Teachers' use of technology at a technology-rich Model school in the Western Cape Province

by

MRS MARILIZE ANTONIZE KOCK

205030289

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SUPERVISOR: Dr Osman Sadeck

CO-SUPERVISOR: Dr Moses Moyo

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DECLARATION

I, *Marilize Antonize Kock*, 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: **Date:**

24/09/2022

TURNITIN SIMILARITY REPORT

This thesis was submitted to Turnitin for similarity check. An overall similarity 13% was obtained with a maximum of 1% for each source. The digital certificate and similarity report are in Appendices F and G respectively.

ABSTRACT

In 2012, the WCED initiated an e-Learning Strategy, aimed at bringing technology into classrooms with the intention of enhancing e-Teaching and e-Learning. The implementation plan for the e-Learning Strategy was the Western Cape Government's (WCG) e-Learning Game Changer, scoped from 2017 to 2019. The Game Changer proposed that all schools in the Western Cape be divided into three categories: Universal schools, Enhanced schools, and Model schools. In the Model school initiative, Model schools received more technology, focused training, and technical support than the other categories of schools. The aim of this qualitative study was to explore and understand the extent to which the implementation of the WCED Model school initiative (MSI) improved teachers' technological knowledge and skills to use technology for teaching and learning. This study adopted the technological pedagogical content knowledge (TPACK) framework. The study focused on a technology-rich Model school in the West Coast Education District (WCD) of the Western Cape Education Department (WCED).

Data were collected by means of a questionnaire, document analysis and semi-structured interviews with six purposely selected teachers. Data were thematically analysed. The findings confirmed that the Model school is technology rich. The findings further indicate that teachers are more motivated to adopt and use technology since the MSI implementation. The training and technical support offered to teachers have developed their professional development, which advanced their technological knowledge (TK). Furthermore, findings indicate that learners benefit from ICT-focused lessons, but that learner disruptions and misuse of devices are barriers to ICT use.

Based on the findings of this study, three recommendations are proposed:

1. Model school communities of practice should be established to share the knowledge and expertise gained during the Model school initiative.
2. To circumvent learner-misuse of devices, an increased emphasis should be placed on learner training to equip them with the essential skills needed to develop into responsible, tech-savvy ICT users.
3. These include the promotion of subject-specific training to develop teachers' technological content knowledge (TCK) and technological pedagogical knowledge (TPK) to promote their TPACK development.

Key words: ICTs, Model school, professional development, ICT integration training, technological knowledge, TPACK

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DEDICATION

This thesis is dedicated to my beloved late husband, **Ronald Kock**

24/02/1986 – 18/12/2020

Your death has left an irreplaceable void, but I am forever grateful for your well-lived life.

The unconditional love, unfaltering support, and constant encouragement you provided during your lifetime will sustain me for the rest of mine…

LIST OF ACRONYMS AND MEANINGS

ACRONYMS	MEANING
APPS	Applications
CAMI	Computer-Aided Maths Instruction
CAPS	Curriculum and Assessment Policy Statement
CAQDAS	Computer-Assisted Quality Data Analysis Software
CK	Content knowledge
CPUT	Cape Peninsula University of Technology
CTLI	Cape Teaching and Learning Institute
DBE	Department of Basic Education
DOE	Department of Education
ECD	Early Child Development
GDE	Gauteng Department of Education
ICT	Information and communication technologies
ITSI	IT School Innovation
LAN	Local Area Network
MSI	Model school initiative
MSSI	Malaysian Smart School Initiative
PCK	Pedagogical content knowledge
PCK	Pedagogical content knowledge
PK	Pedagogical knowledge
SAC	School Access Centres
SAnews	South African Government News Agency
SGB	School governing body
TCK	Technological content knowledge
TK	Technological knowledge
TPACK	Technological pedagogical content knowledge
TPK	Technological pedagogical knowledge
WAN	Wide Area Network
WC	Western Cape
WCED	Western Cape Education Department
WCD	West Coast Education District
WCG	Western Cape Government
WCP	Western Cape Province
WP7	White Paper 7

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CHAPTER 1: INTRODUCTION

1.1 Introduction

Information and Communication Technology (ICTs) play an increasingly significant role in people's lives, and it was envisaged that technological literacy would become a functional requirement for people's work, social, and personal lives (Danner & Pessu, 2013). Currently, ICTs form an integral part of modern education, and the need for their integration in education is continuing to gain momentum. This assertion has long been confirmed by Cawthera (2002:8), who stated that the important role computers play in education and the priority they should have in the allocation limited educational resources, is a vital topic for education discourse. Educational institutions now use various ICTs to create, store, manage, communicate and disseminate information (Fu, 2013). Furthermore, several studies consider ICTs powerful tools for educational change and reform if successfully integrated into teaching, learning and assessment (Fu**,** 2013; Hutchison & Reinking, 2011; Kent & Facer, 2004). Accordingly, Meyer and Gent (2016) posit that ICT use can foster critical thinking skills and are thus power teaching and learning tools. In South Africa, similar observations on the positive contribution of ICT to the quality of education and the performance of learners have been widely reported (Graham, Stols & Kapp, 2020; Meyer & Gent, 2016).

