameworks based on their creators, features, and usefulness. *Learning, Media and Technology*, 46(1):91–116.

Chisango, G. 2021. The digital divide at three disadvantaged secondary schools in Gauteng, South Africa. *Journal of Education*, 82.

Chou, C., Peng, H.Y. & Chang, C.Y. 2010.The technical framework of interactive functions for course-management systems: students' perceptions, uses, and evaluations. *Computers & Education*, 55(3):1004-1017.

Clarke, B. 2013. Using thematic analysis in psychology. *Journal of Chemical Information and Modeling*, 53(9):1689–1699.

Cohen, L., Manion, L. & Morrison, K. 2007. *Research methods in education*. 6th ed. London: Routledge Falmer.

Creswell, J. & Creswell, J. D., 2018*. Research design: qualitative, quantitative, and mixed methods approaches.* 5th Edition ed. Thousand Oaks, United States: SAGE-Publications Inc.

Creswell, J. W., 2007. *Qualitative inquiry and research design: choosing among five approaches.* 2nd ed. Thousand Oaks: SAGE Publications.

Creswell, J.W. & Miller, D.L. 2000. Determining validity in qualitative research. *Theory into Practice*, 39(3):124–130.

Crompton, H., Burke, D., Jordan, K. & Wilson, S.W.G. 2021. Learning with technology during emergencies: A systematic review of K-12 education. *British Journal of Educational Technology*, 52(4):1554–1575.

Crompton, H., Chigona, A. & Burke, D. 2023. Teacher resilience during COVID-19: comparing teachers' shift to online learning in South Africa and the United States. *TechTrends*, 20:1-14.

Culkin, J. 1967. A schoolman's guide to Marshall McLuhan. The *Saturday Review*, 51–53, 70–72.

Czerniewicz, L. & Brown, C. 2005. Access to ICT for teaching and learning: From single artefact to inter-related resources. *Journal of Education*, 1(2):42–56.

Czerniewicz, L., Trotter, H. & Haupt, G. 2019. Online teaching in response to student protests and campus shutdowns: academics' perspectives. *International Journal of Educational Technology in Higher Education*, 16(1).

Demuyakor, J. 2020. Coronavirus (COVID-19) and online learning in higher institutions of education: A survey of the perceptions of Ghanaian international students in China. *Online Journal of Communication and Media Technologies*, 10(3).

Denzin, N.K. & Lincoln, Y.S. 2011. *The SAGE Handbook of Qualitative Research*. CA: SAGE Publications.

Dorfsman, M. & Horenczyk, G. 2022. The coping of academic staff with an extreme situation: The transition from conventional teaching to online teaching. *Education and Information Technologies*, 27(1):267–289.

Dube, B. 2020. Rural online learning in the context of COVID-19 in South Africa: Evoking an inclusive education approach. *Multidisciplinary Journal of Educational Research*, 10(2):135–157.

Eatough, V. & Smith, J.A. 2007. *Interpretative phenomenological analysis*. In The SAGE Handbook of qualitative research in psychology. 179–194.

Ewing, L.A. & Cooper, H.B. 2021. Technology-enabled remote learning during Covid-19: perspectives of Australian teachers, students and parents. *Technology, Pedagogy and Education*, 30(1):41–57.

Eynden, V. Van Den & Brett, B.M. 2010. *Research Ethics and Data Confidentiality*: Informed Consent. Cape Town.

Fenwick, T. & Edwards, R. 2012. *Researching Education Through Actor-Network Theory.* John Wiley & Sons.

Ferri, F., Grifoni, P. & Guzzo, T. 2020. Online learning and emergency remote teaching: Opportunities and challenges in emergency situations. *Societies*, 10(4).

Flyvberg, B. 2006. Five misunderstandings about case-study research. *Qualitative Inquiry*, 12(2):219–245.

Fuchs, K. 2022. The difference between emergency remote teaching and e-learning. *Frontiers in Education*, 7.

Giacosa, A.M. 2020. Can Emergency Remote Education make our universities "smarter "? Some reflections based on students' perceptions. Research Gate, (November).

Given, L.M. & Saumure, K. 2008. *Trustworthiness*. In L. M. Given, ed. The SAGE Encyclopedia of Qualitative Research Methods.

Gonzales, J.K.P. 2020. Rising from COVID-19: private schools' readiness and response amidst a global pandemic. *International Multidisciplinary Research Journal*, 2(2):81–90.

Haider, S. A. & Al-Salman, S. 2020. COVID-19's impact on the higher education system in Jordan: advantages, challenges, and suggestions. *Humanities & Social Sciences Reviews*, 8(4):1418–1428.

Hall, T., Connolly, C., Ó Grádaigh, S., Burden, K., Kearney, M., Schuck, S., Bottema, J., Cazemier, G., Hustinx, W., Evens, M., Koenraad, T., Makridou, E. & Kosmas, P. 2020. Education in precarious times: a comparative study across six countries to identify design priorities for mobile learning in a pandemic. *Information and Learning Science*, 121(5–6): 423–432.

Hamilton, E. R., Rosenberg, J. M., & Akcaoglu, M. 2016. Examining the Substitution Augmentation Modification Redefinition (SAMR) model for technology integration. *TechTrends*, 60:433-441.

Hammersley, M. 2007. The issue of quality in qualitative research*. International Journal of Research & Method in Education*, 30(3):287–305.

Hammersley, M., 2013. *What is Qualitative Research?* London and New York: Bloomsbury.

Hartshorne, R., Baumgartner, E., Kaplan-Rakowski, R., Mouza, C. & Ferdig, R.E. 2020.

Special issue editorial: Preservice and in-service professional development during the COVID-19 pandemic. *Journal of Technology and Teacher Education*, 28(2):137–147.

Hennessy, S., Jordan. K., Wagner, D.A., & EdTech Hub team 2021. Problem analysis and focus of edtech hub's work: technology in education in low- and middle-income countries. [Working Paper 7]. *EdTech Hub*. DOI: 10.5281/zenodo.4332693.

Hicks, D., Tech, V., Lisanti, M. & Van Hover, S. 2020. Shifting the gaze: (mis)using actor-network-theory to examine preservice teachers' uses of digital technologies. *Contemporary Issues in Technology and Teacher Education*, 20(4):730–742.

Hodgman, S., Sabatini, A.& Carminucci, J. 2021. *National survey of public education's response to COVID-19: Teacher interactions with students and families during COVID-19*. American Institutes for Research (AIR)

Hirumi, A. 2009. *A framework for analyzing, designing and sequencing planned e-learning interactions*. In: A. Orellana, T. L. Hudgins, and M. Simonson (Eds.). The perfect online course: Best practices for designing and teaching. Charlotte, NC: Information Age Publishing. 201–228.

Huck, C. & Zhang, J. 2021. Effects of the covid-19 pandemic on k-12 education: a systematic literature review. *New Waves-Educational Research and Development Journal*, 24(1):53–84.

Jackson, E. 2013. Choosing a methodology: philosophical underpinning. *Practitioner Research in Higher Education Journal*, 7(71):49–62.

Jansen, J. (2020) Data or bread? A policy analysis of student experiences of learning under lockdown. *Southern African Review of Education*, 26(1):167–181.

Jelińska, M. & Paradowski, M.B. 2021. Teachers' engagement in and coping with emergency remote instruction during COVID-19-induced school closures: A multinational contextual perspective. *Online Learning Journal*, 25(1):303–328.

Jori, B.S. 2014. *Changing the narrative of teacher preparation: a case study of faculty methods at an urban teacher residency.* George Mason University.

Jung, I., Choi, S., Lim, C. & Leem, J. 2002. Effects of different types of interaction on learning achievement, satisfaction and participation in Web-based instruction*. Innovations in Education and Teaching International*, 39(2):153–162.

Kabaka, M. & Stoltenkamp, J. 2013. eLearning tools for public awareness programme education in disaster risk management: Case study of the City of Cape Town disaster risk management centre. *Proceedings of the International Conference on e-Learning*, ICEL:488–495.

Kang, M. & Im, T. 2013. Factors of learner-instructor interaction which predict perceived learning outcomes in online learning environment. *Journal of Computer Assisted Learning*, 29(3):292–301.

Katsarou, E. & Chatzipanagiotou, P. 2021. A critical review of selected literature on learner-centered interactions in online learning. *Electronic Journal of e-Learning*, 19(5):349–362.

Kihoza, P., Zlotnikova, I., Bada, J. & Kalegele, K. 2016. Classroom ICT integration in Tanzania: Opportunities and challenges from the perspectives of TPACK and SAMR models. *International Journal of Education and Development using Information and Communication Technology*, 12(1):107–128.

Kimmons, R., Graham, C.R. & West, R.E. 2020. *The PICRAT model for technology integration in teacher preparation.*

Kipnis, A.B. 2015. Agency between humanism and posthumanism Latour and his opponents. *Journal of Ethnographic Theory*, 5(2):43–58.

Korstjens, I. & Moser, A. 2018. Series: Practical guidance to qualitative research. Part 4: Trustworthiness and publishing. *European Journal of General Practice*, 0(0):120–124.

Landa, N., Zhou, S. & Marongwe, N. 2021. Education in emergencies: Lessons from COVID-19 in South Africa. *International Review of Education*, 67(1–2):167–183.

Laprairie, K.N. & Hinson, J.M. 2006. When disaster strikes, move your school online. *Journal of Educational Technology Systems*, 35(2):209–214.

Latour, B. (2005). *Reassembling the social*. Oxford, UK: Oxford University Press.

Law, J. (2009). *Actor network theory and material semiotics.* In B. Turner (Ed.), The new Blackwell companion to social theory (pp. 141–158). London, UK: Blackwell Publishing.

Le, V.T., Nguyen, N.H., Tran, T.L.N., Nguyen, L.T., Nguyen, T.A. & Nguyen, M.T. 2022. The interaction patterns of pandemic-initiated online teaching: How teachers adapted. *System*, 105.

Leung, L. 2015. Validity, reliability, and generalizability in qualitative research. *Journal of Family Medicine and Primary Care*, 4(3):324–327.

Lie, A., Tamah, S.M. & Gozali, I. 2023. Appropriating TPACK in preparation for hybrid learning: Innovations in teaching practices. *MexTESOL Journal*, 47(3):0–3.

Lie, A., Tamah, S.M., Gozali, I., Triwidayati, K.R., Utami, T.S.D. & Jemadi, F. 2020. Secondary school language teachers' online learning engagement during the COVID-19 pandemic in Indonesia. *Journal of Information Technology Education*: Research, 19:803–832.

Lynch, T. 2013. *Writing up qualitative research: Methodology*. English Language Teaching Center, 2461(2):1–9.

Mailizar, Almanthari, A., Maulina, S. & Bruce, S. 2020. Secondary school mathematics teachers' views on e-learning implementation barriers during the COVID-19 pandemic: The case of Indonesia. *Eurasia Journal of Mathematics, Science and Technology Education*, 16(7).

Martini, M., Gazzaniga, V., Bragazzi, N.L. & Barberis, I. 2019. *The Spanish influenza pandemic: A lesson from history 100 years after 1918.*

Matthews, A. 2021. Blurring boundaries between humans and technology: postdigital, postphenomenology and actor-network theory in qualitative research. *Qualitative Research in Sport, Exercise and Health*, 13(1):26–40.

Maxwell, J., 2013. *Qualitative research design: An interactive approach*. 3rd ed. Thousand Oaks, CA: Sage Publications.

Maxwell, J.A. 2008. *Designing a Qualitative Study*. In L. Bickman & D. Rog, eds. The Sage handbook of applied social research methods. London. London: Sage: 214–253.

Mazrooei AK., Hatem Almaki S., Gunda M., Alnoor A. & Manji Sulaiman S. 2023. A systematic review of K-12 education responses to emergency remote teaching during the COVID-19 pandemic. *Int Rev Educ 2022;* 68(6):811-841.

Mbhiza, H.W. 2021. Shifting paradigms: Rethinking education during and post-COVID-19 pandemic. *Research in Social Sciences and Technology*, 6(2):279–289.

McCarty, S. 2021. Online education as a discipline. *Academia Letters.*

Mehall, S. 2020. Purposeful interpersonal interaction in online learning: What is it and how is it measured? *Online Learning Journal*, 24(1):182–204.

Merriam, S.B. 1998. *Qualitative research and case study applications in education.* San Francisco California: Jossey-Bass.

Merriam, S.B. 2002. *Introduction to qualitative research*. Josse Bass - John Wiley& Sons.

Merriam, S.B. 2009. *Qualitative research: a guide to design and implementation*. San Francisco, CA: Jossey-Bass.

Mishra, P. & Koehler, M. J., 2006. Technological pedagogical content knowledge: A framework for teacher knowledge. *Teachers College Record*, 108(6):1017-1054.

Mishra, P. 2019. Considering Contextual Knowledge: The TPACK diagram gets an upgrade. *Journal of Digital Learning in Teacher Education.*

Mlitwa, N.B.W. 2007. Technology for teaching and learning in higher education contexts: activity theory and actor network theory analytical perspectives. *International Journal of Education and Development Using Information and Communication Technology* (IJEDICT), 3 (4):54-70.

Moore, M.G. 1989. Three types of interaction. *Educational Technology for Learning*, 3(2):1–7.

Moore, M. G. 2007. *The theory of transactional distance.* In: M. G. Moore (Ed.), Handbook of distance education (2nd Ed.). Mahwah, NJ: Erlbaum. 32-46.

Moorhouse, B.L. & Kohnke, L. 2021. Thriving or Surviving Emergency Remote Teaching Necessitated by COVID-19: University Teachers' Perspectives. *Asia-Pacific Education Researcher*, 30(3):279–287.

Moyo, R., Ngidi, S., Koai, M. & Lemeko, P. 2022. Online teaching and learning experiences of higher education lecturers and students in the COVID-19 era: A leap to digital pedagogies? *Journal of Culture and Values in Education*, 5(1):23–42.

Mseleku, Z. 2020. A literature review of e-learning and e-teaching in the era of Covid-19 pandemic. *International Journal of Innovative Science and Research Technology,* 5(10):588–597.

Murphy, M.P.A. 2020. COVID-19 and emergency e-learning: Consequences of the securitization of higher education for post-pandemic pedagogy. *Contemporary Security Policy,* 41(3):492–505.

Mwapwele, S. D., Marais, M., Dlamini, S., & Van Biljon, J. (2019). Teachers' ICT adoption in South African rural schools: A study of technology readiness and implications for the South Africa Connect broadband policy. *The African Journal of Information and Communication (*AJIC), 24:1-21.

Ndou, K., Mashau, N.L. & Chigada, J. 2021*. Learning Management Systems as a platform for information sharing during the COVID-19*:1–8.

Neuman, W.L. 2017. *Social research methods: qualitative and quantitative approaches*.

Nguyen, C.T. 2015. The interconnection between interpretivist paradigm and qualitative methods in education. *American Journal of Educational Science*, 1(2):200

Padayachee, K. 2017. A snapshot survey of ICT integration in South African schools. *South African Computer Journal*, 29(2):36–65.

Padmanabhanunni, A. & Pretorius, T. 2023. The resilience of South African school teachers in the time of COVID-19: Coping with risk of infection, loneliness, and anxiety. *International Journal of Environmental Research and Public Health*, 20(4).

Patwardharr, V., Rao, S., Thirugnanasambantham, C. & Prabhu, N. 2020. Community of inquiry (Col) framework and course design as predictors of satisfaction in emergency remote teaching: Perspectives of hospitality management students. *Journal of E-Learning and Knowledge Society*, 16(4):94–103.

Peters, M.A., Wang, H., Ogunniran, M.O., Huang, Y., Green, B., Chunga, J.O., Quainoo, E.A., Ren, Z., Hollings, S., Mou, C., Khomera, S.W., Zhang, M., Zhou, S., Laimeche, A., Zheng, W., Xu, R., Jackson, L. & Hayes, S. 2020. China's internationalized higher education during COVID-19: collective student autoethnography. *Postdigital Science and Education*, 2(3): 968–988.

Pietkiewicz, I. & Smith, J.A. 2012. A practical guide to using interpretative phenomenological analysis in qualitative research psychology*. Czasopismo Psychologiczne* (Psychological Journal), 18(2):361–369.

Piyatamrong, T., Derrick, J. & Nyamapfene, A. 2021. Technology-mediated higher education provision during the COVID-19 pandemic: A qualitative assessment of engineering student experiences and sentiments. *Journal of Engineering Education Transformations*, 34 (Special Issue):290–297.

Policy Brief. 2018. *Innovation for inclusive development. school readiness to use information and communication technology for education in South Africa*. Department of Science and Technology, and the Council of Scientific and Industrial Research.

Puentedura, R., 2009*. Learning, technology, and the SAMR model: Goals, processes, and practice.*

Puentedura, R., 2013. *SAMR: A contextualised introduction.* Available at: http://www.hippasus.com/rrpweblog/archives/2013/10/25/SAMRAContextualizedIntroduction.pdf

Rowan, L. & Bigum, C. 2003. Actor network theory and the study of online learning: New perspectives on quality. In *IFIP Advances in Information and Communication Technology*. 179–188.

Ryan, G. 2018. Introduction to positivism, interpretivism and critical theory. *Nurse Researcher*, 25(4):14–20.

Ryan, K.E., Gandha, T., Culbertson, M.J. & Carlson, C. 2014. Focus group evidence: Implications for design and analysis. *American Journal of Evaluation*, 35(3):328–345.

Sackstein, S L. 2021. Understanding external structures, teachers' beliefs, professional dispositions, orientation towards technology and technology use in South African secondary schools: A longitudinal micro-, meso- and meta-theory perspective.

Sadeck, O.G. 2016. An exploration of e-learning practices of teachers at selected schools in the Western Cape. Thesis: Faculty of Informatics and Design, Cape Peninsula University of Technology, South Africa., (May):1–281.

Sahin, I. & Shelley, M. (Eds.). 2020. E*ducational practices during the COVID-19 viral outbreak: International perspectives*. ISTES Organization.

Santandreu Calonge, D., Connor, M., Hultberg, P., Shah, M.A. & Medina Aguerrebere, P. 2021. Contactless higher education: A swot analysis of emergency remote teaching and learning during COVID-19. *Journal of Educational Studies and Multidisciplinary Approaches*, 2(1):17–36.

Sason, H. & Kellerman, A. 2021. Teacher-student interaction in distance learning in emergency situations. *Journal of Information Technology Education: Research*, 20:479–501.

Saunders, M., Lewis, P. & Thornhill, A. 2003. *Research methods for business students*. 3rd ed. Harlow: Pearson Education.

Sayed, Y., Singh, M., Henry, M., Williams, D., Metcalfe, M., Bulgrin, E., Pesambili, J. & Mindao, G. 2021. Teacher Support, Preparedness and Resilience During Times of Crises and Uncertainty: COVID-19 and Education in The Global South. *Journal of Education*, 84.

Schad, M.L., Greene, M.D. & Jones, M. 2021. A review of theory, theoretical and conceptual frameworks in educational technology*. International Journal on E-Learning: Corporate, Government, Healthcare, and Higher Education*, 20(2):187–198.

Schleicher, A. 2020. *The Impact of Covid-19 on Education: Insights from education at a glance 2020.*

Selvaraju, P., Tu, C.H., Yen, C.J. & Chan, &. 2012*. Interaction in online learning environments.* A Review of the Literature Related papers.

Sharin, A.N. 2021. *E-Learning During Covid-19: A Review of Literature.*

Soomro, K.A., Kale, U., Curtis, R. et al. 2018. Development of an instrument to measure Faculty's information and communication technology access (FICTA). *Education and Information Technologies* 23:253–269.

StatsSA. 2020. *Education Series Volume VIII*. www.statssa.gov.za.

Sukendro, S., Habibi, A., Khaeruddin, K., Indrayana, B., Syahruddin, S., Makadada, F.A. & Hakim, H. 2020. Using an extended technology acceptance model to understand students' use of e-learning during COVID-19: Indonesian sport science education context. *Heliyon,* 6(11).

Taherdoost, H., 2018. A Review of technology acceptance and adoption models and theories. *Procedia Manufacturing*, Volume 22:960-967.

Tatnall, A. 2019. Researching computers and education through actor-network theory. In A. Tatnall & N. Mavengere (Eds.), *Sustainable ICT, Education and Learning:*78-88.

Tauson, M., & Stannard, L. 2018. *EdTech for learning in emergencies and displaced settings—A Rigorous Review and Narrative Synthesis*. Save the Children. https://www.eccnetwork.net/sites/default/files/media/file/edtech-learning.pdf

Thomas, T. & De Villiers, C. 2002. Using actor-network theory to study an educational situation: an example from information systems at a technikon. *South African Journal of Higher Education*, 16(3).

Tomczyk, L. & Walker, C. 2021. The emergency (crisis) e-learning as a challenge for teachers in Poland. *Education and Information Technologies*, 26(6):6847–6877

Tülübaş, T., Demirkol, M., Ozdemir, T.Y., Polat, H., Karakose, T. & Yirci, R. (2023). An interview with ChatGPT on emergency remote teaching: A comparative analysis based on human–AI collaboration. *Educational Process: International Journal*, 12(2):93-110.

Tunjera, N. 2019. Teacher Educators' Instructional Strategies in Preparing Pre-Service Teachers to Teach with Digital Technology in the 21st Century. https://etd.cput.ac.za/handle/20.500.11838/3038.