Due to technological developments, the integration and use of ICTs in education and teacher professional development have become important factors in a changing educational environment. The South African Department of Education's (DOE) White Paper on e-Education (WP7 - 2004) was in response to the emergence of an ICT teaching and learning environment in education (South Africa, 2004). White Paper 7 defines ICTs as "the combination of networks, hardware and software as the means of communication, management and exchange of data, information and knowledge" (South Africa, 2004:15). Similarly, Fu (2013: 14) regards ICT as a "collection of computers, the Internet, and electronic delivery systems such as radios, televisions, and projectors among others".

In the Western Cape Province (WCP), the Western Cape Education Department (WCED) has, since the early 2000s, made a concerted effort to bring ICTs into schools across the province. The WCED established two large-scale technology-related projects in the Western Cape (WC), the Khanya technology-in-education project and the e-Learning Strategy. The Khanya Project

(2002 – 2012) envisioned teachers across the province to be empowered to access and use technology and that learners have access to computer facilities (Sadeck, 2016; Van Wyk, 2011). The Khanya Project provided schools with computer laboratories or computer suites, and computers were pre-loaded with mathematics, science and language software.

1.2 The background to the study

The national drive to 'cross the digital divide' with the availability and use of ICTs in education was declared by the then national Minister of Education, Naledi Pandor, in 2004. The DoE published White Paper 7 (South Africa, 2004) on e-Education. This policy laid the groundwork for ICT development and implementation in South African school education. However, provincial education departments loosely coordinate efforts to achieve this endeavour.

To achieve continuity and sustainability after the Khanya Project, the WCED birthed the e-Education Vision for e-Education. This was a 5–10-year plan initiated in 2012 and referred to in this proposal as the e-Learning Strategy (WCED, 2012). The e-Learning Strategy aimed to enhance e-Teaching and e-Learning in the WC by bringing technology directly into the classroom (WCED, 2016), as opposed to computer laboratories. The vision of the e-Learning Strategy was to enact effective integration of ICTs in education that promote profound learning experiences for learners that would lead to enhanced learning outcomes and better-prepared learners for the 21st Century (WCED, 2016:4).

The implementation plan for the e-Learning Strategy was the Western Cape Government's (WCG) e-Learning Game Changer, scoped from 2017 to 2019. The e-Learning Game Changer proposed that all schools in the WC be divided into three categories: Universal schools, Enhanced schools, and Model schools. The Model Schools were schools which benefitted the most with abundant technology for learners and teachers and focused training and technical support for teachers. There are sixteen (16) Model schools: one (1) primary and one (1) high school in each of the eight educational districts across the WCP (PMG, 2019:1). The establishment of the Model schools raised many expectations in the province about the e-Learning environment, with these schools expecting to serve as invaluable yardsticks for future ICT-implementation initiatives. Therefore, the focus of this study is *one Model school in the West Coast Education District of the Western Cape Education Department*.

1.3 Problem statement

The WCED has spent millions of Rands on the e-Learning Game Changer, a technology-heavy e-Learning initiative (WCG, 2019; Zille, 2015). At the time of this study (2019) 32 588 learner devices and 7 778 smart classroom packages were distributed and installed in schools across the WCP (Walker, 2019). This provisioning aligns with preferred ICTs used within schools which includes, inter alia, laptops, data projectors and interactive whiteboards (Mlambo *et al*., 2020; Padayachee, 2017).

The expected outcomes of the MSI were the creation of an eLearning environment, the development of an electronic culture (eCulture) and the building of an ICT field (Western Cape Government, 2017). Focused emphasis was given to the aspects of teacher professional development and training for ICT integration. However, little is known or understood about the return on investments of this significant capital rollout and the effects of the initiative on teachers' technological, pedagogical, and content knowledge (TPACK) development. There is no research output in the public domain regarding the MSI and the MSI teachers' TPACK.

Given the background of the transition between the ICT initiatives in the WCED (Khanya project and e-Learning Game Changer) and its progressive nature of increased access and training, it is important to understand the effects of the initiatives undertaken. This study addressed the gap by exploring the effects of the initiative on the development of TPACK in a technology-rich MSI in the Western Cape Education Department (WCED).

1.4 Research purpose and questions

The above sections set out the background and rationale for this study, which revolves around teachers' use of ICTs at a Model school. Cohen, Manion & Morrison (2007:172) state that research questions should be "clear and unambiguous". Furthermore, McMillan and Schumacher (2014:348) add that these questions are intended to explore or explain the intention of a research study.

1.4.1 Purpose and objectives

Purpose

The purpose of this study was to explore and understand the extent to which the implementation of the WCED Model school initiative progressed teachers' technological pedagogical content knowledge and skills to integrate technology for teaching and learning.