UNESCO. 2023. *Global Education Monitoring Report 2023: Technology in education – A tool on whose terms?* Paris, UNESCO.

Valverde-Berrocoso, J., del Carmen Garrido-Arroyo, M., Burgos-Videla, C. & Morales-Cevallos, M.B. 2020. Trends in educational research about e-Learning: A systematic literature review (2009-2018). *Sustainability* (Switzerland), 12(12).

Van Dijk, J. 2002. A framework for digital divide research. *Electronic Journal of Communication*, 12(1–2):1–7.

Van Dijk, J. 2005. The deepening divide: Inequality in the information society. Thousand Oaks: Sage Publications.

Van Dijk, J. 2012. *The evolution of the digital divide: The digital divide turns to inequality of skills and usage*. In: Bus, J.Crompton, M.Hildebrandt, M., Metakides, G., editors. Digital enlightenment yearbook. Vol. 2012:57-75.

Van Greunen, D., Kativu, K. & Veldsman, A. 2021. *Enhancing ICT readiness of schools in South Africa*. (June):1–9.

Vaughn, M.J., Sayed, Y. & Cooper, A. 2021. Interlocking inequalities, conflicts, and crises: COVID-19 and education in the Global South, *Journal of Education*.

Wade, M.M. 2006. Straws in the wind: Early epidemics of poliomyelitis in Johannesburg, 1918-1945. University of South Africa supervisor: Mr Nd Southey Joint Supervisor: Dr EB van Heyningen.

WCED. Guidelines on cellular phones and other mobile technologies in public schools. 2021.

Wolhuter, C. & Jacobs, L. 2021. COVID-19, the global education project and technology: Disrupting priorities towards rethinking education. *Research in Social Sciences and Technology*, 6(2):96–109.

Woods, R.H. & Baker, J.D. 2004. Interaction and immediacy in online learning. *International Review of Research in Open and Distance Learning*, 5(2).

APPENDIX A: Research approval from the Faculty of Informatics and Design Research Ethics Committee of the Cape Peninsula University of Technology

Cape Peninsula University of Technology
creating futures

PO Box 1906, Bellville, 7535 Symphony Way, Bellville, Cape Town, South Africa
+ 27 (0)21 959 6767 www.facebook.com/cput.ac.za info@cput.ac.za www.cput.ac.za

Office of the Research Ethics Committee
Faculty of Informatics and Design
Room 2.09
80 Roeland Street
Cape Town
Tel: 021-469 1012
Email: ndedem@cput.ac.za
Secretary: Mziyanda Ndede

02 March 2022

Mr Ian Malcolm Kennedy
c/o Department of Information Technology
CPUT

Reference no: 221205314/2022/3

Project title: The Patterns of Technology-Mediated Interaction between Teachers and Learners in a Time of Crisis.

Approval period: 02 March 2022 – 31 December 2023

This is to certify that the Faculty of Informatics and Design Research Ethics Committee of the Cape Peninsula University of Technology conditionally approves the methodology and ethics of Mr Ian Malcolm Kennedy (221205314) for Doctor of Philosophy in Informatics.

Any amendments, extension or other modifications to the protocol must be submitted to the Research Ethics Committee for approval.

The Committee must be informed of any serious adverse event and/or termination of the study.

Dr Blessing Makwambeni
Acting Chair: Research Ethics Committee
Faculty of Informatics and Design
Cape Peninsula University of Technology

APPENDIX B: Research approval by 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: 20220303-318
ENQUIRIES: Mr M Kanzi

Mr Ian Kennedy
De Plattekloof Lifestyle Estate
55 Olienhout Avenue
Plattekloof 3
7500

Dear Mr Ian Kennedy,

RESEARCH PROPOSAL: THE PATTERNS OF TECHNOLOGY-MEDIATED INTERACTION BETWEEN TEACHERS AND LEARNERS IN A TIME OF CRISIS.

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 **3 March 2022 till 30 September 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: 3 March 2022

APPENDIX C: Online questionnaire

The Patterns of Technology-Mediated Interaction between Teachers and Learners in a Time of Crisis.

PhD Research Project
Ian M Kennedy
Cape Peninsula University of Technology
Doctor of Philosophy in Informatics

This study aims to explore the patterns of technology-mediated interaction between secondary school teachers and learners in the Western Cape during the COVID-19 pandemic.

The study is guided by the following research questions:

1. What teacher technological pedagogical knowledge transpired from the COVID-19 pandemic?
2. How did teachers adapt their use of technology for teaching and learning during the COVID-19 pandemic?

The methodology and ethics of the study is approved by:

1. The Faculty of Informatics and Design Research Ethics Committee of the CPUT.
2. The Directorate: Research of the Western Cape Education Department

* Indicates required question

1. I hereby declare that: *

Check all that apply.

- [ ] I have read and understand the information sheet of the research project.
- [ ] I understand that my name. name of my school and my responses will be kept confidential.

Informed Consent

2. I agree to participate in the survey. *

Mark only one oval.

- ◯ Yes
- ◯ No *Skip to section 8 (I agree to participate in the survey.)*

Section A: Personal and School

Information and Communication Technology (ICT) in education, or Educational Technology, can broadly be defined as all digital technologies (including hardware, software and content) that are either designed or appropriated for educational purposes.

3. A1 : How would you rate: *

0 = Low to 3 = High

Mark only one oval per row.

	0	1	2	3
Your proficiency with ICT?	◯	◯	◯	◯
Your use of ICT for teaching and learning?	◯	◯	◯	◯
Teacher access to ICT for teaching and learning at your school?	◯	◯	◯	◯
Your school's use of ICT for teaching and learning?	◯	◯	◯	◯
ICT training at your school?	◯	◯	◯	◯

Section B: Emergency Remote Teaching (ERT)

The digital, fully remote delivery of teaching due to a crisis situation, example COVID-19 pandemic, which makes it impossible to conduct face-to-face lessons.

4. B1: Rate your exposure to the following learning environments prior to the COVID-19 pandemic. *

0 = Low to 3 = High

Mark only one oval per row.

	0	1	2	3
Face-to-face (Classroom)	◯	◯	◯	◯
Online (Remote)	◯	◯	◯	◯
Blended learning - combination of face-to-face and online	◯	◯	◯	◯

5. B2: How did you use ICT in teaching and learning prior to the COVID-19 pandemic? *

Please write short notes in space provided below. E.g. uploading worksheets in PDF for students to access; students use the internet to independently research a topic; students create informative multi-media presentations; students publish their work online where it can be viewed by peers.

6. B3: To what extent did your prior experience with ICT in teaching and learning prepare you for emergency remote teaching during the COVID-19 pandemic? *

Please write short notes in space provided below.

7. B4: What initiatives did your school take to support teachers in transitioning to remote online teaching during the COVID-19 pandemic? *

Please write short notes in space provided below. E.g. training and development; mobile devices; access to internet connection.

8. B5: To what extent did you use the following options to engage with learners remotely during the COVID-19 pandemic? *

0 = Low to 3 = High

Mark only one oval per row.

	0	1	2	3
Asynchronous: Uploaded content for the course for learners to view at any time.	◯	◯	◯	◯
Synchronous: Met with learners online using virtual meeting software.	◯	◯	◯	◯
Combination of asynchronous and synchronous.	◯	◯	◯	◯

9. B6: To what extent do the following statements describe your interaction with learners during the COVID-19 pandemic? *

0 = Low and 3 = High

Mark only one oval per row.

	0	1	2	3
One-way delivery of written information. E.g. posting notes on Google Drive.	◯	◯	◯	◯
Two-way asynchronous exchanges of written information. E.g. assignments on Google Classroom.	◯	◯	◯	◯
Two-way synchronous exchanges of written information. E.g. chats in Microsoft Teams.	◯	◯	◯	◯
One-way visual and two-way voice communication. E.g. lecture on Microsoft Teams.	◯	◯	◯	◯
Two-way voice and visual communication. E.g. group discussions with Microsoft Teams.	◯	◯	◯	◯

10. B7: How efficient were the following online collaborative tools for teacher-learner interaction during the COVID-19 pandemic? *

0 = Low to 3 = High

Mark only one oval per row.

	Not used	0	1	2	3
Skype	◯	◯	◯	◯	◯
Zoom	◯	◯	◯	◯	◯
Microsoft Teams	◯	◯	◯	◯	◯
Edmodo	◯	◯	◯	◯	◯
Google Classroom	◯	◯	◯	◯	◯

11. B8: How efficient were the following social media platforms for teacher-learner interaction during the COVID-19 pandemic? *

0 = Low to 3 = High

Mark only one oval per row.

	Not used	0	1	2	3
Facebook	◯	◯	◯	◯	◯
WhatsApp	◯	◯	◯	◯	◯
YouTube	◯	◯	◯	◯	◯
Wikis	◯	◯	◯	◯	◯
Twitter	◯	◯	◯	◯	◯

12. B9: How did you experience the support dimension of teacher-learner interaction during the COVID-19 pandemic? *

Please write short notes on how you shared information on the syllabus and explained content to facilitate learners' success.

13. B10: How did you experience the affective dimension of teacher-learner interaction during the COVID-19 pandemic? *

Please write short notes on how you acknowledged and built a positive-experienced relationship with learners.

14. B11: Rate the following as challenges in emergency remote teaching during the COVID-19 pandemic. *

0 = Low to 3 = High

Mark only one oval per row.

	0	1	2	3
Teacher and/or learner access to reliable/stable internet connection.	◯	◯	◯	◯
Repurposing and delivering courseware for a face-to-face class to be delivered in a remote online environment.	◯	◯	◯	◯
Overall workload too high.	◯	◯	◯	◯
Self-directed learning – learners attending virtual classes and/or completing assignments.	◯	◯	◯	◯
Issues related to learner assessment and testing.	◯	◯	◯	◯

Section C: Technological Pedagogical Knowledge

Your understanding of how particular technologies can be used in teaching, and how using technology may change your teaching practice.

15. C1: Rate the following as ways in which you gained knowledge about "teaching with technology" since the start of the COVID-19 pandemic. *

0 = Low to 3 = High

Mark only one oval per row.

	0	1	2	3
Outside of school - Part-time professional development	◯	◯	◯	◯
In-school - In-service professional development	◯	◯	◯	◯
Learning on your own.	◯	◯	◯	◯
Social media groups - Personal learning networks	◯	◯	◯	◯
District and regional workshops	◯	◯	◯	◯

16. C2: Total amount of in-service training you received on "teaching with technology" since the start of the COVID-19 pandemic. *

Mark only one oval.

- ◯ None
- ◯ Day
- ◯ Week
- ◯ Month
- ◯ Semester
- ◯ Other: _____

17. C3: Indicate your level of "teaching with technology" knowledge. *

0 = Low to 3 = High

Mark only one oval per row.

	0	1	2	3
Prior to the COVID-19 pandemic.	◯	◯	◯	◯
Current	◯	◯	◯	◯

18. C4 : What is your current perception and understanding of the benefits of "teaching with technology"? *

Please write short notes in space provided below. E.g. more engaged learning environment; prepares learners for the future; accommodates various learning styles.

19. C5: Indicate your school policy for the in-class use of mobile devices by learners. *

Mark only one oval per row.

	Ban use	Discourage use	Encourage use	Require use
Prior to the COVID-19 pandemic.	◯	◯	◯	◯
Current	◯	◯	◯	◯

20. C6: To what extent do you agree with the following statements about learners' in-class use of mobile devices? *

0 = Low to 3 = High

Mark only one oval per row.

	0	1	2	3
In-class use of mobile devices can enhance learning.	◯	◯	◯	◯
In-class use of mobile devices is distracting.	◯	◯	◯	◯
I am concerned about the security / privacy problems of mobile technology.	◯	◯	◯	◯
I would like to have more professional development in integrating mobile devices in courses.	◯	◯	◯	◯
I create assignments that take advantage of students' access to mobile technologies.	◯	◯	◯	◯

Well done - 50% of survey completed - your continued contribution is valued!

Section D: Use of Information Technology

How you use technology to design, develop, and implement learning experiences that result in higher levels of achievement for learners.

21. D1: How do you use ICT in your teaching practice? *

Mark only one oval per row.

	Replace traditional activities and materials with digital versions. E.g., PowerPoint presentation.	Incorporate interactive digital enhancements. E.g., YouTube video.	Use a learning management system. E.g. Moodle for tracking learners' progress.	Learning is fundamentally transformed. E.g., online debates with subject matter experts.
Prior to the COVID-19 pandemic.	◯	◯	◯	◯
Current	◯	◯	◯	◯

22. D2: How did "teaching with technology" during the COVID-19 pandemic support or transform your teaching practice? *

Please write short notes in space provided below. E.g. technology supports traditional teaching methods; technology is used to design innovative learning experiences.

23. D3: Please share some of your successes in "teaching with technology" during the COVID-19 pandemic. *

Please write short notes in space provided below. E.g. increase in knowledge of teaching with technology; support and guidance to learners.

24. D4: Which Learning Management System (LMS) do you use at your school? *

Check all that apply.

- [ ] None
- [ ] Evernote
- [ ] Loom
- [ ] Blackboard
- [ ] Moodle
- [ ] Desire2Learn
- [ ] Instructure Canvas
- [ ] Schoology
- [ ] Locally developed solution
- [ ] Other: _____

25. D5: What are the benefits of using a learning management system (LMS) for teachers and learners? *

Please write short notes in space provided below. E.g. saves time; eases teacher workload; learner access to consistent information.

26. D6: What resources are required to increase the level of information technology integration in your teaching practice? *

Please write short notes in space provided. E.g. more training; IT support; E-books.

27. D7: To what degree did you continue "teaching with technology" when you returned to face-to-face classes? *

Please write short notes in space provided below. E.g. returned to traditional practices; required in-class use of mobile devices; increased implementation of technology.

28. D8: Are there any other comments you wish to make in relation to "teaching with technology" during the COVID-19 pandemic that you believe may be relevant for this study? *

Please write short notes in space provided below.

Section E: Demographic Information

29. E1: Gender *

Mark only one oval.

- Male
- Female
- Other

30. E2: Age *

Mark only one oval.

- 21- 30
- 31 - 40
- 41 - 50
- 51 - 60
- 60 +

31. E3: Teaching experience *

Mark only one oval.

- 1 - 5 years
- 6 - 10 years
- 11 - 15 years
- 16 - 20 years
- 21 - 25 years
- 25 - 30 years
- 30 + years

32. E4: Main subject(s) you teach *

Check all that apply.

- [ ] Mathematics
- [ ] Languages
- [ ] Natural Sciences
- [ ] Social sciences
- [ ] Information Technology
- [ ] Economic and Management Sciences
- [ ] Creative Arts
- [ ] Technical
- [ ] Other: _____

33. E5: School type status *

Mark only one oval.

- ◯ Public
- ◯ Private

34. E6: Socio-economic status of school *

Mark only one oval.

- ◯ Quintile 1 - Low
- ◯ Quintile 2 - Lower middle
- ◯ Quintile 3 - Middle
- ◯ Quintile 4 - Upper middle
- ◯ Quintile 5 - High

Skip to section 9 (Submit Response)

I agree to participate in the survey.

YES - Click BACK or NEXT to participate in survey.

NO - Close BROWSER to exit survey.

Skip to question 2

Submit Response

Thank you for taking time to complete this survey. Your effort is appreciated.

APPENDIX D: Focus group interview

Focus Group Interview
26 July 2022

16:00 - 16:10	Welcome
16:10 - 16:15	Introduction of participants
16:15 - 16:30	The transition from face-to-face classes to Emergency Remote Teaching (ERT)
16:30 - 16:45	Technology-mediated interaction between teachers and learners
16:45 - 17:00	Impact of the pandemic on "teaching with technology" knowledge of teachers
17:00 - 17:15	Impact of the pandemic on "teaching with technology" practices of teachers
17:15 - 17:30	"Teaching with technology" post-pandemic
17:30 - 17:45	Final thoughts
17:45 - 18:00	Thank you

PhD Research Project
Ian M Kennedy
Cape Peninsula University of Technology
Doctor of Philosophy in Informatics

This study aims to explore the patterns of technology-mediated interaction between secondary school teachers and learners in the Western Cape during the COVID-19 pandemic.

The methodology and ethics of the study is approved by:

1. The Faculty of Informatics and Design Research Ethics Committee of the CPUT.
2. The Directorate: Research of the Western Cape Education Department.

- Confidentiality, privacy and anonymity of the selected schools and participating teachers will be ensured by not using real names in reporting the findings.
- Participants will be given the option of not having the interview recorded and will be able to withdraw from the interview at any time.

The transition from face-to-face classes to Emergency Remote Teaching (ERT)

- Traditionally, teachers can choose whether and how to use technology in school.
- However, the global pandemic required nearly all educators to use technology to reach and teach learners at a distance.
- Teachers found themselves in a new relationship with technology and teaching.
- Despite facing a steep learning curve, teachers reacted with resilience and creativity.
- Teachers devised innovative, technology-based solutions to support their students' remote participation and learning.

HOW DID YOU EXPERIENCE THE SWIFT TRANSITION TO ERT?

Technology-mediated interaction between teachers and learners

- Interaction has long been recognized as a critical component of both conventional and distance education.
- Interaction has been highlighted in many studies as a core factor which affects an individual learner's learning and development.
- The shift from face-to-face teaching to remote online instruction had an impact on the interaction patterns between teachers and learners.

HOW DID YOU MANAGE AND EXPERIENCE TEACHER-LEARNER INTERACTION?

Impact of the pandemic on "teaching with technology" knowledge of teachers

- The importance of teacher qualifications became evident during the educational interruption and resulting online distance education caused by the COVID-19 pandemic.
- After the closure of schools, many teachers who had not received sufficient training on online distance education and had never had this kind of experience were caught unprepared for the use of technological devices.
- Studies should be undertaken to develop in teachers the digital and pedagogical competencies required for online distance education.

HOW DID COVID-19 IMPACT YOUR TECHNOLOGICAL-PEDAGOGICAL KNOWLEDGE?

Impact of the pandemic on "teaching with technology" practices of teachers

- An online environment challenges the traditional ways of teaching and learning.
- Online teaching is a complex process requiring a change to the traditional roles of teachers and a shift in their beliefs, pedagogical thinking, and teaching practices.
- This swift move from the conventional to the digital world, and the adoption of new practices, pedagogies, and methodologies is admirable if contrasted to the slow pace of adoption of new technologies by educational institutions prior to the pandemic.

HOW DID YOU ADAPT YOUR TEACHING PRACTICES?

"Teaching with technology" post-pandemic

The education sector should be prepared to continue working in online spaces - online learning may never go away.

HOW WILL YOU BE INTEGRATING INFORMATION TECHNOLOGY IN YOUR TEACHING PRACTICES IN FUTURE?

APPENDIX E: Online questionnaire responses

Respondent #1		Anne
Gender	**Age**	**Teaching experience**
Female	31 - 40	11 – 15 years
Main subject(s)		**Socio-economic status of school**
Social sciences, Technical, Computer Applications Technology		Quintile 5 - High

A1: How would you rate:		
Your proficiency with ICT?		**Your use of ICT for teaching and learning?**
3		2
Teacher access to ICT at school?	**School's use of ICT?**	**ICT training at your school?**
3	3	3

B1: Rate your exposure to the following learning environments prior to the COVID-19 pandemic.		
Face-to-face (Classroom)	**Online (Remote)**	**Blended learning**
3	**0**	**0**

B2: How did you use ICT in teaching and learning prior to the COVID-19 pandemic?
I made use of Google classroom on a regular basis to upload content taught in class (pdf of worksheets and powerpoints)
B3: To what extent did your prior experience with ICT in teaching and learning prepare you for emergency remote teaching during the COVID-19 pandemic?
It helped as I was used to the platforms; however not a lot. I already knew what Google Classroom was and how it worked so I did not need to learn that.
B4: What initiatives did your school take to support teachers in transitioning to remote online teaching during the COVID-19 pandemic?
During hard lockdown we had to sign up for online teaching training workshops to help use learn new ways to teach online. We had to attend three workshops a week. We signed up with a company called PurpleZA which hosted small regular workshops. We could then apply what we had learnt in the week after.
B5: To what extent did you use the following options to engage with learners remotely during the COVID-19 pandemic?

Asynchronous	**Synchronous**	**Combination**
3	3	3

B6: To what extent do the following statements describe your interaction with learners during the COVID-19 pandemic?		
One-way written	**Two-way asynchronous written.**	**Two-way synchronous written.**
2	3	2
One-way visual and two-way voice communication.		**Two-way voice and visual communication.**
3		2

B7: How efficient were the following online collaborative tools for teacher-learner interaction during the COVID-19 pandemic?				
Skype	**Zoom**	**Microsoft Teams**	**Edmodo**	**Google Classroom**
Not used	Not used	Not used	Not used	3

B8: How efficient were the following social media platforms for teacher-learner interaction during the COVID-19 pandemic?				
Facebook	**WhatsApp**	**YouTube**	**Wikis**	**Twitter**
Not used	2	1	Not used	Not used

B9: How did you experience the support dimension of teacher-learner interaction during the COVID-19 pandemic?
I took the curriculum as it was (before it was amended) and took what I wouldve done in a 'normal' setting and then added one-two extra resources per topic. I teach mutiple subjects and grades and this was the least overwhelming way for me to do it. E.g. If I taught Grade 9 Hydraulics- I already had a powerpoint which I wouldve used in class. I then recorded a video of me explaining the content and maybe an edupuzzle or a Google Quiz as an extra resource.
B10: How did you experience the affective dimension of teacher-learner interaction during the COVID-19 pandemic?
We had daily check-ins with the learners. We had to dedicate part of our online lesson to a check-in. Each register class also had a check in with their register teacher. I would pick a topic for the week and ask them a question e.g. what series are you watching at the moment or vanilla or chocolate ice cream and then the leaners would have to answer in the poll. This really ensured a positive relationship and helped the learners engage with me as the teacher and the other classmates. Once we returned to face-to-face learning we continued doing these informal check-ins which the learners appreciated.
B11: Rate the following as challenges in emergency remote teaching during the COVID-19 pandemic.