Objective 1

To determine how technology, professional development, technical support and digital resourcing contributed to teachers' use of technology for teaching and learning.

Objective 2

To determine specific factors of the professional development that contributed to teachers' TPACK development and use of technology.

Main research question

The main research question of the study is:

What were the contributing factors to teachers' TPACK development in the WCEDs' Model school initiative?

To address the main research question, the following sub-questions were used:

Sub-research question 1

How do ICT integration training, technology provisioning and technical support contribute to the use of technology within the Model school?

Sub-research question 2

What specific aspects of professional development support teachers' TPACK development in their practice of using the technology for teaching and learning at the Model school?

1.5 Rationale for the study

The success of ICT initiatives depends strongly on educators (Rana, 2012:192). The importance of teachers is emphasised by Teo (2008:413), who argued that in most cases, the "teacher is key" to the successful implementation of technology in the educational system. Rana (2012:191) supports the "teacher is the key" idea by urging that teachers have always been essential to the "utilization and implementation of innovations".

Padayachee (2017:37) notes that teachers impart meaning and relevance to ICTs integration initiatives in which they are personally and professionally invested. According to Rana (2012:199), information and communication technologies are useful in the capable hands of technologically knowledgeable and skilled teachers, the "change agents in schools". Samaradiwakara and Gunawardena (2014:21) posit that technology is of "little value unless it is used" and that its use and acceptance have "salient theoretical and practical implications". However, access to and availability of ICTs (typical of the Model school initiative) does not guarantee acceptance and use by teachers. As a teacher in a Model school, it can be noted anecdotally that the actual use of ICTs at the Model schools does not appear to be as pervasive as expected.

There are currently no empirical research reports on the implementation of the WCED Model school e-Learning initiative. Sustained efforts to uncover documents have shown that there is no pre-existing research based on these Model schools, except WCED internal managerial reports, political reports, and press statements. As a result, teachers' TPACK development in these exceedingly technology-rich schools is not fully understood. This research thus aims to contribute to the field by exploring the implementation model and teachers' TPACK development. The findings of this exploration could inform the WCED's e-Learning professional development initiatives.

1.6 Theoretical framework

The theoretical framework which underpins this research study is the Technological Pedagogical Content Knowledge (TPACK) framework. Koehler and Mishra (2006:1024) argue that pedagogical uses of technology necessitate the development of a "complex, situated form of knowledge". The TPACK is conceptualised as "a way of thinking about the knowledge teachers need" to comprehend how to effectively integrate technology into teaching and learning (Mishra & Koehler 2008:2). The TPACK builds on the framework of Shulman's construct of pedagogical content knowledge (PCK) by adding technological knowledge (TK) which is representative of teachers' technology integration (Koehler and Mishra, 2006:1017).

Mishra and Koehler (2008:3) posit that Content, Pedagogy and Technology are "at the heart of good teaching". It can thus be argued that teachers need the necessary content knowledge, pedagogical skills, and technological knowledge and skills to teach with technology effectively.

The use of the TPACK framework can aid in gaining insight into the knowledge the teacher-participants have or need to acquire to facilitate the uptake and use of ICT for teaching and learning.

1.7 The research methodology

The research methodology provides a mind map allowing researchers to explore the most optimal way to address research questions. An appropriate design elicits authentic and trustworthy conclusions from the responses to research questions. In this study, an interpretive philosophy and paradigm with a qualitative approach were used. An interpretive paradigm allowed for the investigation and determination of how each of the participants experienced the Model school initiative. Additionally, it allowed the researcher to delve into the participants' use of ICTs, their TPACK and the uptake of ICTs for teaching and learning. In this qualitative study, a case study design was employed, utilising multiple data sources (McMillan & Schumacher, 2014). The case being investigated over a cross-sectional time horizon is the implementation of the MSI at a high school. Subsection 1.7.1 briefly discusses the site and participant selection, 1.7.2 provides a brief layout of data collection and analysis, and 1.7.3 elaborates on the contribution of this study.

1.7.1 Site and participant selection

The site of choice for this research study is a public, ordinary high school situated in the West Coast Education District (WCD) of the WCP. This high school was purposively selected as it is one of the sixteen (16) schools selected as part of the Model school initiative. Furthermore, this school is equipped with teacher and learner devices and is thus technology rich. The site selection is further justified as the teachers received ICT integration training and could thus provide insight into the effects of the MSI on teachers' professional development and their use of ICTs for teaching and learning.

At the time of the study (2021), this school had a population of forty-four (44) teachers, from which six (6) participants were purposively selected. A criterion was set to exclude teachers who were not employed at this school during the period of the MSI implementation, which commenced in 2017, as they might not have received teacher devices and ICT integration training. Including only participants who met the set criterion could lead to valuable insights into the impact of the MSI on teachers' TPACK development.