Access to internet.	**Courseware.**	**Workload too high.**	**Self-directed learning**	**Learner assessment.**
2	2	2	2	3

C1: Rate the following as ways in which you gained knowledge about "teaching with technology" since the start of the COVID-19 pandemic.				
Part-time	**In-service**	**Own learning**	**Social media**	**District workshops**
2	3	3	3	2

C2: Total amount of in-service training you received on "teaching with technology" since the start of the COVID-19 pandemic.
Week

C3: Indicate your level of "teaching with technology" knowledge.	
Prior to the COVID-19 pandemic.	**Current**
2	3
C4 : What is your current perception and understanding of the benefits of "teaching with technology"?	
Technology is the way forward and incorporating it into the classroom is a step in the right direction. There is a world of knowledge and information at their fingertips and if used correctly, technology will help the learners further their knowledge. Since we started doing e-learning their has been more learner engagement in and out of the classroom.	
C5: Indicate your school policy for the in-class use of mobile devices by learners.	
Prior to the COVID-19 pandemic.	**Current**
Require use	Require use
C6: To what extent do you agree with the following statements about learners' in-class use of mobile devices?	
Enhance learning.	**Distracting.**	**Security / privacy problems.**
3	2	2
I would like to have more professional development in integrating mobile devices in courses.	**I create assignments that take advantage of students' access to mobile technologies.**
2	3
D1: How do you use ICT in your teaching practice?	
Prior to the COVID-19 pandemic.	**Current**
Replace traditional activities and materials with digital versions. E.g., PowerPoint presentation.	Use a learning management system. E.g. Moodle for tracking learners' progress.
D2: How did "teaching with technology" during the COVID-19 pandemic support or transform your teaching practice?	
It changed the way I approached teaching during Covid. I was not as stressed about reaching all my learners and completing the work because I knew that the technology in place would support what needed to be done.	
D3: Please share some of your successes in "teaching with technology" during the COVID-19 pandemic.	
I made use of amazing online games and even created my own breakout hidden room. The work that i put in during lockdown will remain for years to come.	
D4: Which Learning Management System (LMS) do you use at your school?	
Google Classroom	
D5: What are the benefits of using a learning management system (LMS) for teachers and learners?	
Saves time, promotes communication	
D6: What resources are required to increase the level of information technology integration in your teaching practice?	
Definitely IT support and school resources	
D7: To what degree did you continue "teaching with technology" when you returned to face-to-face classes?	
I made use of all the same methods which I used during online and applied it when we returned to face-to-face.	
D8: Are there any other comments you wish to make in relation to "teaching with technology" during the COVID-19 pandemic that you believe may be relevant for this study?	
None	

Respondent #2	Lyndon

Gender	Age	Teaching experience
Male	51 - 60	30 + years

Main subject(s)	Socio-economic status of school
Mathematics, Economic and Management Sciences	Quintile 5 - High

A1: How would you rate:

Your proficiency with ICT?	Your use of ICT for teaching and learning?
3	2

Teacher access to ICT at school?	School's use of ICT?	ICT training at your school?
3	2	3

B1: Rate your exposure to the following learning environments prior to the COVID-19 pandemic.

Face-to-face (Classroom)	Online (Remote)	Blended learning
3	**0**	**0**

B2: How did you use ICT in teaching and learning prior to the COVID-19 pandemic?

"Uploading notes and solutions to homework as PDF. Quizzes for EMS - Google Classroom and Kahoot! Geogebra and Autograph in Maths classes"

B3: To what extent did your prior experience with ICT in teaching and learning prepare you for emergency remote teaching during the COVID-19 pandemic?

I had completed Google Educator Level 1 and so was very comfortable using all of the Google products. I used Meet more than ever before but also used shared Docs a lot as well as Forms to check how learners were coping. Classroom was used throughout.

B4: What initiatives did your school take to support teachers in transitioning to remote online teaching during the COVID-19 pandemic?

Offer to help pay for data if a teacher did not have sufficient access to wifi at home.

B5: To what extent did you use the following options to engage with learners remotely during the COVID-19 pandemic?

Asynchronous	Synchronous	Combination
3	3	3

B6: To what extent do the following statements describe your interaction with learners during the COVID-19 pandemic?

One-way written	Two-way asynchronous written.	Two-way synchronous written.
3	3	3

One-way visual and two-way voice communication.	Two-way voice and visual communication.
3	2

B7: How efficient were the following online collaborative tools for teacher-learner interaction during the COVID-19 pandemic?

Skype	Zoom	Microsoft Teams	Edmodo	Google Classroom
Not used	Not used	Not used	Not used	3

B8: How efficient were the following social media platforms for teacher-learner interaction during the COVID-19 pandemic?

Facebook	WhatsApp	YouTube	Wikis	Twitter
Not used	Not used	2	Not used	Not used

B9: How did you experience the support dimension of teacher-learner interaction during the COVID-19 pandemic?

This was challenging as some learners were reluctant to ask for help. Where I felt they needed help, I recorded short videos and posted those on Google Classroom for the whole class or sent them to individuals as required. In some cases I posted a PDF of a written out solution if that would suffice.

B10: How did you experience the affective dimension of teacher-learner interaction during the COVID-19 pandemic?

This was the biggest challenge as most learners merely wanted to be "receivers of knowledge" and it took a while to build up good online relationships, mainly by asking learners questions and checking how they were doing.

B11: Rate the following as challenges in emergency remote teaching during the COVID-19 pandemic.

Access to internet.	Courseware.	Workload too high.	Self-directed learning	Learner assessment.
2	3	3	2	0

C1: Rate the following as ways in which you gained knowledge about "teaching with technology" since the start of the COVID-19 pandemic.

Part-time	In-service	Own learning	Social media	District workshops
3	2	3	1	0

C2: Total amount of in-service training you received on "teaching with technology" since the start of the COVID-19 pandemic.

Month

C3: Indicate your level of "teaching with technology" knowledge.

Prior to the COVID-19 pandemic.	Current
2	3

C4 : What is your current perception and understanding of the benefits of "teaching with technology"?

Being forced to "teach with technology" is one of the very few positives to come out of the pandemic. Even now that we are

back face-to-face I've been using Google Classroom a whole lot more and I've continued to record videos at times as it adds another important dimension to my teaching. When a learner is away ill and has to catch up on work, having videos available is helpful. I do think this has prepared learners for tertiary studies to some extent.

C5: Indicate your school policy for the in-class use of mobile devices by learners.	
Prior to the COVID-19 pandemic.	**Current**
Require use	Require use

C6: To what extent do you agree with the following statements about learners' in-class use of mobile devices?		
Enhance learning.	**Distracting.**	**Security / privacy problems.**
3	2	1

I would like to have more professional development in integrating mobile devices in courses.	**I create assignments that take advantage of students' access to mobile technologies.**
2	2

D1: How do you use ICT in your teaching practice?	
Prior to the COVID-19 pandemic.	**Current**
Incorporate interactive digital enhancements. E.g., YouTube video.	Learning is fundamentally transformed. E.g., online debates with subject matter experts.

D2: How did "teaching with technology" during the COVID-19 pandemic support or transform your teaching practice?
Technology certainly supported traditional teaching methods - both parents and learners wanted traditional teaching methods but technology enhanced that way of teaching and really raised the bar. Some of my colleagues and I took time to find new ways of presenting material or guiding learners to investigate.
D3: Please share some of your successes in "teaching with technology" during the COVID-19 pandemic.
"Better knowledge of distance learning principles and best practice Clearer instructions and guidance to learners - documenting everything More thinking about what I was teaching and how I was teaching it (if I was about to record a video then I was aware that it could be viewed by others as well)"
D4: Which Learning Management System (LMS) do you use at your school?
None
D5: What are the benefits of using a learning management system (LMS) for teachers and learners?
We don't use a LMS
D6: What resources are required to increase the level of information technology integration in your teaching practice?
Continued training to stay up to date
D7: To what degree did you continue "teaching with technology" when you returned to face-to-face classes?
I use a more blended approach now - way more technology than pre-pandemic but not exclusively tech-bound. Both the learners and I are very comfortable with that.
D8: Are there any other comments you wish to make in relation to "teaching with technology" during the COVID-19 pandemic that you believe may be relevant for this study?
I suppose being forced to make such radical changes to the way in which we do things was what we needed - it's very easy to have good intentions about using more or unfamiliar technology but the pandemic made it essential.

Respondent #3	Celeste

Gender	Age	Teaching experience
Female	41 - 50	16 - 20 years

Main subject(s)	Socio-economic status of school
Natural Sciences, Life Sciences	Quintile 5 - High

A1: How would you rate:

Your proficiency with ICT?	Your use of ICT for teaching and learning?
2	2

Teacher access to ICT at school?	School's use of ICT?	ICT training at your school?
2	2	1

B1: Rate your exposure to the following learning environments prior to the COVID-19 pandemic.

Face-to-face (Classroom)	Online (Remote)	Blended learning
3	**0**	**0**

B2: How did you use ICT in teaching and learning prior to the COVID-19 pandemic?

"Used Google Classroom to post information, project details and submissions, uploading of memos, worksheets, videos
Scientific investigation projects that need to be done on a Google doc and submitted via Google Classroom
Use internet to research questions on various topics, also if someone has a question that we want to know the answer to, I ask the student to research it (state source) and provide feedback to the class
Watch Twig videos/experiments, watch youtube videos
Play Kahoots and Quizziz quizzes"

B3: To what extent did your prior experience with ICT in teaching and learning prepare you for emergency remote teaching during the COVID-19 pandemic?

It allowed me to be open to trying new technologies e.g. screencastify

B4: What initiatives did your school take to support teachers in transitioning to remote online teaching during the COVID-19 pandemic?

I have wifi at home, so I didn't really receive support in that respect. I did make use of the school laptop though - to go onto Google Meet and teach my classes. The school assisted students with data etc, so they may have assisted teachers if they asked for it

B5: To what extent did you use the following options to engage with learners remotely during the COVID-19 pandemic?

Asynchronous	Synchronous	Combination
3	3	3

B6: To what extent do the following statements describe your interaction with learners during the COVID-19 pandemic?

One-way written	Two-way asynchronous written.	Two-way synchronous written.
3	2	1

One-way visual and two-way voice communication.	Two-way voice and visual communication.
3	1

B7: How efficient were the following online collaborative tools for teacher-learner interaction during the COVID-19 pandemic?

Skype	Zoom	Microsoft Teams	Edmodo	Google Classroom
Not used	Not used	Not used	Not used	3

B8: How efficient were the following social media platforms for teacher-learner interaction during the COVID-19 pandemic?

Facebook	WhatsApp	YouTube	Wikis	Twitter
Not used	1	1	Not used	Not used

B9: How did you experience the support dimension of teacher-learner interaction during the COVID-19 pandemic?

I created powerpoints on the topics taught and posted it on Google Classroom. I recorded screencastify videos in which I teach using the powerpoints. I shared relevant videos and worksheets as well as useful websites on Google Classroom for the students to access. I also shared the WCED online resources with my classes.

B10: How did you experience the affective dimension of teacher-learner interaction during the COVID-19 pandemic?

I tried to make these user friendly and allowed for built in revision in the powerpoints I created. I also developed a workscheme that the students could work through, which contained links to various resources. I also created a progress document that learners had to complete, so I could view their progress. This did rely on their being honest with me, which may have been taken advantage of. I was also available via email or class whatsapp groups to assist students. The class whatsapp groups were only used when a session was booked with me at a particular time.

B11: Rate the following as challenges in emergency remote teaching during the COVID-19 pandemic.

Access to internet.	Courseware.	Workload too high.	Self-directed learning	Learner assessment.
2	2	2	2	2

C1: Rate the following as ways in which you gained knowledge about "teaching with technology" since the start of the COVID-19 pandemic.

Part-time	In-service	Own learning	Social media	District workshops
3	2	2	0	1

C2: Total amount of in-service training you received on "teaching with technology" since the start of the COVID-19 pandemic.

Day		
C3: Indicate your level of "teaching with technology" knowledge.		
Prior to the COVID-19 pandemic.	**Current**	
1	2	
C4 : What is your current perception and understanding of the benefits of "teaching with technology"?		
It allows learners to engage with content in different ways, which I think is beneficial. Technology definitely has a place in teaching and learning, but I also believe that traditional methods are also effective.		
C5: Indicate your school policy for the in-class use of mobile devices by learners.		
Prior to the COVID-19 pandemic.	**Current**	
Encourage use	Encourage use	
C6: To what extent do you agree with the following statements about learners' in-class use of mobile devices?		
Enhance learning.	**Distracting.**	**Security / privacy problems.**
2	2	2
I would like to have more professional development in integrating mobile devices in courses.	**I create assignments that take advantage of students' access to mobile technologies.**	
1	0	
D1: How do you use ICT in your teaching practice?		
Prior to the COVID-19 pandemic.	**Current**	
Incorporate interactive digital enhancements. E.g., YouTube video.	Incorporate interactive digital enhancements. E.g., YouTube video.	
D2: How did "teaching with technology" during the COVID-19 pandemic support or transform your teaching practice?		
I learnt new ways of doing things, streamlining processes. Technology in my subject is particularly useful as I can show simulations/animations to assist understanding. Prior to COVID, I would do this in class in the traditional way.		
D3: Please share some of your successes in "teaching with technology" during the COVID-19 pandemic.		
I made a concerted effort to upskill myself in order to create content that was useful to my students. For example, I learnt how to use screencastify to record videos to assist learning when students worked through the powerpoints I created		
D4: Which Learning Management System (LMS) do you use at your school?		
None		
D5: What are the benefits of using a learning management system (LMS) for teachers and learners?		
I do not use a LMS		
D6: What resources are required to increase the level of information technology integration in your teaching practice?		
I could do some more courses to assist me in improving my use of technology in me subject specifically.		
D7: To what degree did you continue "teaching with technology" when you returned to face-to-face classes?		
We still use the powerpoints we created in lockdown. We still encourage online submissions of projects (which we did before COVID as well). I think that traditional practices have merit and I used these a lot, but I had to record my lessons for learners working from home (in the beginning) and so had to ensure I was in front of a screen for them and also use the board or smartboard to make notes or highlight content.		
D8: Are there any other comments you wish to make in relation to "teaching with technology" during the COVID-19 pandemic that you believe may be relevant for this study?		
None		

Respondent #4	Lourens

Gender	Age	Teaching experience
Male	41 - 50	16 - 20 years

Main subject(s)	Socio-economic status of school
Mathematics, Natural Sciences	Quintile 2 - Lower middle

A1: How would you rate:

Your proficiency with ICT?	Your use of ICT for teaching and learning?
2	1

Teacher access to ICT at school?	School's use of ICT?	ICT training at your school?
2	1	1

B1: Rate your exposure to the following learning environments prior to the COVID-19 pandemic.

Face-to-face (Classroom)	Online (Remote)	Blended learning
3	**0**	**1**

B2: How did you use ICT in teaching and learning prior to the COVID-19 pandemic?

Interactive whiteboards, you tube videos, projectors in class with internet and powepoit presentations

B3: To what extent did your prior experience with ICT in teaching and learning prepare you for emergency remote teaching during the COVID-19 pandemic?

Just to use of technology

B4: What initiatives did your school take to support teachers in transitioning to remote online teaching during the COVID-19 pandemic?

Google class and internet teaching and sharing training

B5: To what extent did you use the following options to engage with learners remotely during the COVID-19 pandemic?

Asynchronous	Synchronous	Combination
2	1	2

B6: To what extent do the following statements describe your interaction with learners during the COVID-19 pandemic?

One-way written	Two-way asynchronous written.	Two-way synchronous written.
2	2	1

One-way visual and two-way voice communication.	Two-way voice and visual communication.
2	1

B7: How efficient were the following online collaborative tools for teacher-learner interaction during the COVID-19 pandemic?

Skype	Zoom	Microsoft Teams	Edmodo	Google Classroom
0	1	1	Not used	3

B8: How efficient were the following social media platforms for teacher-learner interaction during the COVID-19 pandemic?

Facebook	WhatsApp	YouTube	Wikis	Twitter
1	3	2	Not used	0

B9: How did you experience the support dimension of teacher-learner interaction during the COVID-19 pandemic?

The department tried to do what they could but to slow and to late. The school had to be pro-active

B10: How did you experience the affective dimension of teacher-learner interaction during the COVID-19 pandemic?

Something new but only effective for learners that computers and internet at home. Poor learners did not hae much communication

B11: Rate the following as challenges in emergency remote teaching during the COVID-19 pandemic.

Access to internet.	Courseware.	Workload too high.	Self-directed learning	Learner assessment.
3	1	2	1	3

C1: Rate the following as ways in which you gained knowledge about "teaching with technology" since the start of the COVID-19 pandemic.

Part-time	In-service	Own learning	Social media	District workshops
2	2	3	2	2

C2: Total amount of in-service training you received on "teaching with technology" since the start of the COVID-19 pandemic.

Month

C3: Indicate your level of "teaching with technology" knowledge.

Prior to the COVID-19 pandemic.	Current
2	3

C4: What is your current perception and understanding of the benefits of "teaching with technology"?

There is other ways of learning as well. The system cab change tot face tot face for certain learners and teaching with technology for others and it works.

C5: Indicate your school policy for the in-class use of mobile devices by learners.

Prior to the COVID-19 pandemic.	Current
Discourage use	Encourage use

C6: To what extent do you agree with the following statements about learners' in-class use of mobile devices?		
Enhance learning.	**Distracting.**	**Security / privacy problems.**
2	2	3
I would like to have more professional development in integrating mobile devices in courses.	**I create assignments that take advantage of students' access to mobile technologies.**	
3	1	
D1: How do you use ICT in your teaching practice?		
Prior to the COVID-19 pandemic.	**Current**	
Incorporate interactive digital enhancements. E.g., YouTube video.	Learning is fundamentally transformed. E.g., online debates with subject matter experts.	
D2: How did "teaching with technology" during the COVID-19 pandemic support or transform your teaching practice?		
Showed us that tried and used method is not the only method and we can renew teaching in SA		
D3: Please share some of your successes in "teaching with technology" during the COVID-19 pandemic.		
Giving classes through whats-up and the responses from the learners to that.		
D4: Which Learning Management System (LMS) do you use at your school?		
Locally developed solution		
D5: What are the benefits of using a learning management system (LMS) for teachers and learners?		
Everbody can use it and all the information are stored		
D6: What resources are required to increase the level of information technology integration in your teaching practice?		
More computers, better and faster access to internet. Younger teachers are more on the ball than older teachers		
D7: To what degree did you continue "teaching with technology" when you returned to face-to-face classes?		
Extra-classes still on whatsup that thay can look and learn whenever they havr change.		
D8: Are there any other comments you wish to make in relation to "teaching with technology" during the COVID-19 pandemic that you believe may be relevant for this study?		
We must change the old school system in South Africa		

Respondent #5			Lisanne	
Gender	**Age**		**Teaching experience**	
Female	31 - 40		6 - 10 years	
Main subject(s)			**Socio-economic status of school**	
Economic and Management Sciences, Accounting			Quintile 3 - Middle	
A1: How would you rate:				
Your proficiency with ICT?			**Your use of ICT for teaching and learning?**	
3			3	
Teacher access to ICT at school?	**School's use of ICT?**		**ICT training at your school?**	
3	1		1	
B1: Rate your exposure to the following learning environments prior to the COVID-19 pandemic.				
Face-to-face (Classroom)	**Online (Remote)**		**Blended learning**	
3	**2**		**1**	
B2: How did you use ICT in teaching and learning prior to the COVID-19 pandemic?				
Google classroom; shared drive; interactive whiteboard; visualizer				
B3: To what extent did your prior experience with ICT in teaching and learning prepare you for emergency remote teaching during the COVID-19 pandemic?				
It was easy to have a setup to still give my classes. I could continue teaching the same way i did before Covid. Now i only had to record myself doing it.				
B4: What initiatives did your school take to support teachers in transitioning to remote online teaching during the COVID-19 pandemic?				
Creating Whatsapp groups for better communication with learners. We were allowed to take school ICTs home.				
B5: To what extent did you use the following options to engage with learners remotely during the COVID-19 pandemic?				
Asynchronous	**Synchronous**		**Combination**	
3	**2**		3	
B6: To what extent do the following statements describe your interaction with learners during the COVID-19 pandemic?				
One-way written	**Two-way asynchronous written.**		**Two-way synchronous written.**	
1	3		3	
One-way visual and two-way voice communication.			**Two-way voice and visual communication.**	
3			3	
B7: How efficient were the following online collaborative tools for teacher-learner interaction during the COVID-19 pandemic?				
Skype	**Zoom**	**Microsoft Teams**	**Edmodo**	**Google Classroom**
Not used	3	1	0	2
B8: How efficient were the following social media platforms for teacher-learner interaction during the COVID-19 pandemic?				
Facebook	**WhatsApp**	**YouTube**	**Wikis**	**Twitter**
Not used	3	1	Not used	Not used
B9: How did you experience the support dimension of teacher-learner interaction during the COVID-19 pandemic?				
During online classes.				
B10: How did you experience the affective dimension of teacher-learner interaction during the COVID-19 pandemic?				
I had better communication with learners and parents. Learners are more confident sending a whatsapp if they dont understand something.				
B11: Rate the following as challenges in emergency remote teaching during the COVID-19 pandemic.				
Access to internet.	**Courseware.**	**Workload too high.**	**Self-directed learning**	**Learner assessment.**
2	2	2	3	3
C1: Rate the following as ways in which you gained knowledge about "teaching with technology" since the start of the COVID-19 pandemic.				
Part-time	**In-service**	**Own learning**	**Social media**	**District workshops**
3	3	3	3	3
C2: Total amount of in-service training you received on "teaching with technology" since the start of the COVID-19 pandemic.				
Semester				
C3: Indicate your level of "teaching with technology" knowledge.				
Prior to the COVID-19 pandemic.			**Current**	
3			3	
C4: What is your current perception and understanding of the benefits of "teaching with technology"?				
I think the classroom should be a combination of "old school" interaction and using technology in order to be or stay in touch with your learners and accommodate their learning style.				
C5: Indicate your school policy for the in-class use of mobile devices by learners.				
Prior to the COVID-19 pandemic.			**Current**	