1.7.2 Data collection and analysis

Multiple data collection strategies were employed. These included a questionnaire, individual semi-structured interviews and document analysis. The questionnaire, produced on Google Forms, was sent to all teachers currently employed at the school via WhatsApp. The questionnaire included items of a biographical nature and specific questions to establish their eligibility for the study. Additional items in the questionnaire focused on teachers' use of ICT, their attitude towards using ICT, and their skills and knowledge of ICT use. Six teachers were purposely selected based on a selection criterion which excluded teachers who were not employed at this school during the duration of the MSI (since 2017). The six selected teachers were invited to face-to-face semi-structured interviews. As qualitative data collection yields a large amount of data, the data were thematically analysed using a Computer-Aided Qualitative Data Analysis Software (CAQDAS) named ATLAS.ti 8.

The data from the questionnaire answers, as well as the transcripts, were initially coded according to the research and sub-research questions, then according to individual questions on the interview schedule. The next step was to assign initial codes. During the coding process, major and minor codes were identified, which evolved into categories and sub-categories. Finally, minor or vague codes were deleted or re-coded, continually refining the coding process.

1.7.3 Contributions of this study

This research study report serves as an invaluable resource to other schools, the WCED and other relevant stakeholders as it sheds light on the effects of the implementation model in this study. It highlights factors which inform teachers' attitudes towards the use and adoption of ICT and how attitudes can ultimately contribute to the successful implementation of an ICT program. This study further highlights how the MSI affected teachers' TPACK. The findings provide empirical evidence regarding technical, professional development, and personal and methodological aspects related to a technology-driven intervention. Recommendations from this study provide leads to the areas that could be maintained and those that could be enhanced. Additionally, recommendations from this study can inform which aspects of a technology-driven intervention can be changed or eliminated.

1.8 Definition of terms

For clarification purposes, the researcher chose to offer a brief explanation of the following key terminology used in the research purpose, objectives and main question and sub-questions: ICTs, professional development, Model schools and ICT integration training.

ICTs – Information and communication technologies, which characterize the amalgamation of information technology and communication technology (South Africa, 2004:42). White paper 7 (South Africa, 2004) states that ICTs are a combination of hardware, software and communication media which enables the processing, administration and exchange of data, information, and knowledge.

Professional development – The focus of this research study is specifically on the ICT-based professional development of teachers. The ICT integration training teachers receive, and the devices-usage training is considered part of the teachers' professional development.

Model schools – Technology-rich schools earmarked to integrate ICTs into teaching and learning. Only sixteen (16) schools across the WCP were identified by WCED, of which eight (8) were high schools and eight (8) were primary schools. All Model schools received teacher devices as part of the Smart classroom package, learner devices in the form of Chromebooks and tablets and ICT integration training.

ICT integration training – Training which promotes the integration of ICTs into teaching and learning. In this study, ICT integration training refers to training provided to teachers by WCED, WCED service providers, district officials and ICT champions (school-based educators). ICT training aims to equip teachers with the necessary ICT (TPACK) integration skills, which include teacher readiness and professional development (WCED, 2016).

1.9 Structure of the research study

Figure 1.1 provides a flow diagram representing the structure of this research study.

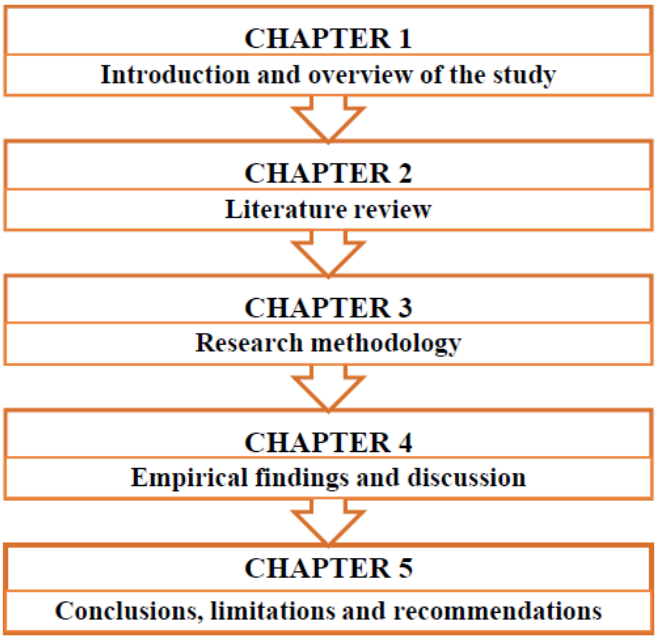


Figure 1.1: Structure of the thesis

Chapter one provides an introduction, background, problem statement and the rationale of this research study. The research purpose and main research questions, and sub-research questions are outlined. The rationale for using TPACK as the theoretical framework underpinning this research study, and furthermore, a delineation of the research methodology is outlined.