Ban use		Discourage use
C6: To what extent do you agree with the following statements about learners' in-class use of mobile devices?		
Enhance learning.	**Distracting.**	**Security / privacy problems.**
2	2	0
I would like to have more professional development in integrating mobile devices in courses.		**I create assignments that take advantage of students' access to mobile technologies.**
0		0
D1: How do you use ICT in your teaching practice?		
Prior to the COVID-19 pandemic.		**Current**
Incorporate interactive digital enhancements. E.g., YouTube video.		Incorporate interactive digital enhancements. E.g., YouTube video.
D2: How did "teaching with technology" during the COVID-19 pandemic support or transform your teaching practice?		
Technology must be used with traditional ways of teaching		
D3: Please share some of your successes in "teaching with technology" during the COVID-19 pandemic.		
Beacause i record my lessons, the learners can go back to the lessons at any time. This makes exam prep very easy and learners being absent from school can still keep up with work.		
D4: Which Learning Management System (LMS) do you use at your school?		
None		
D5: What are the benefits of using a learning management system (LMS) for teachers and learners?		
Not applicable		
D6: What resources are required to increase the level of information technology integration in your teaching practice?		
E-Books		
D7: To what degree did you continue "teaching with technology" when you returned to face-to-face classes?		
Still record important lessons, virtual extra classes		
D8: Are there any other comments you wish to make in relation to "teaching with technology" during the COVID-19 pandemic that you believe may be relevant for this study?		
Biggest disadvantage of remote teaching is the fact that teachers lost all their privacy. Kids and parent all have access to our cell phones and email adresses		

Respondent #6		David
Gender	**Age**	**Teaching experience**
Male	21- 30	6 - 10 years
Main subject(s)		**Socio-economic status of school**
Mathematics, Physical Science		Quintile 4 - Upper middle
A1: How would you rate:		
Your proficiency with ICT?		**Your use of ICT for teaching and learning?**
2		2
Teacher access to ICT at school?	**School's use of ICT?**	**ICT training at your school?**
2	2	1
B1: Rate your exposure to the following learning environments prior to the COVID-19 pandemic.		
Face-to-face (Classroom)	**Online (Remote)**	**Blended learning**
3	**0**	**0**
B2: How did you use ICT in teaching and learning prior to the COVID-19 pandemic?		
students create informative multi-media presentations		
B3: To what extent did your prior experience with ICT in teaching and learning prepare you for emergency remote teaching during the COVID-19 pandemic?		
Was not fully prepared, the problem was mostly that kids does not have acces to internet.		
B4: What initiatives did your school take to support teachers in transitioning to remote online teaching during the COVID-19 pandemic?		
access to internet connection. Use WhatsApp groups mostly		
B5: To what extent did you use the following options to engage with learners remotely during the COVID-19 pandemic?		
Asynchronous	**Synchronous**	**Combination**
2	1	2
B6: To what extent do the following statements describe your interaction with learners during the COVID-19 pandemic?		
One-way written	**Two-way asynchronous written.**	**Two-way synchronous written.**
2	1	0
One-way visual and two-way voice communication.		**Two-way voice and visual communication.**
0		0

B7: How efficient were the following online collaborative tools for teacher-learner interaction during the COVID-19 pandemic?				
Skype	**Zoom**	**Microsoft Teams**	**Edmodo**	**Google Classroom**
Not used	Not used	Not used	Not used	Not used
B8: How efficient were the following social media platforms for teacher-learner interaction during the COVID-19 pandemic?				
Facebook	**WhatsApp**	**YouTube**	**Wikis**	**Twitter**
Not used	2	0	Not used	Not used

B9: How did you experience the support dimension of teacher-learner interaction during the COVID-19 pandemic?
Gave homework over whatsapp
B10: How did you experience the affective dimension of teacher-learner interaction during the COVID-19 pandemic?
Encouragement through whatsapp

B11: Rate the following as challenges in emergency remote teaching during the COVID-19 pandemic.				
Access to internet.	**Courseware.**	**Workload too high.**	**Self-directed learning**	**Learner assessment.**
3	2	3	3	1
C1: Rate the following as ways in which you gained knowledge about "teaching with technology" since the start of the COVID-19 pandemic.				
Part-time	**In-service**	**Own learning**	**Social media**	**District workshops**
3	1	2	0	0

C2: Total amount of in-service training you received on "teaching with technology" since the start of the COVID-19 pandemic.
Day
C3: Indicate your level of "teaching with technology" knowledge.

Prior to the COVID-19 pandemic.	Current
2	2
C4: What is your current perception and understanding of the benefits of "teaching with technology"?	
Technology can be a wonderful tool to be used for educative purposes. Depending on the circumstances a variety of tools can be used to support the educational process. Technology stays a tool to be used and does not replace the process.	
C5: Indicate your school policy for the in-class use of mobile devices by learners.	
Prior to the COVID-19 pandemic.	**Current**
Ban use	Ban use

C6: To what extent do you agree with the following statements about learners' in-class use of mobile devices?		
Enhance learning.	**Distracting.**	**Security / privacy problems.**
1	3	2

I would like to have more professional development in integrating mobile devices in courses.	I create assignments that take advantage of students' access to mobile technologies.
0	1

D1: How do you use ICT in your teaching practice?	
Prior to the COVID-19 pandemic.	**Current**
Incorporate interactive digital enhancements. E.g., YouTube video.	Incorporate interactive digital enhancements. E.g., YouTube video.

D2: How did "teaching with technology" during the COVID-19 pandemic support or transform your teaching practice?
technology supports traditional teaching methods
D3: Please share some of your successes in "teaching with technology" during the COVID-19 pandemic.
support and guidance to learners
D4: Which Learning Management System (LMS) do you use at your school?
Google Classroom
D5: What are the benefits of using a learning management system (LMS) for teachers and learners?
eases teacher workload
D6: What resources are required to increase the level of information technology integration in your teaching practice?
IT support
D7: To what degree did you continue "teaching with technology" when you returned to face-to-face classes?
returned to traditional practices
D8: Are there any other comments you wish to make in relation to "teaching with technology" during the COVID-19 pandemic that you believe may be relevant for this study?
Technology is a very loosly defined term. When we say mobile devices, extensive studies have been done on the negative impact it has on our youth and their development, so if technology means mobile devices then we need to work against the increase in our schools and society. If technology means digital tools used to strengthen working educative strategies then it should be encouraged and funded.

Respondent #7		Che
Gender	**Age**	**Teaching experience**
Female	21- 30	1 - 5 years
Main subject(s)		**Socio-economic status of school**
Social sciences, Geography		Quintile 5 - High
A1: How would you rate:		
Your proficiency with ICT?		**Your use of ICT for teaching and learning?**
2		2
Teacher access to ICT at school?	**School's use of ICT?**	**ICT training at your school?**
3	2	2
B1: Rate your exposure to the following learning environments prior to the COVID-19 pandemic.		
Face-to-face (Classroom)	**Online (Remote)**	**Blended learning**
3	**0**	**0**
B2: How did you use ICT in teaching and learning prior to the COVID-19 pandemic?		
N/A (I only started teaching during covid-19)		
B3: To what extent did your prior experience with ICT in teaching and learning prepare you for emergency remote teaching during the COVID-19 pandemic?		
Gained this experience during my teaching practical in 2020. It truly helped me navigate the space with greater ease. So it definitely helped to a GREAT extent.		
B4: What initiatives did your school take to support teachers in transitioning to remote online teaching during the COVID-19 pandemic?		
Training on google classroom. Training on google meet and how to record lessons and upload them on classroom. Better access to wi-fi. Advanced laptops.		
B5: To what extent did you use the following options to engage with learners remotely during the COVID-19 pandemic?		
Asynchronous	**Synchronous**	**Combination**
3	3	3
B6: To what extent do the following statements describe your interaction with learners during the COVID-19 pandemic?		
One-way written	**Two-way asynchronous written.**	**Two-way synchronous written.**
0	3	3
One-way visual and two-way voice communication.		**Two-way voice and visual communication.**
2		2

B7: How efficient were the following online collaborative tools for teacher-learner interaction during the COVID-19 pandemic?				
Skype	**Zoom**	**Microsoft Teams**	**Edmodo**	**Google Classroom**
Not used	2	3	Not used	3
B8: How efficient were the following social media platforms for teacher-learner interaction during the COVID-19 pandemic?				
Facebook	**WhatsApp**	**YouTube**	**Wikis**	**Twitter**
Not used	2	3	2	Not used
B9: How did you experience the support dimension of teacher-learner interaction during the COVID-19 pandemic?				
I recorded voice notes explaining each PowerPoint slide as I would have in class. These slides were uploaded on google classroom for learners to access. Furthermore, these were accompanied with YouTube video links which further explained the work covered. Google forms were a great tool for post lesson activities, to check learners understanding.				
B10: How did you experience the affective dimension of teacher-learner interaction during the COVID-19 pandemic?				
This was very challenging but I tried to make lessons as simple and straight to the point as possible so that learners do not have a negative outlook on their education. I was in constant contact with my learners and checking in on them even on days where we didn't have lessons.				
B11: Rate the following as challenges in emergency remote teaching during the COVID-19 pandemic.				
Access to internet.	**Courseware.**	**Workload too high.**	**Self-directed learning**	**Learner assessment.**
3	3	2	3	3
C1: Rate the following as ways in which you gained knowledge about "teaching with technology" since the start of the COVID-19 pandemic.				
Part-time	**In-service**	**Own learning**	**Social media**	**District workshops**
3	3	2	2	0
C2: Total amount of in-service training you received on "teaching with technology" since the start of the COVID-19 pandemic.				
Day				
C3: Indicate your level of "teaching with technology" knowledge.				
Prior to the COVID-19 pandemic.			**Current**	
0			2	
C4: What is your current perception and understanding of the benefits of "teaching with technology"?				
It is forward looking and prepares learners for the future.				

C5: Indicate your school policy for the in-class use of mobile devices by learners.	
Prior to the COVID-19 pandemic.	**Current**
Discourage use	Require use

C6: To what extent do you agree with the following statements about learners' in-class use of mobile devices?		
Enhance learning.	**Distracting.**	**Security / privacy problems.**
3	3	1

I would like to have more professional development in integrating mobile devices in courses.	I create assignments that take advantage of students' access to mobile technologies.
0	2

D1: How do you use ICT in your teaching practice?	
Prior to the COVID-19 pandemic.	**Current**
Replace traditional activities and materials with digital versions. E.g., PowerPoint presentation.	Incorporate interactive digital enhancements. E.g., YouTube video.

D2: How did "teaching with technology" during the COVID-19 pandemic support or transform your teaching practice?
Made study materials easily accessible. Enhanced classroom interaction.
D3: Please share some of your successes in "teaching with technology" during the COVID-19 pandemic.
Gained digital skills. Opened my mind to different ways of teaching particular content.
D4: Which Learning Management System (LMS) do you use at your school?
Google Classroom
D5: What are the benefits of using a learning management system (LMS) for teachers and learners?
Easy access to work. Easy communication and evidence thereof (no he say, she say). Less administrative load.
D6: What resources are required to increase the level of information technology integration in your teaching practice?
Training.
D7: To what degree did you continue "teaching with technology" when you returned to face-to-face classes?
Still used PowerPoint slides and google classroom to upload notes, assignments and homework.
D8: Are there any other comments you wish to make in relation to "teaching with technology" during the COVID-19 pandemic that you believe may be relevant for this study?
None

Respondent #8			Iwaan	
Gender	**Age**		**Teaching experience**	
Male	31 - 40		11 - 15 years	
Main subject(s)			**Socio-economic status of school**	
Mathematics, CAT			Quintile 5 - High	
A1: How would you rate:				
Your proficiency with ICT?			**Your use of ICT for teaching and learning?**	
3			1	
Teacher access to ICT at school?	**School's use of ICT?**		**ICT training at your school?**	
3	1		2	
B1: Rate your exposure to the following learning environments prior to the COVID-19 pandemic.				
Face-to-face (Classroom)	**Online (Remote)**		**Blended learning**	
3	**1**		**1**	
B2: How did you use ICT in teaching and learning prior to the COVID-19 pandemic?				
WhatsApp support and explanations about topics				
B3: To what extent did your prior experience with ICT in teaching and learning prepare you for emergency remote teaching during the COVID-19 pandemic?				
I was used to using ICT in my classes, but still didn't develop the necessary means to assess learners.				
B4: What initiatives did your school take to support teachers in transitioning to remote online teaching during the COVID-19 pandemic?				
Laptops, worksheets and staff development using ict				
B5: To what extent did you use the following options to engage with learners remotely during the COVID-19 pandemic?				
Asynchronous	**Synchronous**		**Combination**	
3	3		3	
B6: To what extent do the following statements describe your interaction with learners during the COVID-19 pandemic?				
One-way written	**Two-way asynchronous written.**		**Two-way synchronous written.**	
2	1		2	
One-way visual and two-way voice communication.			**Two-way voice and visual communication.**	
2			2	
B7: How efficient were the following online collaborative tools for teacher-learner interaction during the COVID-19 pandemic?				
Skype	**Zoom**	**Microsoft Teams**	**Edmodo**	**Google Classroom**
Not used	2	Not used	Not used	0
B8: How efficient were the following social media platforms for teacher-learner interaction during the COVID-19 pandemic?				
Facebook	**WhatsApp**	**YouTube**	**Wikis**	**Twitter**
Not used	2	1	Not used	Not used
B9: How did you experience the support dimension of teacher-learner interaction during the COVID-19 pandemic?				
Most learners started eager but faded as we progressed				
B10: How did you experience the affective dimension of teacher-learner interaction during the COVID-19 pandemic?				
Some learners did perform better in subjects. Some would ask questions easily and redirect from each other.				
B11: Rate the following as challenges in emergency remote teaching during the COVID-19 pandemic.				
Access to internet.	**Courseware.**	**Workload too high.**	**Self-directed learning**	**Learner assessment.**
3	3	3	2	3
C1: Rate the following as ways in which you gained knowledge about "teaching with technology" since the start of the COVID-19 pandemic.				
Part-time	**In-service**	**Own learning**	**Social media**	**District workshops**
3	1	3	0	0
C2: Total amount of in-service training you received on "teaching with technology" since the start of the COVID-19 pandemic.				
None				
C3: Indicate your level of "teaching with technology" knowledge.				
Prior to the COVID-19 pandemic.			**Current**	
1			2	
C4: What is your current perception and understanding of the benefits of "teaching with technology"?				
Love the concept but some learners don't have stable connections and being absent from lessons. Assessing learner and letting the marks actually count towards SBA's.				
C5: Indicate your school policy for the in-class use of mobile devices by learners.				
Prior to the COVID-19 pandemic.			**Current**	
Ban use			Discourage use	

C6: To what extent do you agree with the following statements about learners' in-class use of mobile devices?		
Enhance learning.	**Distracting.**	**Security / privacy problems.**
2	1	3

I would like to have more professional development in integrating mobile devices in courses.	I create assignments that take advantage of students' access to mobile technologies.
3	3

D1: How do you use ICT in your teaching practice?	
Prior to the COVID-19 pandemic.	**Current**
Incorporate interactive digital enhancements. E.g., YouTube video.	Incorporate interactive digital enhancements. E.g., YouTube video.

D2: How did "teaching with technology" during the COVID-19 pandemic support or transform your teaching practice?
More able to use videos and technology for support.
D3: Please share some of your successes in "teaching with technology" during the COVID-19 pandemic.
Motivated learners more and help some of the slower learners to rewarch videos.
D4: Which Learning Management System (LMS) do you use at your school?
Loom
D5: What are the benefits of using a learning management system (LMS) for teachers and learners?
Help teachers and learners to a better understanding of work and how to overcome obstacles
D6: What resources are required to increase the level of information technology integration in your teaching practice?
Ebooks, software and training
D7: To what degree did you continue "teaching with technology" when you returned to face-to-face classes?
Kept with the videos and support after hours
D8: Are there any other comments you wish to make in relation to "teaching with technology" during the COVID-19 pandemic that you believe may be relevant for this study?
Allowing the kids to study at their own pace

Respondent #9		Rossouw
Gender	**Age**	**Teaching experience**
Male	21- 30	1 - 5 years
Main subject(s)		**Socio-economic status of school**
Mathematics, Technical		Quintile 5 - High
A1: How would you rate:		
Your proficiency with ICT?		**Your use of ICT for teaching and learning?**
3		3
Teacher access to ICT at school?	**School's use of ICT?**	**ICT training at your school?**
2	2	1
B1: Rate your exposure to the following learning environments prior to the COVID-19 pandemic.		
Face-to-face (Classroom)	**Online (Remote)**	**Blended learning**
0	**0**	**0**
B2: How did you use ICT in teaching and learning prior to the COVID-19 pandemic?		
I was a student prior to COVID-19		
B3: To what extent did your prior experience with ICT in teaching and learning prepare you for emergency remote teaching during the COVID-19 pandemic?		
I was already familiar with online teaching due to teaching assistant work and it assisted me greatly.		
B4: What initiatives did your school take to support teachers in transitioning to remote online teaching during the COVID-19 pandemic?		
WhatsApp groups, Google Classroom, and MS Teams		
B5: To what extent did you use the following options to engage with learners remotely during the COVID-19 pandemic?		
Asynchronous	**Synchronous**	**Combination**
3	**2**	**2**
B6: To what extent do the following statements describe your interaction with learners during the COVID-19 pandemic?		
One-way written	**Two-way asynchronous written.**	**Two-way synchronous written.**
3	2	2
One-way visual and two-way voice communication.		**Two-way voice and visual communication.**
2		2

B7: How efficient were the following online collaborative tools for teacher-learner interaction during the COVID-19 pandemic?				
Skype	**Zoom**	**Microsoft Teams**	**Edmodo**	**Google Classroom**
0	0	3	0	3
B8: How efficient were the following social media platforms for teacher-learner interaction during the COVID-19 pandemic?				
Facebook	**WhatsApp**	**YouTube**	**Wikis**	**Twitter**
Not used	3	2	Not used	Not used
B9: How did you experience the support dimension of teacher-learner interaction during the COVID-19 pandemic?				
No support				
B10: How did you experience the affective dimension of teacher-learner interaction during the COVID-19 pandemic?				
Bad				
B11: Rate the following as challenges in emergency remote teaching during the COVID-19 pandemic.				
Access to internet.	**Courseware.**	**Workload too high.**	**Self-directed learning**	**Learner assessment.**
2	2	2	1	3
C1: Rate the following as ways in which you gained knowledge about "teaching with technology" since the start of the COVID-19 pandemic.				
Part-time	**In-service**	**Own learning**	**Social media**	**District workshops**
3	1	3	1	0
C2: Total amount of in-service training you received on "teaching with technology" since the start of the COVID-19 pandemic.				
Day				
C3: Indicate your level of "teaching with technology" knowledge.				
Prior to the COVID-19 pandemic.			**Current**	
3			3	
C4: What is your current perception and understanding of the benefits of "teaching with technology"?				
Teaching with technology helps with communication and continued learning outside of the classroom.				
C5: Indicate your school policy for the in-class use of mobile devices by learners.				
Prior to the COVID-19 pandemic.			**Current**	
Ban use			Discourage use	
C6: To what extent do you agree with the following statements about learners' in-class use of mobile devices?				

Enhance learning.	Distracting.	Security / privacy problems.
2	3	3

I would like to have more professional development in integrating mobile devices in courses.	I create assignments that take advantage of students' access to mobile technologies.
2	1

D1: How do you use ICT in your teaching practice?	
Prior to the COVID-19 pandemic.	**Current**
Incorporate interactive digital enhancements. E.g., YouTube video.	Incorporate interactive digital enhancements. E.g., YouTube video.