Chapter two is a literature review exploring and critically analysing literature pertaining to this research study. As this research study takes place within the South African context, the literature explored e-Education in South Africa and, specifically, the Western Cape Province. This study is concerned with how the MSI progressed teachers' technological knowledge and skills to use technology for teaching and learning. With this objective in mind, the researcher concludes Chapter 2 by delineating TPACK as the chosen theoretical framework of this study.

Chapter three outlines the research methodology employed in this study. The Research Onion, developed by Saunders, Lewis and Thornhill (2009), provides a mind map which guides the research philosophy, paradigm and approach. The research design discusses the design strategy governing the acquisition of data, the research choices made and the time horizon of this study. The research techniques and procedures are explained by focussing on the selection of the site, the population and participants, the data collection instruments and the data collection process. The chapter is concluded by outlining the thematic data analysis method, how trustworthiness was ensured, the researcher's position and the ethical considerations of this research study.

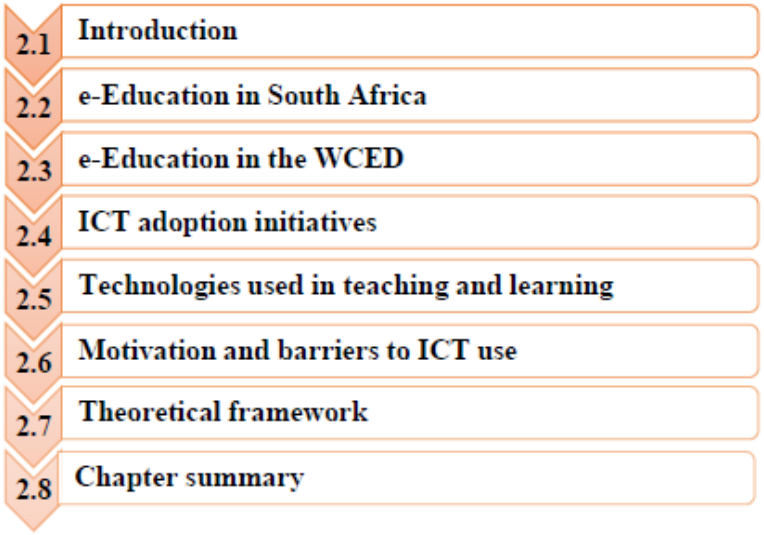
Chapter four reports on the thematically analysed empirical findings of this study. It offers supporting discussions on the significance of these findings. This chapter discusses the ICT integration training teachers at the Model school received, technology provisioning and use at the Model school, teachers' motivators and barriers to ICT use, and the technical support provided.

Chapter five presents the conclusions, limitations, and recommendations of this study. The chapter reports on the impact of the MSI on teachers' professional development and learners and learning, the adoption of ICTs and the TPACK development of teachers. In conclusion, the limitations of this study are highlighted, and recommendations are offered.

1.10 Summary of the chapter

In this chapter, the background, problem statement and rationale of this research were put forth. Furthermore, the research purpose and questions were stated. Technological Pedagogical Content Knowledge as the chosen theoretical framework was introduced, and the rationale for adopting TPACK was clarified. Chapter 1 also provided a brief breakdown of the research methodology by highlighting the interpretative philosophy and paradigm used and the research design of this study. A high school located in the WCD of WCP is identified as the site, and the purposive sampling method used for participant selection is briefly explained. The three (3) data collection methods are outlined, and an outline of the thematic analysis process is provided. This chapter concludes by stating the contribution of this study, an explanation of key terms, and the structure of this research study.

CHAPTER 2: LITERATURE REVIEW



Organisation of Chapter 2

2.1 Introduction

This research study's purpose was stated in Chapter 1, which was to explore and understand the extent to which the implementation of the WCED MSI progressed teachers' technological knowledge and skills to use technology for teaching and learning. To achieve the main purpose, this study sought to comprehend how technology, professional development, technical support, and digital resourcing aspects contributed to teachers' use of technology for teaching and learning. It was, therefore, imperative that previous local and global research studies on related topics were explored and critically analysed. Yin (2009:14) postulates that literature reviews are not only done to seek answers on a known topic but aim to develop "sharper" and insightful questions on a research topic.

2.2 e-Education in South Africa

In 2004, WP7 (SA government e-Education policy) was declared (South Africa, 2004), which laid the groundwork for ICT implementation and adoption in South Africa. It represented the South African government's response to the changing ICT environment and aimed at promoting the use of ICTs to create opportunities for easily accessible, quality education and bridging the "digital divide" (South Africa, 2004:6). White Paper 7 surmises that the digital divide in education includes, inter alia, the following (South Africa, 2004:9):

- disparities regarding connectivity and infrastructure;

- the development of local content;
- the generation of collective knowledge; and
- the improvement of Internet access and educational offerings in schools and tertiary institutions.

Even with ICTs significantly impacting curriculum development and delivery, WP7 noted three (3) challenges to education and training systems (South Africa, 2004:8).
These challenges were:

1. participation in the information society;
2. impact of ICTs on access, cost-effectiveness, and quality of education; and
3. integration of ICTs into the learning and teaching process.