D2: How did "teaching with technology" during the COVID-19 pandemic support or transform your teaching practice?
Not applicable
D3: Please share some of your successes in "teaching with technology" during the COVID-19 pandemic.
Not applicable
D4: Which Learning Management System (LMS) do you use at your school?
None
D5: What are the benefits of using a learning management system (LMS) for teachers and learners?
Not applicable
D6: What resources are required to increase the level of information technology integration in your teaching practice?
IT support
D7: To what degree did you continue "teaching with technology" when you returned to face-to-face classes?
Fully
D8: Are there any other comments you wish to make in relation to "teaching with technology" during the COVID-19 pandemic that you believe may be relevant for this study?
None

Respondent #10		Amy
Gender	**Age**	**Teaching experience**
Female	21- 30	1 - 5 years
Main subject(s)		**Socio-economic status of school**
Economic and Management Sciences		Quintile 3 - Middle
A1: How would you rate:		
Your proficiency with ICT?		**Your use of ICT for teaching and learning?**
2		2
Teacher access to ICT at school?	**School's use of ICT?**	**ICT training at your school?**
3	2	1
B1: Rate your exposure to the following learning environments prior to the COVID-19 pandemic.		
Face-to-face (Classroom)	**Online (Remote)**	**Blended learning**
1	**1**	**1**
B2: How did you use ICT in teaching and learning prior to the COVID-19 pandemic?		
"Uploading Power Point presentations with voice overs for learners Students publish their work online where it can be viewed by peers Uploading worksheets in PDF Learners create a video where they need to do a speech (their faces should be visible and wear school clothing)"		
B3: To what extent did your prior experience with ICT in teaching and learning prepare you for emergency remote teaching during the COVID-19 pandemic?		
I was not prepared for online/remote teaching and learning as I could have been.		
B4: What initiatives did your school take to support teachers in transitioning to remote online teaching during the COVID-19 pandemic?		
WhatsApp groups, access to internet connection, Google Classroom		
B5: To what extent did you use the following options to engage with learners remotely during the COVID-19 pandemic?		
Asynchronous	**Synchronous**	**Combination**
2	2	2
B6: To what extent do the following statements describe your interaction with learners during the COVID-19 pandemic?		
One-way written	**Two-way asynchronous written.**	**Two-way synchronous written.**
2	2	2
One-way visual and two-way voice communication.		**Two-way voice and visual communication.**
2		2

B7: How efficient were the following online collaborative tools for teacher-learner interaction during the COVID-19 pandemic?				
Skype	**Zoom**	**Microsoft Teams**	**Edmodo**	**Google Classroom**
0	3	2	Not used	3
B8: How efficient were the following social media platforms for teacher-learner interaction during the COVID-19 pandemic?				
Facebook	**WhatsApp**	**YouTube**	**Wikis**	**Twitter**
1	3	1	Not used	Not used
B9: How did you experience the support dimension of teacher-learner interaction during the COVID-19 pandemic?				
Uploaded Power Point presentations with voice overs and PDF documents				
B10: How did you experience the affective dimension of teacher-learner interaction during the COVID-19 pandemic?				
"Kept the learners motivated by setting goals Give them specific dates when they need to be at a certain point so that they keep on working hard to reach their goals"				
B11: Rate the following as challenges in emergency remote teaching during the COVID-19 pandemic.				
Access to internet.	**Courseware.**	**Workload too high.**	**Self-directed learning**	**Learner assessment.**
3	3	3	3	3
C1: Rate the following as ways in which you gained knowledge about "teaching with technology" since the start of the COVID-19 pandemic.				
Part-time	**In-service**	**Own learning**	**Social media**	**District workshops**
2	1	3	1	0
C2: Total amount of in-service training you received on "teaching with technology" since the start of the COVID-19 pandemic.				
Semester				
C3: Indicate your level of "teaching with technology" knowledge.				
Prior to the COVID-19 pandemic.			**Current**	
2			3	
C4: What is your current perception and understanding of the benefits of "teaching with technology"?				
Learners are more engaged, if the learners were absent from school they are able to catch up since everything is posted on Google Classroom, various learning styles are accommodated and you reach some learners easier, prepare learners for their studies after school as well				

C5: Indicate your school policy for the in-class use of mobile devices by learners.	
Prior to the COVID-19 pandemic.	**Current**
Ban use	Ban use

C6: To what extent do you agree with the following statements about learners' in-class use of mobile devices?		
Enhance learning.	**Distracting.**	**Security / privacy problems.**
2	3	2

I would like to have more professional development in integrating mobile devices in courses.	**I create assignments that take advantage of students' access to mobile technologies.**
1	2

D1: How do you use ICT in your teaching practice?	
Prior to the COVID-19 pandemic.	**Current**
Replace traditional activities and materials with digital versions. E.g., PowerPoint presentation.	Incorporate interactive digital enhancements. E.g., YouTube video.

D2: How did "teaching with technology" during the COVID-19 pandemic support or transform your teaching practice?
"Technology expands the traditional way of learning and make it more interesting for the learners - their attention is kept Technology accommodates learners with different types of learning Learners can remember the content better when technology is used to explain"
D3: Please share some of your successes in "teaching with technology" during the COVID-19 pandemic.
"Learners performs better in tests when teaching with technology They gain a broader perspective of the content of the work"
D4: Which Learning Management System (LMS) do you use at your school?
None
D5: What are the benefits of using a learning management system (LMS) for teachers and learners?
"Learner have better access to information on each of their subjects anywhere anytime Saves time and paper Sometimes it increase the workload of the teacher but we are here to help the children, because in the long run the learners have access to information on each subject and then the teacher's workload is less"
D6: What resources are required to increase the level of information technology integration in your teaching practice?
"Definitely more training More equipment to be able to use technology better"
D7: To what degree did you continue "teaching with technology" when you returned to face-to-face classes?
I increased my use of technology in class
D8: Are there any other comments you wish to make in relation to "teaching with technology" during the COVID-19 pandemic that you believe may be relevant for this study?
I think that technology definitely improves the quality of learning and that we should incorporate it more and more in class

Respondent #11	Mark

Gender	Age	Teaching experience
Male	60 +	30 + years

Main subject(s)	Socio-economic status of school
Natural Sciences	Quintile 5 - High

A1: How would you rate:

Your proficiency with ICT?	Your use of ICT for teaching and learning?
3	2

Teacher access to ICT at school?	School's use of ICT?	ICT training at your school?
3	3	2

B1: Rate your exposure to the following learning environments prior to the COVID-19 pandemic.

Face-to-face (Classroom)	Online (Remote)	Blended learning
3	**0**	**0**

B2: How did you use ICT in teaching and learning prior to the COVID-19 pandemic?

Smart board in classroom, use of science simulations (PhET), video material from YouTube, limited use of Google Classroom, all off a PC in the classroom

B3: To what extent did your prior experience with ICT in teaching and learning prepare you for emergency remote teaching during the COVID-19 pandemic?

Negligible - almost all use was in face to face lessons. The only extended use was posting resources like past tests and exams on Google Classroom

B4: What initiatives did your school take to support teachers in transitioning to remote online teaching during the COVID-19 pandemic?

We all already had iPads and had received some training on their use, but I was not yet using it in the classroom. The school had no opportunity to train teachers specifically for teaching during lockdown so we were all feeling our way.

B5: To what extent did you use the following options to engage with learners remotely during the COVID-19 pandemic?

Asynchronous	Synchronous	Combination
3	0	0

B6: To what extent do the following statements describe your interaction with learners during the COVID-19 pandemic?

One-way written	Two-way asynchronous written.	Two-way synchronous written.
3	3	0

One-way visual and two-way voice communication.	Two-way voice and visual communication.
0	0

B7: How efficient were the following online collaborative tools for teacher-learner interaction during the COVID-19 pandemic?

Skype	Zoom	Microsoft Teams	Edmodo	Google Classroom
Not used	Not used	Not used	Not used	3

B8: How efficient were the following social media platforms for teacher-learner interaction during the COVID-19 pandemic?

Facebook	WhatsApp	YouTube	Wikis	Twitter
Not used	Not used	1	Not used	Not used

B9: How did you experience the support dimension of teacher-learner interaction during the COVID-19 pandemic?

Made short videos, either as voice-overs to teaching slides or my talking head - some practical demonstrations (initially limited to what I had at home, later extended to use school science apparatus)

B10: How did you experience the affective dimension of teacher-learner interaction during the COVID-19 pandemic?

Completely cut off during initial lockdown - send video chats to my register class to keep them up to date. Later, as students returned part-time, contact time was maximised for learning, with further back-up from Google Classroom.

B11: Rate the following as challenges in emergency remote teaching during the COVID-19 pandemic.

Access to internet.	Courseware.	Workload too high.	Self-directed learning	Learner assessment.
1	2	2	2	3

C1: Rate the following as ways in which you gained knowledge about "teaching with technology" since the start of the COVID-19 pandemic.

Part-time	In-service	Own learning	Social media	District workshops
1	2	3	0	0

C2: Total amount of in-service training you received on "teaching with technology" since the start of the COVID-19 pandemic.

None

C3: Indicate your level of "teaching with technology" knowledge.

Prior to the COVID-19 pandemic.	Current
1	2

C4: What is your current perception and understanding of the benefits of "teaching with technology"?

Keep up to date, draw from a wider resource bank, multiple ways of communicating with students, set explicit tasks and deadlines, increase accountability to parents, increase individualised feedback to students, support students who miss school

C5: Indicate your school policy for the in-class use of mobile devices by learners.	
Prior to the COVID-19 pandemic.	**Current**
Ban use	Discourage use

C6: To what extent do you agree with the following statements about learners' in-class use of mobile devices?		
Enhance learning.	**Distracting.**	**Security / privacy problems.**
2	1	3

I would like to have more professional development in integrating mobile devices in courses.	**I create assignments that take advantage of students' access to mobile technologies.**
1	2

D1: How do you use ICT in your teaching practice?	
Prior to the COVID-19 pandemic.	**Current**
Incorporate interactive digital enhancements. E.g., YouTube video.	Incorporate interactive digital enhancements. E.g., YouTube video.

D2: How did "teaching with technology" during the COVID-19 pandemic support or transform your teaching practice?
Was able to cover the whole science syllabus by distance learning, and later blended learning. Google Classroom was the main platform for all lesson plans, notes, instructions and for students to hand on assignments.
D3: Please share some of your successes in "teaching with technology" during the COVID-19 pandemic.
I could teach and assess the full curriculum so our students were not as far behind as was feared by the NDoE.
D4: Which Learning Management System (LMS) do you use at your school?
EdAdmin? (the term 'learning management system' is unfamiliar)
D5: What are the benefits of using a learning management system (LMS) for teachers and learners?
This is not a sensible question. Our school uses EdAdmin to inter alia record marks and generate reports, but each teacher of subject department steered their own course. In the Science department, we use a shared drive on the Google drive (no student access), but then loaded material onto Google classroom for students.
D6: What resources are required to increase the level of information technology integration in your teaching practice?
We are considering the use of e-books.
D7: To what degree did you continue "teaching with technology" when you returned to face-to-face classes?
Continued to use Google classroom, but returned feedback to classroom context. I have much more time to teach!
D8: Are there any other comments you wish to make in relation to "teaching with technology" during the COVID-19 pandemic that you believe may be relevant for this study?
I presented a seminar to colleagues on my use of Google classroom. I do think we need to ask the students how they experienced the change.

Respondent #12		Petrus
Gender	**Age**	**Teaching experience**
Male	41 - 50	16 - 20 years
Main subject(s)		**Socio-economic status of school**
Physical Science		Quintile 5 - High
A1: How would you rate:		
Your proficiency with ICT?		**Your use of ICT for teaching and learning?**
2		1
Teacher access to ICT at school?	**School's use of ICT?**	**ICT training at your school?**
3	1	2
B1: Rate your exposure to the following learning environments prior to the COVID-19 pandemic.		
Face-to-face (Classroom)	**Online (Remote)**	**Blended learning**
3	**0**	**1**
B2: How did you use ICT in teaching and learning prior to the COVID-19 pandemic?		
Doing science practicals with online interactive simulations. Using these same simulations in teaching class content.		
B3: To what extent did your prior experience with ICT in teaching and learning prepare you for emergency remote teaching during the COVID-19 pandemic?		
I was not resistant to engaging with online learning.		
B4: What initiatives did your school take to support teachers in transitioning to remote online teaching during the COVID-19 pandemic?		
Microsoft Office training, especially for using Teams. Providing laptops and data for teachers.		
B5: To what extent did you use the following options to engage with learners remotely during the COVID-19 pandemic?		
Asynchronous	**Synchronous**	**Combination**
3	1	1
B6: To what extent do the following statements describe your interaction with learners during the COVID-19 pandemic?		
One-way written	**Two-way asynchronous written.**	**Two-way synchronous written.**
2	3	1
One-way visual and two-way voice communication.		**Two-way voice and visual communication.**
1		0

B7: How efficient were the following online collaborative tools for teacher-learner interaction during the COVID-19 pandemic?				
Skype	**Zoom**	**Microsoft Teams**	**Edmodo**	**Google Classroom**
Not used	2	2	Not used	Not used

B8: How efficient were the following social media platforms for teacher-learner interaction during the COVID-19 pandemic?				
Facebook	**WhatsApp**	**YouTube**	**Wikis**	**Twitter**
Not used	3	1	Not used	Not used

B9: How did you experience the support dimension of teacher-learner interaction during the COVID-19 pandemic?
Learners could access videos, powerpoint and notes via Teams. They could ask questions via WhatsApp or Teams. Assignment was given, handed in and graded via Teams.
B10: How did you experience the affective dimension of teacher-learner interaction during the COVID-19 pandemic?
There was not much direct interaction.

B11: Rate the following as challenges in emergency remote teaching during the COVID-19 pandemic.				
Access to internet.	**Courseware.**	**Workload too high.**	**Self-directed learning**	**Learner assessment.**
1	2	2	2	3

C1: Rate the following as ways in which you gained knowledge about "teaching with technology" since the start of the COVID-19 pandemic.				
Part-time	**In-service**	**Own learning**	**Social media**	**District workshops**
2	2	2	0	0

C2: Total amount of in-service training you received on "teaching with technology" since the start of the COVID-19 pandemic.
Month
C3: Indicate your level of "teaching with technology" knowledge.

Prior to the COVID-19 pandemic.	Current
1	2
C4: What is your current perception and understanding of the benefits of "teaching with technology"?	
Various learning styles and tempos can be accommodated. Learners can be given the opportunity to pace their work themselves.	
C5: Indicate your school policy for the in-class use of mobile devices by learners.	
Prior to the COVID-19 pandemic.	**Current**
Discourage use	Encourage use

C6: To what extent do you agree with the following statements about learners' in-class use of mobile devices?		
Enhance learning.	**Distracting.**	**Security / privacy problems.**
2	2	1

I would like to have more professional development in integrating mobile devices in courses.	I create assignments that take advantage of students' access to mobile technologies.
2	0

D1: How do you use ICT in your teaching practice?	
Prior to the COVID-19 pandemic.	**Current**
Incorporate interactive digital enhancements. E.g., YouTube video.	Use a learning management system. E.g. Moodle for tracking learners' progress.

D2: How did "teaching with technology" during the COVID-19 pandemic support or transform your teaching practice?
I have become more aware and comfortable with using these.
D3: Please share some of your successes in "teaching with technology" during the COVID-19 pandemic.
Very effective webinars was presented with Science Clinic (Pty.) Ltd. via Zoom.
D4: Which Learning Management System (LMS) do you use at your school?
Microsoft Teams
D5: What are the benefits of using a learning management system (LMS) for teachers and learners?
Consistency for learners.
D6: What resources are required to increase the level of information technology integration in your teaching practice?
Time
D7: To what degree did you continue "teaching with technology" when you returned to face-to-face classes?
Very difficult to run two systems. If you teach face-to-face it is really hard to try to integrate online teaching as well.
D8: Are there any other comments you wish to make in relation to "teaching with technology" during the COVID-19 pandemic that you believe may be relevant for this study?
None

Respondent #13		Yvette
Gender	**Age**	**Teaching experience**
Female	41 - 50	16 - 20 years
Main subject(s)		**Socio-economic status of school**
Economic and Management Sciences		Quintile 5 - High
A1: How would you rate:		
Your proficiency with ICT?		**Your use of ICT for teaching and learning?**
3		2
Teacher access to ICT at school?	**School's use of ICT?**	**ICT training at your school?**
3	1	0
B1: Rate your exposure to the following learning environments prior to the COVID-19 pandemic.		
Face-to-face (Classroom)	**Online (Remote)**	**Blended learning**
3	**0**	**0**
B2: How did you use ICT in teaching and learning prior to the COVID-19 pandemic?		
I used Edmodo experimentally to provide learners with alternative/informal assessments and share learning resources that we did not copy. Not very often, but sometimes, I would encourage learners to do research via the internet to support learning of topics we cover in the subject/class. Online platforms like Flipgrid was used to collect video's of presentations learners had to complete (in stead of using class time to present)		
B3: To what extent did your prior experience with ICT in teaching and learning prepare you for emergency remote teaching during the COVID-19 pandemic?		
For the most part, the previous experience prepared me to be willing to experiment and not be too afraid of trying new things. My school has been trying to get all teachers on board to use Office products and the introductory training we had, peeked my interest. So when the early closures of schools were announced and alternative plans had to be made, I had already set up learner profiles and during the last days at school prepared my learners about what we would be doing.		
B4: What initiatives did your school take to support teachers in transitioning to remote online teaching during the COVID-19 pandemic?		
"There was training and development (via Zoom) Additional allowances paid to assist in the costs of data/internet working from home In cases were teachers did not have access to personal computers/laptops, it was provided A core team was established that assisted other teachers to troubleshoot technological problems"		
B5: To what extent did you use the following options to engage with learners remotely during the COVID-19 pandemic?		
Asynchronous	**Synchronous**	**Combination**
3	**1**	**2**
B6: To what extent do the following statements describe your interaction with learners during the COVID-19 pandemic?		
One-way written	**Two-way asynchronous written.**	**Two-way synchronous written.**
3	1	1
One-way visual and two-way voice communication.		**Two-way voice and visual communication.**
2		0

B7: How efficient were the following online collaborative tools for teacher-learner interaction during the COVID-19 pandemic?				
Skype	**Zoom**	**Microsoft Teams**	**Edmodo**	**Google Classroom**
Not used	Not used	2	Not used	Not used
B8: How efficient were the following social media platforms for teacher-learner interaction during the COVID-19 pandemic?				
Facebook	**WhatsApp**	**YouTube**	**Wikis**	**Twitter**
Not used	2	Not used	Not used	Not used

B9: How did you experience the support dimension of teacher-learner interaction during the COVID-19 pandemic?
"Feedback from learners was very bad. During interactive lectures/chats on Teams learners were hesitant to turn on cameras / participate in discussions. Some learners only responded to information posted if the were mentioned personally (many were not active, not even ""liking"" posts) This made it very hard/ineffective to support learners. Also, some learners had challenges with using tech to upload tasks for me to view and assess and provide the necessary support. I share most of my information via PowerPoints uploaded on Teams, with some voice recordings. The same PowerPoints were converted to PDF and shared via WhatsApp for learners who struggled with access. I would meet online periodically and (especially with the grade 12 learners) have a recap online lesson - that was not compulsory. This lesson was also recorded for learners to access later if they could not attend / needed to revise."
B10: How did you experience the affective dimension of teacher-learner interaction during the COVID-19 pandemic?
Giving emotional, social, esthetic, moral, spiritual, and motivational support was extremely hard, since learners did not actively communicate. I encouraged non-academic feedback, for instance learners had to share a picture showing their experience of the pandemic/lockdown and based on the pictures I received I could see who had a more challenging experience and who were engaging in fun activities. But many learners just "disappeared". It was much easier to share the experiences we had once we started back at school and in person.

B11: Rate the following as challenges in emergency remote teaching during the COVID-19 pandemic.				
Access to internet.	**Courseware.**	**Workload too high.**	**Self-directed learning**	**Learner assessment.**
2	2	3	3	0

C1: Rate the following as ways in which you gained knowledge about "teaching with technology" since the start of the COVID-19 pandemic.

Part-time	In-service	Own learning	Social media	District workshops
1	2	3	1	0

C2: Total amount of in-service training you received on "teaching with technology" since the start of the COVID-19 pandemic.

Day

C3: Indicate your level of "teaching with technology" knowledge.

Prior to the COVID-19 pandemic.	Current
1	2

C4: What is your current perception and understanding of the benefits of "teaching with technology"?

If it is used correctly it can definitely add to a more engaging learning experience. I also think there are ways that technology can accommodate for different learning styles (and perhaps learning barriers - e.g. reading of text for learners that usually have a scribe/ speech to text applications.) If we provide a variety of learning tools using technology we could accommodate the learner that wants to watch the video multiple times while practicing the work (of if a learner can process info faster, they can speed up the playback speed). Technology is also a definite certainty in their lives and the world they will study/work in, but if teaching doesn't use it, the "entertainment" world will be the only use they know and a "less intelligent" consumer of online games and video's will be the result.

C5: Indicate your school policy for the in-class use of mobile devices by learners.

Prior to the COVID-19 pandemic.	Current
Discourage use	Discourage use

C6: To what extent do you agree with the following statements about learners' in-class use of mobile devices?

Enhance learning.	Distracting.	Security / privacy problems.
3	3	3

I would like to have more professional development in integrating mobile devices in courses.	I create assignments that take advantage of students' access to mobile technologies.
2	2

D1: How do you use ICT in your teaching practice?

Prior to the COVID-19 pandemic.	Current
Incorporate interactive digital enhancements. E.g., YouTube video.	Incorporate interactive digital enhancements. E.g., YouTube video.

D2: How did "teaching with technology" during the COVID-19 pandemic support or transform your teaching practice?

Because I experimented beforehand it provided me with the opportunity to test out things. I still have a long way to go, but it definitely challenged me to be more innovative

D3: Please share some of your successes in "teaching with technology" during the COVID-19 pandemic.

The largest benefit to myself is the additional knowledge I gained. From screen recordings, to "screen clippings" - converting PDF to editable Word documents, I have been part of PLC's doing recorded lessons, tutoring online for lower performing schools (some opportunities to generate additional income) .

D4: Which Learning Management System (LMS) do you use at your school?

Teams (which is not really a LMS)

D5: What are the benefits of using a learning management system (LMS) for teachers and learners?

Providing access for learners to learning material and other resources (in an easily accessible space especially if it is well organized). I find it helps lighten the workload when it comes to following up on outstanding tasks and also helps me since every class is separated, so I also know exactly were to find everything!

D6: What resources are required to increase the level of information technology integration in your teaching practice?

"Some training, but perhaps more on a troubleshoot basis have support.
Tools (not only mobile devices, because that is still limited in functions) perhaps if our school's firewall is up and running and we can limit the access learners have to sites (games, social media platforms) that distract them it will be easier. There is still learners who have no devices/devices with very limited functionality and using these in class actually create inequality / makes learning less inclusive."

D7: To what degree did you continue "teaching with technology" when you returned to face-to-face classes?

Mostly traditional practices (although some of it was using devices), during the pandemic there was a lighter load in terms of timetables (staggered returns to school, not all grades back / attending class everyday and/or half of learners attending one day the rest the next day) so it was easier use new practices, since the return to classrooms we are busier than ever, no time to make mistakes and very little time to try new things!

D8: Are there any other comments you wish to make in relation to "teaching with technology" during the COVID-19 pandemic that you believe may be relevant for this study?

There are many challenges (including the access to technology and tools) and integrating technology into classrooms while also policing the use of the technology is difficult, but the largest challenge is still sufficient time to prepare/transfer our materials to a useful online format and platform. During the pandemic we were had to "survive" so a lot of what was created was very experimental and since then we have learnt a lot, but now there is no time to go back and change it or generate new material - teachers are overwhelmed with the amount of work we do day-to-day and sadly we have not learnt to work more collaboratively!

Respondent #14		Christa
Gender	**Age**	**Teaching experience**
Female	41 - 50	16 - 20 years
Main subject(s)		**Socio-economic status of school**
Economic and Management Sciences		Quintile 5 - High
A1: How would you rate:		
Your proficiency with ICT?		**Your use of ICT for teaching and learning?**
3		3
Teacher access to ICT at school?	**School's use of ICT?**	**ICT training at your school?**
3	3	3
B1: Rate your exposure to the following learning environments prior to the COVID-19 pandemic.		
Face-to-face (Classroom)	**Online (Remote)**	**Blended learning**
3	1	1
B2: How did you use ICT in teaching and learning prior to the COVID-19 pandemic?		
WhatsApp communication		
B3: To what extent did your prior experience with ICT in teaching and learning prepare you for emergency remote teaching during the COVID-19 pandemic?		
WhatsApp initially and then teams		
B4: What initiatives did your school take to support teachers in transitioning to remote online teaching during the COVID-19 pandemic?		
training, data provided,		
B5: To what extent did you use the following options to engage with learners remotely during the COVID-19 pandemic?		
Asynchronous	**Synchronous**	**Combination**
3	**1**	1
B6: To what extent do the following statements describe your interaction with learners during the COVID-19 pandemic?		
One-way written	**Two-way asynchronous written.**	**Two-way synchronous written.**
3	2	1
One-way visual and two-way voice communication.		**Two-way voice and visual communication.**
0		1

B7: How efficient were the following online collaborative tools for teacher-learner interaction during the COVID-19 pandemic?				
Skype	**Zoom**	**Microsoft Teams**	**Edmodo**	**Google Classroom**
Not used	Not used	3	Not used	Not used
B8: How efficient were the following social media platforms for teacher-learner interaction during the COVID-19 pandemic?				
Facebook	**WhatsApp**	**YouTube**	**Wikis**	**Twitter**
Not used	3	3	Not used	Not used

B9: How did you experience the support dimension of teacher-learner interaction during the COVID-19 pandemic?
face to face is still better
B10: How did you experience the affective dimension of teacher-learner interaction during the COVID-19 pandemic?
not to good
B11: Rate the following as challenges in emergency remote teaching during the COVID-19 pandemic.

Access to internet.	**Courseware.**	**Workload too high.**	**Self-directed learning**	**Learner assessment.**
3	2	2	2	2
C1: Rate the following as ways in which you gained knowledge about "teaching with technology" since the start of the COVID-19 pandemic.				
Part-time	**In-service**	**Own learning**	**Social media**	**District workshops**
2	2	2	2	2

C2: Total amount of in-service training you received on "teaching with technology" since the start of the COVID-19 pandemic.
Week
C3: Indicate your level of "teaching with technology" knowledge.

Prior to the COVID-19 pandemic.	**Current**
1	3
C4: What is your current perception and understanding of the benefits of "teaching with technology"?	
benefits the learners when they are absent due to illness ect	
C5: Indicate your school policy for the in-class use of mobile devices by learners.	
Prior to the COVID-19 pandemic.	**Current**
Ban use	Discourage use
C6: To what extent do you agree with the following statements about learners' in-class use of mobile devices?	

Enhance learning.	Distracting.	Security / privacy problems.
1	3	0

I would like to have more professional development in integrating mobile devices in courses.	I create assignments that take advantage of students' access to mobile technologies.
1	0

D1: How do you use ICT in your teaching practice?	
Prior to the COVID-19 pandemic.	**Current**
Replace traditional activities and materials with digital versions. E.g., PowerPoint presentation.	Incorporate interactive digital enhancements. E.g., YouTube video.

D2: How did "teaching with technology" during the COVID-19 pandemic support or transform your teaching practice?
Made video's on youtube
D3: Please share some of your successes in "teaching with technology" during the COVID-19 pandemic.
The videos helped, the kids could listen to them more than once
D4: Which Learning Management System (LMS) do you use at your school?
None
D5: What are the benefits of using a learning management system (LMS) for teachers and learners?
Not applicable
D6: What resources are required to increase the level of information technology integration in your teaching practice?
soft copies of all the textbooks
D7: To what degree did you continue "teaching with technology" when you returned to face-to-face classes?
WhatsApp
D8: Are there any other comments you wish to make in relation to "teaching with technology" during the COVID-19 pandemic that you believe may be relevant for this study?
Parents now think that their kids can skip school and that they will be able to learn remotely.

Respondent #15		Lillibet
Gender	**Age**	**Teaching experience**
Female	31 - 40	11 - 15 years
Main subject(s)		**Socio-economic status of school**
Natural Sciences		Quintile 5 - High
A1: How would you rate:		
Your proficiency with ICT?		**Your use of ICT for teaching and learning?**
3		2
Teacher access to ICT at school?	**School's use of ICT?**	**ICT training at your school?**
2	1	1
B1: Rate your exposure to the following learning environments prior to the COVID-19 pandemic.		
Face-to-face (Classroom)	**Online (Remote)**	**Blended learning**
3	0	0
B2: How did you use ICT in teaching and learning prior to the COVID-19 pandemic?		
Learners used the internet independently to complete tasks.		
B3: To what extent did your prior experience with ICT in teaching and learning prepare you for emergency remote teaching during the COVID-19 pandemic?		
I am computer literate and fast learner, so all though I did not have knowledge on the new systems we were using, I was able to adapt easily		
B4: What initiatives did your school take to support teachers in transitioning to remote online teaching during the COVID-19 pandemic?		
Training in MS Teams; Provision of laptops to those that need it; data allowance.		
B5: To what extent did you use the following options to engage with learners remotely during the COVID-19 pandemic?		
Asynchronous	**Synchronous**	**Combination**
3	1	1
B6: To what extent do the following statements describe your interaction with learners during the COVID-19 pandemic?		
One-way written	**Two-way asynchronous written.**	**Two-way synchronous written.**
3	1	1
One-way visual and two-way voice communication.		**Two-way voice and visual communication.**
1		0

B7: How efficient were the following online collaborative tools for teacher-learner interaction during the COVID-19 pandemic?				
Skype	**Zoom**	**Microsoft Teams**	**Edmodo**	**Google Classroom**
Not used	Not used	2	3	Not used
B8: How efficient were the following social media platforms for teacher-learner interaction during the COVID-19 pandemic?				
Facebook	**WhatsApp**	**YouTube**	**Wikis**	**Twitter**
Not used	Not used	3	1	Not used

B9: How did you experience the support dimension of teacher-learner interaction during the COVID-19 pandemic?
Short, concise information was given; unnecessary work cut; all work explained again when learners returned to class.
B10: How did you experience the affective dimension of teacher-learner interaction during the COVID-19 pandemic?
Spoke to learners more one on one.
B11: Rate the following as challenges in emergency remote teaching during the COVID-19 pandemic.

Access to internet.	**Courseware.**	**Workload too high.**	**Self-directed learning**	**Learner assessment.**
3	2	1	3	3
C1: Rate the following as ways in which you gained knowledge about "teaching with technology" since the start of the COVID-19 pandemic.				
Part-time	**In-service**	**Own learning**	**Social media**	**District workshops**
0	1	3	3	1

C2: Total amount of in-service training you received on "teaching with technology" since the start of the COVID-19 pandemic.
Semester
C3: Indicate your level of "teaching with technology" knowledge.

Prior to the COVID-19 pandemic.	**Current**
1	3
C4: What is your current perception and understanding of the benefits of "teaching with technology"?	
Helps learners with different learning styles; gives learners the chance to go through the lesson again (when lesson is recorded); helps learners to work independently; easier for learners to catch up when they are sick/absent.	
C5: Indicate your school policy for the in-class use of mobile devices by learners.	
Prior to the COVID-19 pandemic.	**Current**
Discourage use	Discourage use

C6: To what extent do you agree with the following statements about learners' in-class use of mobile devices?		
Enhance learning.	**Distracting.**	**Security / privacy problems.**
3	3	2

I would like to have more professional development in integrating mobile devices in courses.	I create assignments that take advantage of students' access to mobile technologies.
3	0

D1: How do you use ICT in your teaching practice?	
Prior to the COVID-19 pandemic.	**Current**
Incorporate interactive digital enhancements. E.g., YouTube video.	Incorporate interactive digital enhancements. E.g., YouTube video.

D2: How did "teaching with technology" during the COVID-19 pandemic support or transform your teaching practice?
New technology helped me to use different methods to teach the same work in order to help learners with different learning abilities/study methods; technology helps learners learn while having fun.
D3: Please share some of your successes in "teaching with technology" during the COVID-19 pandemic.
Increased knowledge about different teaching methods using technology; more adventurous - not scared to try new technology in class.
D4: Which Learning Management System (LMS) do you use at your school?
MS Teams /Staffroom
D5: What are the benefits of using a learning management system (LMS) for teachers and learners?
Helps teachers to see a bigger picture of learners (Staffroom) as all notes on students are stored there; MS Teams: makes it easy for learners to receive notes, hand in tasks etc.
D6: What resources are required to increase the level of information technology integration in your teaching practice?
More training
D7: To what degree did you continue "teaching with technology" when you returned to face-to-face classes?
Mostly returned to normal, but added use of cellphones, other technology - but not as often.
D8: Are there any other comments you wish to make in relation to "teaching with technology" during the COVID-19 pandemic that you believe may be relevant for this study?
"A lot of teachers are creatures of habit and don't like to try new technology - it scares them; Some subjects are better off being taught in a ""traditional"" manner; Data allowance and access to cellphones or laptops remains a huge problem."

Respondent #16	Martin

Gender	Age	Teaching experience
Male	31 - 40	6 - 10 years

Main subject(s)	Socio-economic status of school
Technical	Quintile 3 - Middle

A1: How would you rate:

Your proficiency with ICT?	Your use of ICT for teaching and learning?
3	2

Teacher access to ICT at school?	School's use of ICT?	ICT training at your school?
3	2	3

B1: Rate your exposure to the following learning environments prior to the COVID-19 pandemic.

Face-to-face (Classroom)	Online (Remote)	Blended learning
3	1	2

B2: How did you use ICT in teaching and learning prior to the COVID-19 pandemic?

I used Google classroom and created PowerPoints, videos, work sheets and uploaded PDF documents.

B3: To what extent did your prior experience with ICT in teaching and learning prepare you for emergency remote teaching during the COVID-19 pandemic?

I studied online and recently completed my honors, this helped me with working with online platforms. My hobby is building and restoring computer and it gave me prior knowledge to the situation. and my previous employer Worcester gymnasium implemented technology based learning which was also an great help.

B4: What initiatives did your school take to support teachers in transitioning to remote online teaching during the COVID-19 pandemic?

The School provided us with training and developments; access to internet connection and the capability to use mobile devices and laptops with google classroom

B5: To what extent did you use the following options to engage with learners remotely during the COVID-19 pandemic?

Asynchronous	Synchronous	Combination
3	1	1

B6: To what extent do the following statements describe your interaction with learners during the COVID-19 pandemic?

One-way written	Two-way asynchronous written.	Two-way synchronous written.
3	1	1

One-way visual and two-way voice communication.	Two-way voice and visual communication.
1	1

B7: How efficient were the following online collaborative tools for teacher-learner interaction during the COVID-19 pandemic?

Skype	Zoom	Microsoft Teams	Edmodo	Google Classroom
1	3	3	Not used	3

B8: How efficient were the following social media platforms for teacher-learner interaction during the COVID-19 pandemic?

Facebook	WhatsApp	YouTube	Wikis	Twitter
Not used	3	3	Not used	Not used

B9: How did you experience the support dimension of teacher-learner interaction during the COVID-19 pandemic?

not much support other than the school structure.

B10: How did you experience the affective dimension of teacher-learner interaction during the COVID-19 pandemic?

"The relationship was good but covid showed me that student need the classroom environment to achieve their highest performance when it come to mid and low tier learners. however strong leaners did just fine. "

B11: Rate the following as challenges in emergency remote teaching during the COVID-19 pandemic.

Access to internet.	Courseware.	Workload too high.	Self-directed learning	Learner assessment.
1	2	2	1	1

C1: Rate the following as ways in which you gained knowledge about "teaching with technology" since the start of the COVID-19 pandemic.

Part-time	In-service	Own learning	Social media	District workshops
3	2	3	2	1

C2: Total amount of in-service training you received on "teaching with technology" since the start of the COVID-19 pandemic.

Week

C3: Indicate your level of "teaching with technology" knowledge.

Prior to the COVID-19 pandemic.	Current
2	3

C4: What is your current perception and understanding of the benefits of "teaching with technology"?

can be very helpful, gives more information, more information for leaners, better communication.

C5: Indicate your school policy for the in-class use of mobile devices by learners.

Prior to the COVID-19 pandemic.		Current
Ban use		Ban use
C6: To what extent do you agree with the following statements about learners' in-class use of mobile devices?		
Enhance learning.	**Distracting.**	**Security / privacy problems.**
2	1	2
I would like to have more professional development in integrating mobile devices in courses.		**I create assignments that take advantage of students' access to mobile technologies.**
3		1
D1: How do you use ICT in your teaching practice?		
Prior to the COVID-19 pandemic.		**Current**
Incorporate interactive digital enhancements. E.g., YouTube video.		Incorporate interactive digital enhancements. E.g., YouTube video.
D2: How did "teaching with technology" during the COVID-19 pandemic support or transform your teaching practice?		
more integrated lessons		
D3: Please share some of your successes in "teaching with technology" during the COVID-19 pandemic.		
better learner support, easier access to lesson content		
D4: Which Learning Management System (LMS) do you use at your school?		
google classroom, D6		
D5: What are the benefits of using a learning management system (LMS) for teachers and learners?		
learner access to consistent information, easier access to teaching documents		
D6: What resources are required to increase the level of information technology integration in your teaching practice?		
Government must upgrade syllabus , proper training by professionals, more learner options		
D7: To what degree did you continue "teaching with technology" when you returned to face-to-face classes?		
I stayed as close as possible.		
D8: Are there any other comments you wish to make in relation to "teaching with technology" during the COVID-19 pandemic that you believe may be relevant for this study?		
None		

Respondent #17	Shireen

Gender	Age	Teaching experience
Female	31 - 40	6 - 10 years

Main subject(s)	Socio-economic status of school
Mathematics	Quintile 1 - Low

A1: How would you rate:

Your proficiency with ICT?	Your use of ICT for teaching and learning?
3	3

Teacher access to ICT at school?	School's use of ICT?	ICT training at your school?
3	2	2

B1: Rate your exposure to the following learning environments prior to the COVID-19 pandemic.

Face-to-face (Classroom)	Online (Remote)	Blended learning
3	0	0

B2: How did you use ICT in teaching and learning prior to the COVID-19 pandemic?

None of the above

B3: To what extent did your prior experience with ICT in teaching and learning prepare you for emergency remote teaching during the COVID-19 pandemic?

I had attended training sessions where I learnt about certain technology that could support learning example plickers, kahoot ect.

B4: What initiatives did your school take to support teachers in transitioning to remote online teaching during the COVID-19 pandemic?

Google Classroom training, supplying learners and staff with data and supplying some faculties with Wacoms and Visualisers.

B5: To what extent did you use the following options to engage with learners remotely during the COVID-19 pandemic?

Asynchronous	Synchronous	Combination
3	0	0

B6: To what extent do the following statements describe your interaction with learners during the COVID-19 pandemic?

One-way written	Two-way asynchronous written.	Two-way synchronous written.
2	2	1

One-way visual and two-way voice communication.	Two-way voice and visual communication.
0	0

B7: How efficient were the following online collaborative tools for teacher-learner interaction during the COVID-19 pandemic?

Skype	Zoom	Microsoft Teams	Edmodo	Google Classroom
Not used	Not used	Not used	Not used	3

B8: How efficient were the following social media platforms for teacher-learner interaction during the COVID-19 pandemic?

Facebook	WhatsApp	YouTube	Wikis	Twitter
Not used	Not used	1	Not used	Not used

B9: How did you experience the support dimension of teacher-learner interaction during the COVID-19 pandemic?

I recorded lessons on PowerPoint and uploaded it to Google Classroom. I supplied learners with PDF notes of the lesson and access to additional resources.

B10: How did you experience the affective dimension of teacher-learner interaction during the COVID-19 pandemic?

I would switch on my camera whilst recording the PowerPoint presentation so that learners would recognise my face and not just hear a voice. That it could create a atmosphere that is familiar to the learners. I also asked alumni from the school to record messages for the learners as motivation and uploaded in to each class.

B11: Rate the following as challenges in emergency remote teaching during the COVID-19 pandemic.

Access to internet.	Courseware.	Workload too high.	Self-directed learning	Learner assessment.
2	0	1	1	1

C1: Rate the following as ways in which you gained knowledge about "teaching with technology" since the start of the COVID-19 pandemic.

Part-time	In-service	Own learning	Social media	District workshops
2	3	3	0	1

C2: Total amount of in-service training you received on "teaching with technology" since the start of the COVID-19 pandemic.

Semester

C3: Indicate your level of "teaching with technology" knowledge.

Prior to the COVID-19 pandemic.	Current
2	3

C4: What is your current perception and understanding of the benefits of "teaching with technology"?

Gives learners the opportunity for direct access of classroom note and encourages self learning.

C5: Indicate your school policy for the in-class use of mobile devices by learners.