Almost two decades later, these challenges are still relevant in the South African context.

2.3 e-Education in the WCED

2.3.1 Khanya Project

The WCP is considered a leading province regarding ICT implementation in schools as it has strived over the years to implement ICTs across the province (Miller, Naidoo & Van Belle, 2009). The WCED's 2002 Khanya technology-in-education project, which was scoped for ten years (2002-2012), was regarded as an African leader in its field (Van Wyk. 2011), preceded WP7 and was mandated to provide ICTs to all public schools by 2012 (Chigona and Mooketsi, 2011). Du Toit (2005) postulated that the Khanya Project was launched to position ICT use in answer to a crisis in South African education. Chigona and Mooketsi (2011:2) and Bladergroen, Chigona, Bytheway, Cox, Dumas and Van Zyl (2012:111) further added that the Khanya Project aimed at equipping WCP schools with ICTs to ensure effective curriculum delivery through improved teaching and learning.

The goal of the Khanya Project was twofold: bridging the digital divide; and improving Mathematics and Science enrolment numbers and Grade 12 results (Sadeck, 2016; Van Wyk, 2011; Du Toit, 2005). To achieve these goals, the Khanya Project proposed the integration and use of appropriate, available and affordable technology in Western Cape schools, initially focussing on schools in poorly resourced areas (Du Toit, 2005). Miller *et al*. (2009:3) concurred that the Khanya Project targeted technology implementation in technology-poor schools for "curriculum development and delivery". In its drive to improve Mathematics results, the

Khanya Project used commercially available educational application software. Computer-Aided Maths Instruction (CAMI) and MacMillan Publishers, inter alia, provided schools with software products (Van Wyk, 2011). In addition, the CAMI initiative donated Mathematics and Science software to secondary and intermediary schools (valid for one year) and Grade 1-3 reading books were purchased from MacMillan Publishers to promote English as a first additional language (Van Wyk, 2011).

The Khanya Project provided approximately 35 000 computers to schools from 2002 to 2012. These computers, which were housed in networked computer labs, came with "proprietary software" which concentrated on languages, science, and mathematics (Sadeck, 2016:7). Teachers (approximately 26 000) received training in the Microsoft Office package, Internet and email use, computer literacy and integration training, and the usage of the proprietary software. These teachers were trained and supported by facilitators.

Du Toit (2005:2) stated that the Khanya facilitators were ex-teachers with at least ten years of teaching experience, including experience in "curriculum delivery through ICT", which were deemed to ensure "long-term success and operational sustainability". Initial ICT skill training was face-to-face and was then adapted to suit the existing learning level of educators, often followed by demo lessons and ongoing technical and software support (Du Toit, 2005). According to Van Wyk (2011) and Du Toit (2005), the facilitators played a crucial role in the success of the Khanya project.

Van Wyk (2011) observed that despite receiving training and technical support through the Khanya Project, teachers still lacked motivation for ICT integration. Chigona and Mooketsi (2011:11) add that a lack of technical support hindered teachers' adoption and integration of ICTs in learning and teaching. Moreover, Van Wyk (2011:6) noted that although many teachers successfully integrated ICTs into their teaching and learning, a lot of teachers still experienced the following barriers to ICT integration:

- poor leadership provided by principals regarding ICT use and integration;
- the reluctance of teachers to move out of their comfort zone;
- insufficient time to conceptualise new ways of teaching using ICTs;
- new in-service teachers gaining little or no exposure to technology and e-Learning in their graduate studies;
- poor, existing teaching practice;

- WCED district and head office staff lacking the necessary skills to motivate, guide and support teachers in their ICT use; and
- lack of technical support in schools.

In the Khanya Project evaluation, Du Toit (2005) found that many teachers might not have been familiar with technology, have not used it and might have felt threatened by new technologies; this inevitably delayed or prevented ICT integration. Chigona, Chigona, Kayongo and Kausa (2010:27) found that teachers' perceptions of ICT's role in education changed gradually and that administrative tasks and learner engagement increased due to ICT integration. However, as Chigona and Mooketsi (2011:5) found, learners, and often those from disadvantaged backgrounds, lack prior technical knowledge to utilise devices and the resources to practise learnt skills at home.

2.3.2 WCED e-Learning unit

The WCED e-Learning unit was established in 2007 to address e-Learning in the WCED, resulting in the unit inheriting the Khanya project. In 2008, The e-Learning unit implemented, *inter alia*, the following strategies (Sadeck, 2016:8):

- Introducing a learning management system (LMS);
- Introducing open educational resources and freeware;
- Prioritising and implementing ICT-integrated training for teachers; and
- Introducing a blended training model with a face-to-face and online mode,

The e-Learning unit built on the vision of the Khanya Project and consequently initiated the e-Vision for e-Education. The WCED's "e-Vision for e-Education: e-Learning and e-Teaching in schools of the future" was released in 2012, scoped as a 5-10-year plan. The e-Vision endorsed the effective integration of ICTs into teaching and learning activities through e-teaching and e-learning. In addition, it sought to promote profound learning experiences for learners leading to:

- enhanced learning outcomes; and
- well-equipped learners for the 21st Century working environment and lifelong learning (Schreuder 2016).