Prior to the COVID-19 pandemic.		Current
Discourage use		Discourage use
C6: To what extent do you agree with the following statements about learners' in-class use of mobile devices?		
Enhance learning.	**Distracting.**	**Security / privacy problems.**
2	1	3
I would like to have more professional development in integrating mobile devices in courses.		**I create assignments that take advantage of students' access to mobile technologies.**
0		0
D1: How do you use ICT in your teaching practice?		
Prior to the COVID-19 pandemic.		**Current**
Incorporate interactive digital enhancements. E.g., YouTube video.		Incorporate interactive digital enhancements. E.g., YouTube video.
D2: How did "teaching with technology" during the COVID-19 pandemic support or transform your teaching practice?		
technology supports traditional teaching methods		
D3: Please share some of your successes in "teaching with technology" during the COVID-19 pandemic.		
Staff and learner improvement of using technology		
D4: Which Learning Management System (LMS) do you use at your school?		
None		
D5: What are the benefits of using a learning management system (LMS) for teachers and learners?		
Not applicable		
D6: What resources are required to increase the level of information technology integration in your teaching practice?		
E-books and more training		
D7: To what degree did you continue "teaching with technology" when you returned to face-to-face classes?		
Increased implementation of technology		
D8: Are there any other comments you wish to make in relation to "teaching with technology" during the COVID-19 pandemic that you believe may be relevant for this study?		
None		

Respondent #18		Nyanda
Gender	**Age**	**Teaching experience**
Female	51 - 60	6 - 10 years
Main subject(s)		**Socio-economic status of school**
Physical Sciences		Quintile 5 - High
A1: How would you rate:		
Your proficiency with ICT?		**Your use of ICT for teaching and learning?**
3		3
Teacher access to ICT at school?	**School's use of ICT?**	**ICT training at your school?**
3	2	3
B1: Rate your exposure to the following learning environments prior to the COVID-19 pandemic.		
Face-to-face (Classroom)	**Online (Remote)**	**Blended learning**
3	1	0
B2: How did you use ICT in teaching and learning prior to the COVID-19 pandemic?		
Document camera, internet and online simulations		
B3: To what extent did your prior experience with ICT in teaching and learning prepare you for emergency remote teaching during the COVID-19 pandemic?		
Was used to online content delivery via UNISA and TUKS		
B4: What initiatives did your school take to support teachers in transitioning to remote online teaching during the COVID-19 pandemic?		
Training in Google Classroom		
B5: To what extent did you use the following options to engage with learners remotely during the COVID-19 pandemic?		
Asynchronous	**Synchronous**	**Combination**
3	0	1
B6: To what extent do the following statements describe your interaction with learners during the COVID-19 pandemic?		
One-way written	**Two-way asynchronous written.**	**Two-way synchronous written.**
3	2	0
One-way visual and two-way voice communication.		**Two-way voice and visual communication.**
0		0

B7: How efficient were the following online collaborative tools for teacher-learner interaction during the COVID-19 pandemic?				
Skype	**Zoom**	**Microsoft Teams**	**Edmodo**	**Google Classroom**
Not used	Not used	Not used	Not used	3
B8: How efficient were the following social media platforms for teacher-learner interaction during the COVID-19 pandemic?				
Facebook	**WhatsApp**	**YouTube**	**Wikis**	**Twitter**
Not used	3	1	Not used	Not used

B9: How did you experience the support dimension of teacher-learner interaction during the COVID-19 pandemic?
Parents were mostly required to support their children, teachers delivered content
B10: How did you experience the affective dimension of teacher-learner interaction during the COVID-19 pandemic?
Daily messages on Goggle Classroom to encourage
B11: Rate the following as challenges in emergency remote teaching during the COVID-19 pandemic.

Access to internet.	**Courseware.**	**Workload too high.**	**Self-directed learning**	**Learner assessment.**
1	3	2	2	0
C1: Rate the following as ways in which you gained knowledge about "teaching with technology" since the start of the COVID-19 pandemic.				
Part-time	**In-service**	**Own learning**	**Social media**	**District workshops**
3	2	3	2	0

C2: Total amount of in-service training you received on "teaching with technology" since the start of the COVID-19 pandemic.
Week
C3: Indicate your level of "teaching with technology" knowledge.

Prior to the COVID-19 pandemic.	**Current**
2	3
C4: What is your current perception and understanding of the benefits of "teaching with technology"?	
Enhances contact with teacher, re-enforces concepts, good platform to share info	
C5: Indicate your school policy for the in-class use of mobile devices by learners.	
Prior to the COVID-19 pandemic.	**Current**
Ban use	Discourage use
C6: To what extent do you agree with the following statements about learners' in-class use of mobile devices?	

Enhance learning.	Distracting.	Security / privacy problems.
1	3	3

I would like to have more professional development in integrating mobile devices in courses.	I create assignments that take advantage of students' access to mobile technologies.
1	0

D1: How do you use ICT in your teaching practice?	
Prior to the COVID-19 pandemic.	**Current**
Incorporate interactive digital enhancements. E.g., YouTube video.	Use a learning management system. E.g. Moodle for tracking learners' progress.

D2: How did "teaching with technology" during the COVID-19 pandemic support or transform your teaching practice?
Simulations are valuable learning tools
D3: Please share some of your successes in "teaching with technology" during the COVID-19 pandemic.
Constant after hours access to learning material and teacher notes
D4: Which Learning Management System (LMS) do you use at your school?
None, Google Classroom
D5: What are the benefits of using a learning management system (LMS) for teachers and learners?
Not used extensively.
D6: What resources are required to increase the level of information technology integration in your teaching practice?
Time constraint is the greatest hurdle, it takes a long time to set up properly.
D7: To what degree did you continue "teaching with technology" when you returned to face-to-face classes?
Mostly returned to traditional practices
D8: Are there any other comments you wish to make in relation to "teaching with technology" during the COVID-19 pandemic that you believe may be relevant for this study?
None

Respondent #19			Ann	
Gender	**Age**		**Teaching experience**	
Female	31 - 40		11 - 15 years	
Main subject(s)			**Socio-economic status of school**	
Mathematics			Quintile 2 - Lower middle	
A1: How would you rate:				
Your proficiency with ICT?			**Your use of ICT for teaching and learning?**	
1			2	
Teacher access to ICT at school?	**School's use of ICT?**		**ICT training at your school?**	
2	2		2	
B1: Rate your exposure to the following learning environments prior to the COVID-19 pandemic.				
Face-to-face (Classroom)	**Online (Remote)**		**Blended learning**	
3	0		0	
B2: How did you use ICT in teaching and learning prior to the COVID-19 pandemic?				
None student do not have computers				
B3: To what extent did your prior experience with ICT in teaching and learning prepare you for emergency remote teaching during the COVID-19 pandemic?				
It did not help because our students do not have access to internet or computers				
B4: What initiatives did your school take to support teachers in transitioning to remote online teaching during the COVID-19 pandemic?				
We did not use online teaching, notes and worksheets we dropped off at the students homes				
B5: To what extent did you use the following options to engage with learners remotely during the COVID-19 pandemic?				
Asynchronous	**Synchronous**		**Combination**	
0	0		0	
B6: To what extent do the following statements describe your interaction with learners during the COVID-19 pandemic?				
One-way written	**Two-way asynchronous written.**		**Two-way synchronous written.**	
2	1		0	
One-way visual and two-way voice communication.			**Two-way voice and visual communication.**	
0			0	
B7: How efficient were the following online collaborative tools for teacher-learner interaction during the COVID-19 pandemic?				
Skype	**Zoom**	**Microsoft Teams**	**Edmodo**	**Google Classroom**
Not used	Not used	Not used	Not used	Not used
B8: How efficient were the following social media platforms for teacher-learner interaction during the COVID-19 pandemic?				
Facebook	**WhatsApp**	**YouTube**	**Wikis**	**Twitter**
2	3	1	Not used	Not used
B9: How did you experience the support dimension of teacher-learner interaction during the COVID-19 pandemic?				
It was difficult because learners do not have access to ICT				
B10: How did you experience the affective dimension of teacher-learner interaction during the COVID-19 pandemic?				
It was limited				
B11: Rate the following as challenges in emergency remote teaching during the COVID-19 pandemic.				
Access to internet.	**Courseware.**	**Workload too high.**	**Self-directed learning**	**Learner assessment.**
2	1	1	2	2
C1: Rate the following as ways in which you gained knowledge about "teaching with technology" since the start of the COVID-19 pandemic.				
Part-time	**In-service**	**Own learning**	**Social media**	**District workshops**
2	2	2	2	3
C2: Total amount of in-service training you received on "teaching with technology" since the start of the COVID-19 pandemic.				
Week				
C3: Indicate your level of "teaching with technology" knowledge.				
Prior to the COVID-19 pandemic.			**Current**	
1			2	
C4: What is your current perception and understanding of the benefits of "teaching with technology"?				
There are many benefits				
C5: Indicate your school policy for the in-class use of mobile devices by learners.				
Prior to the COVID-19 pandemic.			**Current**	
Ban use			Ban use	
C6: To what extent do you agree with the following statements about learners' in-class use of mobile devices?				

Enhance learning.	Distracting.	Security / privacy problems.
0	3	3

I would like to have more professional development in integrating mobile devices in courses.	I create assignments that take advantage of students' access to mobile technologies.
0	0

D1: How do you use ICT in your teaching practice?	
Prior to the COVID-19 pandemic.	**Current**
Replace traditional activities and materials with digital versions. E.g., PowerPoint presentation.	Replace traditional activities and materials with digital versions. E.g., PowerPoint presentation.

D2: How did "teaching with technology" during the COVID-19 pandemic support or transform your teaching practice?
Technology can help only if all leaner have access
D3: Please share some of your successes in "teaching with technology" during the COVID-19 pandemic.
None
D4: Which Learning Management System (LMS) do you use at your school?
None
D5: What are the benefits of using a learning management system (LMS) for teachers and learners?
Do not know
D6: What resources are required to increase the level of information technology integration in your teaching practice?
More access to computers
D7: To what degree did you continue "teaching with technology" when you returned to face-to-face classes?
Returned to traditional practices
D8: Are there any other comments you wish to make in relation to "teaching with technology" during the COVID-19 pandemic that you believe may be relevant for this study?
None

Respondent #20			Lynette	
Gender	**Age**		**Teaching experience**	
Female	51 - 60		21 - 25 years	
Main subject(s)			**Socio-economic status of school**	
Mathematics, Natural Sciences			Quintile 3 - Middle	
A1: How would you rate:				
Your proficiency with ICT?			**Your use of ICT for teaching and learning?**	
2			2	
Teacher access to ICT at school?	**School's use of ICT?**		**ICT training at your school?**	
3	2		2	
B1: Rate your exposure to the following learning environments prior to the COVID-19 pandemic.				
Face-to-face (Classroom)	**Online (Remote)**		**Blended learning**	
1	3		2	
B2: How did you use ICT in teaching and learning prior to the COVID-19 pandemic?				
Use cell groups and load subject material and videos on google classroom				
B3: To what extent did your prior experience with ICT in teaching and learning prepare you for emergency remote teaching during the COVID-19 pandemic?				
Was forced to learn new way of teaching and communication				
B4: What initiatives did your school take to support teachers in transitioning to remote online teaching during the COVID-19 pandemic?				
Did training and support of google classroom and mobile devices.				
B5: To what extent did you use the following options to engage with learners remotely during the COVID-19 pandemic?				
Asynchronous	**Synchronous**		**Combination**	
3	1		1	
B6: To what extent do the following statements describe your interaction with learners during the COVID-19 pandemic?				
One-way written	**Two-way asynchronous written.**		**Two-way synchronous written.**	
1	2		2	
One-way visual and two-way voice communication.			**Two-way voice and visual communication.**	
2			2	
B7: How efficient were the following online collaborative tools for teacher-learner interaction during the COVID-19 pandemic?				
Skype	**Zoom**	**Microsoft Teams**	**Edmodo**	**Google Classroom**
Not used	1	1	Not used	3
B8: How efficient were the following social media platforms for teacher-learner interaction during the COVID-19 pandemic?				
Facebook	**WhatsApp**	**YouTube**	**Wikis**	**Twitter**
Not used	3	2	Not used	Not used
B9: How did you experience the support dimension of teacher-learner interaction during the COVID-19 pandemic?				
Good support from the school				
B10: How did you experience the affective dimension of teacher-learner interaction during the COVID-19 pandemic?				
Better understanding of the learners needs and try to support them				
B11: Rate the following as challenges in emergency remote teaching during the COVID-19 pandemic.				
Access to internet.	**Courseware.**	**Workload too high.**	**Self-directed learning**	**Learner assessment.**
2	2	2	1	2
C1: Rate the following as ways in which you gained knowledge about "teaching with technology" since the start of the COVID-19 pandemic.				
Part-time	**In-service**	**Own learning**	**Social media**	**District workshops**
2	2	2	2	2
C2: Total amount of in-service training you received on "teaching with technology" since the start of the COVID-19 pandemic.				
Week				
C3: Indicate your level of "teaching with technology" knowledge.				
Prior to the COVID-19 pandemic.			**Current**	
2			2	
C4: What is your current perception and understanding of the benefits of "teaching with technology"?				
prepare learners for future and different learning styles				
C5: Indicate your school policy for the in-class use of mobile devices by learners.				
Prior to the COVID-19 pandemic.			**Current**	
Discourage use			Encourage use	
C6: To what extent do you agree with the following statements about learners' in-class use of mobile devices?				

Enhance learning.	Distracting.	Security / privacy problems.
2	1	3

I would like to have more professional development in integrating mobile devices in courses.	I create assignments that take advantage of students' access to mobile technologies.
2	2

D1: How do you use ICT in your teaching practice?	
Prior to the COVID-19 pandemic.	**Current**
Replace traditional activities and materials with digital versions. E.g., PowerPoint presentation.	Incorporate interactive digital enhancements. E.g., YouTube video.

D2: How did "teaching with technology" during the COVID-19 pandemic support or transform your teaching practice?
Technology supports traditional teaching methods
D3: Please share some of your successes in "teaching with technology" during the COVID-19 pandemic.
Increase knowledge of teaching use technology
D4: Which Learning Management System (LMS) do you use at your school?
Moodle
D5: What are the benefits of using a learning management system (LMS) for teachers and learners?
Saves time
D6: What resources are required to increase the level of information technology integration in your teaching practice?
More experience and use of technology
D7: To what degree did you continue "teaching with technology" when you returned to face-to-face classes?
Increased implementation of technology
D8: Are there any other comments you wish to make in relation to "teaching with technology" during the COVID-19 pandemic that you believe may be relevant for this study?
Took teachers out of comfort zone

Respondent #21	Susan

Gender	Age	Teaching experience
Female	31 - 40	1 - 5 years

Main subject(s)	Socio-economic status of school
Mathematics, Social sciences	Quintile 4 - Upper middle

A1: How would you rate:

Your proficiency with ICT?	Your use of ICT for teaching and learning?
3	3

Teacher access to ICT at school?	School's use of ICT?	ICT training at your school?
3	3	3

B1: Rate your exposure to the following learning environments prior to the COVID-19 pandemic.

Face-to-face (Classroom)	Online (Remote)	Blended learning
3	2	2

B2: How did you use ICT in teaching and learning prior to the COVID-19 pandemic?

I used it occasionally in my lesson and only when needed.

B3: To what extent did your prior experience with ICT in teaching and learning prepare you for emergency remote teaching during the COVID-19 pandemic?

Enhanced learning in the classroom, efficiency and effectively in classroom activities.

B4: What initiatives did your school take to support teachers in transitioning to remote online teaching during the COVID-19 pandemic?

Weekly training session on ICT, access to the internet to all learners and educators.

B5: To what extent did you use the following options to engage with learners remotely during the COVID-19 pandemic?

Asynchronous	Synchronous	Combination
3	2	2

B6: To what extent do the following statements describe your interaction with learners during the COVID-19 pandemic?

One-way written	Two-way asynchronous written.	Two-way synchronous written.
2	2	1

One-way visual and two-way voice communication.	Two-way voice and visual communication.
2	2

B7: How efficient were the following online collaborative tools for teacher-learner interaction during the COVID-19 pandemic?

Skype	Zoom	Microsoft Teams	Edmodo	Google Classroom
Not used	3	Not used	Not used	3

B8: How efficient were the following social media platforms for teacher-learner interaction during the COVID-19 pandemic?

Facebook	WhatsApp	YouTube	Wikis	Twitter
Not used	3	3	Not used	Not used

B9: How did you experience the support dimension of teacher-learner interaction during the COVID-19 pandemic?

We used google classroom to share info amongst teachers and to moderate assessments.

B10: How did you experience the affective dimension of teacher-learner interaction during the COVID-19 pandemic?

It helped built positive relationships.

B11: Rate the following as challenges in emergency remote teaching during the COVID-19 pandemic.

Access to internet.	Courseware.	Workload too high.	Self-directed learning	Learner assessment.
1	1	2	2	1

C1: Rate the following as ways in which you gained knowledge about "teaching with technology" since the start of the COVID-19 pandemic.

Part-time	In-service	Own learning	Social media	District workshops
3	3	3	3	2

C2: Total amount of in-service training you received on "teaching with technology" since the start of the COVID-19 pandemic.

Week

C3: Indicate your level of "teaching with technology" knowledge.

Prior to the COVID-19 pandemic.	Current
1	2

C4: What is your current perception and understanding of the benefits of "teaching with technology"?

Preparing learners for the future and the world out there, accommodates various learning stules, more engaging learning environment.

C5: Indicate your school policy for the in-class use of mobile devices by learners.

Prior to the COVID-19 pandemic.	Current
Require use	Require use

C6: To what extent do you agree with the following statements about learners' in-class use of mobile devices?		
Enhance learning.	**Distracting.**	**Security / privacy problems.**
2	1	0

I would like to have more professional development in integrating mobile devices in courses.	I create assignments that take advantage of students' access to mobile technologies.
1	1

D1: How do you use ICT in your teaching practice?	
Prior to the COVID-19 pandemic.	**Current**
Replace traditional activities and materials with digital versions. E.g., PowerPoint presentation.	Incorporate interactive digital enhancements. E.g., YouTube video.

D2: How did "teaching with technology" during the COVID-19 pandemic support or transform your teaching practice?
Technology is used to design innovative learning experiences.
D3: Please share some of your successes in "teaching with technology" during the COVID-19 pandemic.
Increased knowledge of teaching with technology.
D4: Which Learning Management System (LMS) do you use at your school?
white board, TV, etc
D5: What are the benefits of using a learning management system (LMS) for teachers and learners?
saves time, eases teachers workload, efficiency in learning.
D6: What resources are required to increase the level of information technology integration in your teaching practice?
Ebooks, IT support
D7: To what degree did you continue "teaching with technology" when you returned to face-to-face classes?
Increased the implementation of technology.
D8: Are there any other comments you wish to make in relation to "teaching with technology" during the COVID-19 pandemic that you believe may be relevant for this study?
None

Respondent #22		Annette
Gender	**Age**	**Teaching experience**
Female	31 - 40	6 - 10 years
Main subject(s)		**Socio-economic status of school**
Languages, Natural Sciences		Quintile 1 - Low
A1: How would you rate:		
Your proficiency with ICT?		**Your use of ICT for teaching and learning?**
2		3
Teacher access to ICT at school?	**School's use of ICT?**	**ICT training at your school?**
2	1	2
B1: Rate your exposure to the following learning environments prior to the COVID-19 pandemic.		
Face-to-face (Classroom)	**Online (Remote)**	**Blended learning**
3	1	1
B2: How did you use ICT in teaching and learning prior to the COVID-19 pandemic?		
Use of videos and pictures to enhance learning experience. Power point presentations		
B3: To what extent did your prior experience with ICT in teaching and learning prepare you for emergency remote teaching during the COVID-19 pandemic?		
No remote teaching was done, as the curriculum changed.		
B4: What initiatives did your school take to support teachers in transitioning to remote online teaching during the COVID-19 pandemic?		
Training		
B5: To what extent did you use the following options to engage with learners remotely during the COVID-19 pandemic?		
Asynchronous	**Synchronous**	**Combination**
1	0	0
B6: To what extent do the following statements describe your interaction with learners during the COVID-19 pandemic?		
One-way written	**Two-way asynchronous written.**	**Two-way synchronous written.**
1	1	0
One-way visual and two-way voice communication.		**Two-way voice and visual communication.**
0		0

B7: How efficient were the following online collaborative tools for teacher-learner interaction during the COVID-19 pandemic?				
Skype	**Zoom**	**Microsoft Teams**	**Edmodo**	**Google Classroom**
Not used	Not used	Not used	Not used	0
B8: How efficient were the following social media platforms for teacher-learner interaction during the COVID-19 pandemic?				
Facebook	**WhatsApp**	**YouTube**	**Wikis**	**Twitter**
Not used	1	Not used	Not used	Not used

B9: How did you experience the support dimension of teacher-learner interaction during the COVID-19 pandemic?
Only focused on important concepts that was needed in order for learners to be successful.
B10: How did you experience the affective dimension of teacher-learner interaction during the COVID-19 pandemic?
Learners were anxious and quiet.
B11: Rate the following as challenges in emergency remote teaching during the COVID-19 pandemic.

Access to internet.	**Courseware.**	**Workload too high.**	**Self-directed learning**	**Learner assessment.**
0	0	3	0	1
C1: Rate the following as ways in which you gained knowledge about "teaching with technology" since the start of the COVID-19 pandemic.				
Part-time	**In-service**	**Own learning**	**Social media**	**District workshops**
2	2	2	3	1

C2: Total amount of in-service training you received on "teaching with technology" since the start of the COVID-19 pandemic.
Week
C3: Indicate your level of "teaching with technology" knowledge.

Prior to the COVID-19 pandemic.	**Current**
1	2
C4: What is your current perception and understanding of the benefits of "teaching with technology"?	
With the use of technology, all learners can be stimulated based on their various learning styles.	
C5: Indicate your school policy for the in-class use of mobile devices by learners.	
Prior to the COVID-19 pandemic.	**Current**
Encourage use	Ban use
C6: To what extent do you agree with the following statements about learners' in-class use of mobile devices?	

Enhance learning.	Distracting.	Security / privacy problems.
2	3	1

I would like to have more professional development in integrating mobile devices in courses.	I create assignments that take advantage of students' access to mobile technologies.
2	2

D1: How do you use ICT in your teaching practice?	
Prior to the COVID-19 pandemic.	**Current**
Replace traditional activities and materials with digital versions. E.g., PowerPoint presentation.	Incorporate interactive digital enhancements. E.g., YouTube video.