At the time of the emergence of the e-Vision (2012), the ICT hardware in Western Cape schools included computers, laptops, data projectors, interactive whiteboards, and servers (Western Cape Education Department 2012). The use of technology for teaching and learning could be described in two categories:

1. An e-Learning practice based on a 1970s methodology of computer-based teaching (CBT) indicated using closed (propriety) software in computer laboratory configurations primarily for drill and practice, and
2. e-Teaching practices using data projectors and interactive boards through conventional teaching methods (Western Cape Education Department 2012).

The WCED e-Vision, focused on six workstreams: e-Teaching; e-Learning; Curriculum / Education; Systems; Environment and e-Administration (Western Cape Education Department, 2012:8). In 2016, the WCED released its e-Learning Strategy, which was aimed at the actualisation of the e-Vision for e-Education of 2012.

2.3.3 WCED Game Changer

The WCED's e-Learning Strategy, which aimed to enhance e-Teaching and e-Learning (WCED, 2016), was taken up as the WCG's politically motivated e-Learning Game Changer in 2015. The WCG identified eight game changers that could address challenges faced by the province's citizens (Zille, 2015:1). The eight game changers were:

1. Expansion of apprenticeships
2. Achievement of energy security
3. Deliver high-speed broadband
4. Implementation of quality e-Learning at schools
5. Expansion of quality after-school activities
6. Pioneer a better living model
7. Reducing alcohol-related harms
8. Providing water and decent sanitation

Game changer number four (4) was the e-Learning Game Changer, which included:

- Linking schools through high-speed Wide Area Network (WAN).
- Providing Local Area Networks (LANs) in schools.

- Refreshing current computer labs and provisioning new labs and technology-rich classrooms (Smart classrooms).
- Developing and expanding accessible online digital resources that all learners, parents, and teachers could easily access.
- Training and developing teachers in ICTs and utilising e-Learning and e-Teaching in schools.

The six workstreams identified for the e-Learning Game Changer were drawn from the e-Vision streams and further simplified to underpin the e-Learning Game Changer goal statement (Walker, 2019; Western Cape Government, 2019). The workstreams are set out in Figure 2.1.

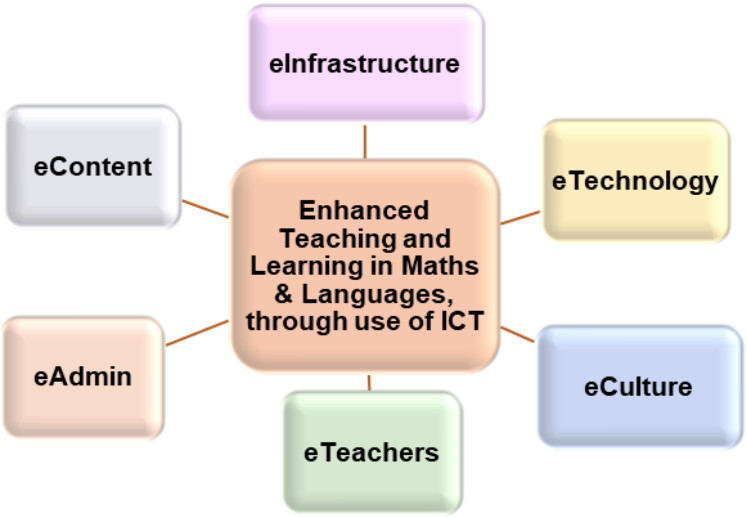


Figure 2.1: e-Learning Game Changer: Six workstreams
Adapted from Western Cape Government (2019)

eInfrastructure encapsulates the infrastructure installed to connect schools to the internet. This includes WAN, which connects schools to the internet and LAN, which connects different classrooms to a local WI-FI.

eTechnology refers to the ICTs used in classrooms, i.e., the teacher and learner devices distributed. **eCulture** promotes a change in how ICTs are viewed and used in schools by teachers and learners. The eCulture workstream is promoted through three focus areas:

(i) Classroom and school ICT Change and Adoption,
(ii) Cyber-Safety/ Wellness, and
(iii) Responsible citizenry.

To promote **eTeachers**, ICT integration training is also offered to teachers, principals, school management and support teams (Western Cape Government, 2019) for professional development purposes. The **eAdmin** workstream was aimed at freeing teachers to teach and minimising the manual administrative tasks of teachers and principals. The WCED has various digital administrative resources to promote eAdmin (Western Cape Government, 2019). Inter alia, there are learner, learning, classroom, and school management systems as well as an ePortal, a cloud-based up-to-date Curriculum and Assessment Policy Statement (CAPS)-aligned (Western Cape Government, 2019) learner and teacher resource (**eContent**).