D2: How did "teaching with technology" during the COVID-19 pandemic support or transform your teaching practice?
Technology helps to strengthen concepts taught within the various subjects.
D3: Please share some of your successes in "teaching with technology" during the COVID-19 pandemic.
Helps to support learners understanding of concepts.
D4: Which Learning Management System (LMS) do you use at your school?
Blackboard
D5: What are the benefits of using a learning management system (LMS) for teachers and learners?
Save time and makes workload easier.
D6: What resources are required to increase the level of information technology integration in your teaching practice?
IT support
D7: To what degree did you continue "teaching with technology" when you returned to face-to-face classes?
Increased the use of technology and now and then gave learners the opportunity to to work on their mobile devices.
D8: Are there any other comments you wish to make in relation to "teaching with technology" during the COVID-19 pandemic that you believe may be relevant for this study?
Not all learners have access to mobile devices, which made it difficult to teach on-line.

APPENDIX F: Focus group interview transcripts

Introduction and background with reference to teaching during COVID-19	
Santi I'm currently teaching at a school that is basically distance learning. COVID did not really have an impact on our school as we basically just moved, the next day when school shut down, to our houses and we continued teaching. The only difference was now that instead of a blackboard I had a whiteboard, and suddenly zoom sessions in front of me, not the children in front of me anymore. So that was a small change. But there was no, suddenly I had to learn new stuff, or that that kind of thing, because you basically use that every single day of our school year. As 90% of our learners are distant learners. I've got two or three learners in my class and 25 learners all over the country. So that was, for our school, not really an upset in terms of, we continued from day one, right through COVID. There was not one single day that we said, there's no school, we didn't have to adopt to a new syllabus or that kind of thing. So I think we are privileged to do that, that kind of way. And during that time out the numbers in our school, climbed by 50% basically, because most of the teachers or parents took the children out of the schools and suddenly put them in our school because they had school, whereas in other schools, I remember my sister's children in White River, basically sat at home for two months, no school, no nothing. And we can continue, they was never one single day that we said, no school. Learners know what to do every single day. They had the planning ahead, because we plan ahead of each term. So there was no stop in planning, nothing, nothing. The only difference was I was teaching my pyjamas instead of dressed properly. So that basically the last two years how things worked at our school, I honestly have to say, I don't know if I would have coped with this whole process if I was still at a normal department school, how to reach out children suddenly. And because those kinds of children don't use the kind of media that we use, basically on a daily turn. Our kids are used to using a platform we use Leersfeer as our platform. That is basically the communication with us. There's no face to face communication. So that was an advantage to our children. Way ahead of COVID. We already had this in place.	Sipho Staying in Rustenberg. I am a Gr 8 to 12 teacher. Yes, and then I'm working at this other school outside of Rustenberg, back by the name of Malifo. And then it is just a small located area outside of Rustenberg. And then I've been teaching grade eight up to 12, grade eight, EMS, nine EMS and then 10 level and 12 mathematics as well as accounting. So in terms of COVID-19, for the past two years, which we were struggling in terms of teaching and learning. In our school the problem with a e-learning is that we experience lack of devices which will assist us to carry out the teaching and learning. During the pandemic, where the only the Gr 12s were able to interact with us the Grade 12 educators, because they had access to the tablets, even though the tablets, they had the tablets, but then they were lacking data for the connection, because the only platform that we could use was WhatsApp. And then others since well, I started in the ICT with around I started around 2019 even myself I was I'm still in new in this ICT thing. Therefore I couldn't use other options to maybe interact freely with these Grade 12 learners. So during the pandemic it was very difficult for teaching and learning because sometimes you prepare some work through maybe PDF to send this learners when we have created the groups to teach but then you cannot access all of them because of a lack of data and then even the area where I am the data is moderate poor connection sometimes is there sometimes sufficient sometimes there's no proper data for proper communication you see, and then even the in terms of the infrastructure at the school they have something like three classes which have interactive whiteboards of which is the school has got around 780 to 800 learners as of which three classes is not enough for take for carrying out the Teaching and Learning with this ICT. So that's the challenge that we had, that I had, in fact, so far during the COVID-19, in terms of teaching and learning is concerned.

Primary lessons or your takeaways from that rapid overnight news that the teaching scenario is going to change.	
Santi What I take from that overnight from immediate effect, what the President said on that night was, I need to be prepared. Luckily, from our point of view, we prepare a term ahead and the learners had the whole terms planning with them. But if I didn't have that planning, I don't know. There was nothing to do the next day. So I was really grateful for my planning already. Because the next morning, I could say right grade eight grade nines or whatever, let's carry on with for instance lesson 14. So planning ahead was the most important thing during that COVID crisis. Even to us, it had an effect, because suddenly mom and dad are at home, they're not usually at home. And these brothers and sisters that's not usually there with our distant learners, they were moved and they're not at home, and suddenly, they were crowded houses and stuff like that. And yes, suddenly, there was no Internet, or not data for that. So that was a struggle to get to all our learners at once. Because we basically work on a one on one communication, two or three learners at a time, and not all 50 of them. So the biggest struggle was, well, we were planned, we, I was organized. According to my work, I knew exactly what to do. The most, the biggest concern was at that stage to get the children involved, because now their friends are at home, and why did they have to work and mum and dad is as I said, suddenly at home, with the whole family and to get them involved in a proper routine. That was the most difficult part in the beginning of the COVID. situation. Later on, they complied and they carry on as if the normal. Our normal was back after two or three weeks. And I have to say after the second time we were stuck at home. Things kind of just carry on normally. But at first it was a struggle to get children behind the wheel and to carry on with the work because the rest of the friends and people around them don't have school. So that that was my biggest problem. It was, first it was easy to them because we were at school and they are the houses and they just carry on with us. But suddenly, if you got to sit at home, and did that mindset that might change was difficult in the beginning, but we won it over. And at the end of the day, everything worked out fine. And we could have carried on.	Sipho in terms of transition, I it was very difficult because you'll find this learners who are used to learn with their teachers present whereby they are in fact they are used to a teaching strategy, contact whereby a teacher is there and then they are there to monitor them while they are learning. And then now they are there at home with parents, Teacher cannot access them. And then even if you give them work for them to submit or send back your work that you've given them, it becomes difficult. And then one more thing it was also the teachers. Because there have been some programs from the department whereby they were the making workshops for the old teachers to go and attend. But as you know that some people are reluctant. In fact, it was very difficult, they could not even use a whatsapp to communicate experience during that time for most of us, and then again, even the devices, the tablets that were issued to the school to give to learners, some of them, they were not enough for the grade twelves. And then again, some of them even who had the tablets, like I'm saying, some must even stay in very far, whereby internet is totally not working there. Therefore, they will be having the tablets, but then they cannot be able to utilize them, you see. And then the second phase as well, when they came, it became a problem again, because they could not even the half of learners who change here, they could not use this ICT, because of the devices that in fact, here in rural areas, the problem is the devices in the infrastructure and also teaching from the teachers point of view, so that they can be able to utilize this ICT teaching and learning programs, because you'll find out that you're having your laptops here 10 laptops, but only one or two people can be able to actually use them, and then the rest will just be staying there. And then the teachers, the ones who are reluctant to use this ICT, they will be a continuing with their old way of teaching, even though some of the electronics will be there, the projectors will be there. But transition was very difficult even now. Remember there is lost time, they cannot even give learners extra work to go and work maybe during holidays, and be able to communicate with them during that holiday time. So that is the challenge that I saw in our school during this two year period of COVID-19. Pre and Post.

Teacher-learner interaction during COVID-19.	
Santi We had zoom sessions. And I have to say that our learner are kind of looking forward to the zoom session, keep my situation in mind is that most of my learners are 100, 200, 500, 1000 kilometres away from towns, normal towns, they on farms, rural areas, small places, they're not close to town, so they looking forward to the Zoom sessions, because then they can basically see their classmates. And the problem with that was now they believe they can talk to you 24/7. So there's no strict time from 7 to 2. That is school time, like it used to be. And now suddenly, I had calls from two o'clock in the morning. Mam I'm struggling with this program, can you help I mean, it's two o'clock in the morning, way before seven o'clock. And while we were running around in the house in some somebody else, I started with my work, please help me mam. There was no time - 7 to 2 did not exist to this learners. So we had to put a few rules in place as well. I prefer when I speak to my learners, keep your video open, because I would like to see your facial expression, put up your hand like you would have done in a classroom, don't use these little icons here at the bottom. I want to see your face expression talk to me if I want interaction as is, as people doing in class. It's kind of difficult if this is just a screen between me and the children. Mostly it's me and my dogs and the rest of the class. That's my way of seeing that my learners understand what I'm doing in class. I look at the faces. You can immediately see in a learner's eyes and facial expression. Do they know what's going on? Or are they with me? Do they hear me speak? And then people tend to do they mute everything. And so they are there, but they're not there? Or they don't show the video. So I don't know if they are there as part of the class. So I had to set a few rules. As I said, I prefer them to put on your video. I mean, even leave open the mic. So that immediate response, if you agree or disagree with me, talk to me immediately. Don't wait till I am done so that it becomes more formal. So that's the way that I worked during COVID. And even today, immediate reaction from the learners so that we can work behind the screen that's in front of us so that it feels like we are in a classroom. Yeah, that's basically what we've done was we created, we were very close with Wolkskool, the Skool Onderdesteuning Sentrum, and I created classes in Wolkskool as well. So constantly the learners know all their assignments were their I can see when they work two o'clock in the morning three o'clock in the morning when they submit their tasks. So that worked as well, for learners to kind of feel I'm not alone, I can see Pietie and Kosie and Jannie are busy working	Sipho In terms of face to face, running of education. Since Well, myself, the zoom thing and a video teaching and learning activities. I didn't do them, in fact, at all because of the situation that I'm in, you see, but then sometimes I'll try and create a small video to send them to show me doing some activities for them. But then I'd see that it is not effective, because some would say Sir was teaching this part this topic or whatever that he was teaching, but then we could not understand it and then communication becomes a problem and then come back and then we can and then we discuss the problem later stage. But I think all in all the zoom the interaction whereby you will be presenting your lesson through zoom. I think it will be better when the session is taking place. I believe that when the teacher is busy delivering a session learners should all be active. The videos should always be on so that whenever you are delivering your content, you will be able to have eye contact with them so that we can see in their eyes, whether they are comprehending whatever that you are teaching them or not. And again, sometimes it is better if all of them mute their voice so that there won't be a disturbance amongst your learners, because in my case I will be having maybe 40 learners or even 50 learners, which we have to teach. So you can imagine if all of them come in while you are busy teaching them they'll eventually disturb your session. Yeah, in terms of face to face. I don't know. But in my case, I don't think is going to it was going to be a little bit of a problem. Where you have to now start by teaching them how to utilize this thing. And sometimes you experience a poor network connection with them. While they're busy listening to you, sometimes the network gets off from their side, and then the lesson becomes a disturbed.

on this as well. So just to create that kind of group feeling as well, because I also believe I prefer to work in groups more than one on one. Because I want to see everybody, one on one doesn't work for me. Because if I work one on one, people tend to not join my meeting. So I prefer to work in my group so that I can see all the faces who's here everybody. And I want to talk to everybody, everybody has to say hi, and by and put up there and stuff like that. But as we're doing this 24/7 In my school, I have to make sure that I Zoom constantly this is basically a zoom session every single day. So that's my way to get to know my learners. If it wasn't for zoom it will always be a Pietie van der Merwe on my class list. But thanks to zoom Pietie van der Merwe becomes a face in my classroom and becomes part of my classroom is not just the name on my class list.	

Impact of COVID-19 on the technological-pedagogical or teaching with technology knowledge of teachers.	
Santi For teaching with technology first of all, I found there was a lot of fear from teachers, even though they used this constantly. But then they had to, they have to use that not on their own terms. But now they have to because I as Head of the Department am going to watch them and suddenly there was fear. So what we do with this, we share this on our platform, and link and the learners have to just click on the link and they will pull up the lesson. And then that way I can get access to that lesson as well. It's just a normal lesson. So fear was the most important thing. That was the biggest problem at that stage. So what I tend to see was some of teachers and strangely, the younger teachers, they prefer to record a lesson and then just put it on the platform or on a zoom session or something like that because they feel they want to give a proper perfect lesson. Instead of I'm 51 years old, I don't care anymore. If the children laugh at me or whatever, if I make mistakes, in fact, I believe a teacher has to make mistakes. So I just get on behind the screen and teach my lesson without any recordings. Because the learners have to see as well I make mistakes, they make mistakes, and there's more interaction. So that the younger teachers think to even nowadays, they they're scared, and I have to sit there and please, mam help us with this. And they rather record session. And it's played to the learners and which are, well, they have success with that. And that way the learners can watch this whenever they want to. There's no interaction learners can hide behind their videos whatsoever, whereas I prefer to, to, to have an open session with my learners. So no perfect lesson for me then, but there was a lesson. So in terms of teaching, the technology was all the teachers at our school have laptops, because they use them daily, whether we use it for a zoom session, whether we use it for the Wolkskool videos that we watch, we part of that, we incorporate Dr. Cas Olivier’s thinking tools program, as well. So this constantly computers in our classrooms for the learners as well, as well as for the teachers. So we were basically trained, not in an advanced way, but we used to using computers, luckily, we have that technology. It's not the best computers but we can communicate with each other, whether you are 500 kilometers away from us, or whether you sit right next to me and share the screen with me. So basically, if I have to say teaching, anything in technology at that stage, it was to teach them to relax behind the screen, it's a different situation. It was something we have to get used to because at that stage, we didn't know when it will stop. Teachers have been	Sipho Teaching with technology saves time to start with. So pre teaching with technology most of my colleagues didn't see it as something that is of much value or importance that we can use because You've got two options to use teaching with technology or use the traditional way of teaching. Therefore, during the process of the pandemic, then they realized that now there's poor contact. In fact, there's no contact between them and the learners. Therefore, some wanted now to learn how to teach with technology, and then, but then it was difficult because almost everyone was afraid of the pandemic. And then communication and contact was very poor, amongst a colleagues as well. So post COVID teaching with technology, now is that they realize that it's something that is good, and something that can have value for them to use, even if anything can happen at any time. So in our school, in my case, teaching with technology, it had small impact because of poor devices and infrastructure that we have. But it is something that is great. And it saves time, like, in my case, I'm using it. When I'm teaching accounting. I don't have to waste too much of my time, trying to rewrite whatever's as in fact, some are the problems on the chalkboard, I'll just have to go and then flash everything more or give it to the learners so that they can go and work by themselves and then myself is just to facilitate and then ensure that teaching and learning takes place. Yeah, thanks.

taught like that we interact with children right in front of us. And suddenly everybody was scared. And most of all the younger teachers at school that was very strange, because I mean, they were born with a phone or a computer in their hands. And now suddenly, they were scared. And yeah, so there was a difference between the older teachers or the more advanced teachers, they just kind of sit for the 30 or 40 minutes behind the screen, give the lesson and carry on with life. Whereas the younger teachers was kind of worried, would it be perfect? Will, I do the right role, the learners get everything from me that they want and preferred at that stage to record the video, show it to me and say is it fine mam. Then they just open the zoom session and play the video share their screen from the computers. So y'all, that was basically the situation at our school by then. Today, we had zoom sessions in the beginning of the term now in week three, we had compulsory zoom sessions with our learners this week with our grade 10 and 11 learners and teachers get used to that. It's part of our daily life. Hopefully it will get better by times.	

Impact of COVID-19 on teaching practices.	
Santi I would say for example, the IT classes I was teaching and I shared my screen with them and there was kind of not a lot of responses as if they feel I'm not supposed to waste Mam's time. I'm not supposed to ask her or I should wait until she's done. So I motivated them a lot to please just answer me put up your hand. Talk to me open your mic. Don't mute that talk to me constantly, so that there is interaction. So yes definitely, I don't think we will ever stop teaching technology to ourselves as well as to our learners, I think we can learn a lot from our learners, they way more advanced than any of us will ever be in our age. It taught me how to swap between different mediums. I've got zoom open, and then I can share my Wolkskool and then suddenly I open a Google class and I can show them video, I became a YouTube advanced user. Because there's so much there as well that I can suddenly use in my classroom that I wouldn't do when I was in a normal clothes situation because there's no time to do that. But now I'm stuck behind my computer, and I've got the world in front of me. All the library's information is right in front of me and I can immediately share that with the learners. So I think it will never stop because every single day there's something new. So that was an advantage to me using my computer suddenly to teach instead, instead of standing in front of a class situation and every now and then talk to our distant learners. Suddenly, I have the whole group with all the learners in Orania, all our distant learners was in one class. And I can share the same lesson to all of them at once using all this all this amazing information at the fingertips by just using my keyboard and working between these mediums. So that was an advantage to me, which I tend to use more. Because I was kind of pressured to use that at that stage, because they were looking to me, please help Mam we are stuck at home. So now what now we've to every, every little bit that I could get hold of, I could immediately share with my learners. And I have to be honest, I don't do that lately of the COVID. It's like, there's no time to do that. But But I was forced to use that in COVID. And luckily, I've got that in the back of my mind, too. Every now and then I can remember, Oh, wow, these YouTube videos, let's quickly have a look at it. Don't forget about the VOC school videos, let's quickly look at this, look at that. All this information that we got together, but that time, we can use now, not so much lately. Sad to say I have to admit, but I was kind of forced to, to, to use all of that in an advanced way.	Sipho The technology in terms of teaching, in fact the way and the beliefs of this teaching with technology has transformed a lot because like, so Santi just said, you prepare one thing you take maybe a day or whatever to prepare, but then eventually we can share it with the whole world. And even now in class, when we have to maybe prove to this learners that this thing do exist and stuff, they can easily go to Google and go to whatever get all the information, grab them together, and then they can see it now. Not say no, bring something to show you tomorrow, you do it now. So it has transformed my teaching fairly well. Because now we can, I can be able to teach a lot of things in a short space of time, in terms of technology. So it has worked for me very, very well. Because even now, even if I'm not at work may be away for some reason, I can quickly prepare something for the learners. So that someone maybe colleagues can just go and connect and plugin give this learner something for the day to learn, regardless of my absence, you see, so yeah, it has a effect. It has worked very well and I think it's something that is going to continue and then the more it improves, the more it works well for us as educators, the more it works well for the learners, in fact for everybody, because now a lot of things have changed and then we are not going back in fact we are going forward. Therefore, when you have to go and prepare for the learners. You are not going back to that old where you're saying, I'm taking a book and preparing a lot of notes. Sometimes when you go and check that book of yours is lost and whatsoever. Now, if you've got this little thing in front of you, you can save it as backup, there's a lot of things you, you can prepare once, and then we will keep on updating as things as things change, and then going forward.

Teaching with technology post-COVID	
Santi COVID was good to us, I have to say because we will definitely continue working in in in such way and we did. There are a few things that grew from that as well. In the past we have Herf Skool once a year for grade 10 and elevens all our learners have to come to Orania. And since COVID It changed we still got the Herf Skool to see all our learners at once at our school. But we continue with the Zoom sessions, and we've got compulsory zoom sessions with our ten and elevens, that were never there. Thanks to COVID, we suddenly feel the need for that, even without great twelves we are, will usually only see them at our Slypskool at the end of September beginning of October. But suddenly off the COVID, it all changed. We now have a virtual Slypskool just before they record exam. And then we still got our formal Slypskool in October. But there was suddenly a need from our learners side as well as from the teacher side to see each other more. And the only way that we could have done that was via zoom sessions, via Google classrooms that we've created, via, as I said before, Wolkskool classrooms that we've created. It was never in place, times to COVID that forced us to put something in place, we continue to use that. So we actually is our platform, as I said, we use Leersfeer as a platform. It came from Moodle, and then we designed our own stuff because there was a need for that. And every single thing that we share with our learners is placed on Leersfeer. So they have 24/7 access to all the assignments to assessments, whatever they see all they need from us, they will find the they submit all the facts, formal assessment posts to our platform as well. They give them marks via our platform as well read all that is in perfect working order now. And I have to admit it was not like this three years ago. So at the end of the day COVID was good to us. if I can just, if we should take this time now, and you should learn from each other, I don't think if your school got a winning situation going on, I think you should share that with other schools. Because not all schools are on same on the same level. And as, as we discussed, today's things are not going to be ever go back to where we were, we've got all this truth in our hands. And I think we should share with other schools, they should be more meetings and discussions and stuff on this kind of teaching. They still school struggling, and we're other schools got this. We worked through all the problems, and I feel there's a big need for knowledge on where we are today, we should actually share and help each other with this.	Sipho Yes. Post COVID teaching technology, I believe, yeah, like he was saying, you'll never know what I did, you will go or no, but I think it will never go online teaching will never go is going to be with us for some quite for some time. So for from my own point of view, or perspective, is that since well, I'm, like I told you that I'm in a public school whereby sometimes we rely on government to give some of the things but on the other hand, since well, most of the learners now have got access to cell phones, whereby they can easily access more online things through their own personal cell phones, even if maybe they do, they are not offered the free devices from the school. But since online teaching or teaching with technology has made things more easier. For me going forward, I believe, I should just write to the school or talk to the principal to at least ensure that we have a enough space for teaching with this technology, because I believe is something that is going to be with us for some time. And it saves time, you know, into our time it saves too much of time more often. Therefore, I believe that personally using it is going to be something that is going to benefit me and my learner's a lot because even if they have got challenges and I'm away from them, we can be able to communicate and then time will be saved no need for me to go to them and then physically express or explain whatever that the they want me to. So I believe is going to be something that is going to not going to end now. Therefore we just need to keep on making use of it. And then ensuring that we make proper teaching and learning to this technology.