2.3.4 Implementation of the e-Learning Game Changer's e-Learning Strategy

There are currently (2022) 1456 public ordinary schools in the WCED (WCED, 2022). The e-Learning Strategy proposed that all schools in the Western Cape province be divided into three categories: Universal schools, Enhanced schools, and Model schools. This categorisation was to ensure that all schools could reap the benefits of e-Learning within the proposed timeline and possibly beyond. Furthermore, it was intended that the primary and high schools in an area be synced to allow learners to move from primary to secondary education in a school of the same category (Walker, 2019).

The categorising of WCED schools could be informed by budgetary constraints; therefore, only classifying sixteen (16) schools as Model schools to be used as pilots. Details accessed from WCED documentation show (PMG, 2019; Schafer, 2019; Walker, 2019; WCED, 2019):

- **Universal schools:**

There are 821 universal schools, which were provided with basic access to the internet through a computer lab or subject-specific ICT suite. Computer labs or ICT suites were furnished with desktop computers, a data projector, and a printer. This category of schools is much like the Khanya project, with teachers and learners only having access to centralised computer labs or ICT suites, which hinders e-teaching and e-learning. The WCG provides teachers and learners with access to digital resources on the WCED e-Portal, Wide Area Network (WAN) and centralised Wi-Fi access points.

- **Enhanced schools:**

There are 684 enhanced schools where Local Area Network (LAN) were installed, provided the school was not equipped with LAN pre-2017. Learners were to bring their own devices (BOYD). Teachers were to receive access to technology-enabled classrooms in the form of Smart classrooms. The benefit of enhanced schools is to equip more classrooms with ICTs to boost and promote widespread e-teaching and e-learning. However, it is noteworthy that the documents obtained indicated that from 2018 it was not explicitly stated that Universal and Enhanced schools had received learner devices.

- **Model schools:**

The 16 Model schools identified by the WCED had to develop and contribute to e-Content and establish an e-Culture (Schafer, 2019; Western Cape Government, 2017:26; WCED, 2016). These selected schools are situated across the Western Cape Province to provide the WCED with an understanding of how different schools in unique contexts can be supported (PMG, 2019:2; Schafer, 2019). This category of schools was earmarked to integrate e-Learning into their teaching and learning practice as per the province's e-Learning Strategy. Model schools received broadband connectivity, with LAN connectivity in all classrooms, halls, and corridors. All classrooms were earmarked as Smart classes, and school computer labs or ICT suites had to be refreshed (PMG, 2019; Western Cape Government, 2017). Refreshing a computer LAB or ICT suite refers to periodically refreshing and updating computer programs (PMG, 2019).

Smart classrooms are normal classrooms equipped with digital technologies to "help make teaching and learning better" (Western Cape Government, 2019). The concept of a Smart classroom installation comprised: a laptop, whiteboards, eBeams (to render the whiteboard interactive), a document viewer and a data projector. These devices can either be installed in a classroom or allocated to a teacher to use in a classroom. As of 2019, there had been 7700 Smart classrooms installed at schools within the various categories (PMG, 2019).

At both Model primary schools, all Grades 4-7 learners and, at the Model high schools, all Grades 8-12 learners were allocated a device. Learners received tablets (Grades 4-9) and Chromebooks (Grades 10-12). All Model school teachers were proposed to have access to Smart classroom technology and professional development in ICT skills, integration, collaboration, and Cloud platforms (Western Cape Government, 2017). It is noted that in 2019,

in a WCED parliamentary briefing, the WCED indicated that 32 588 learner devices were to be provided to the 16 Model schools by 2019 (PMG, 2019).

All Model schools received digital resources in the form of interactive digital textbooks through the IT School Innovation (ITSI). The IT School Innovation is an educational technology company that provides digital resources to schools and tertiary institutions. The IT School Innovation has an e-reader app, miEbooks, which allows online and offline availability of digital textbooks (e-books). Learners and teachers had access to the miEbooks app and the textbooks on their respective devices. The digital licences for ITSI were purchased by WCED and were valid for three (3) years, after which the schools had to purchase the license on their own or discontinue use. At the site of this research study, the school chose not to purchase the licence due to budgetary constraints and therefore had to discontinue use. This implication surely goes against the notion of "bridging the digital divide", as underprivileged or socially disadvantaged schools often end up with the short end of the stick.

Curriculum integration and ICT technical support are provided to all Model schools. Each educational district has e-Learning advisory teams, which consist of one or two e-Learning advisors and an e-Learning project manager. In addition, each district is supported and coordinated by a team at the WCED head office. School-based support can be in the form of an ICT champion/ champ, usually technology-proficient teachers earmarked by school principals or school management teams. Additionally, a centralised support or help desk provides a one-call service to schools by re-routing and escalating (WCED, 2019) technical issues.

2.4 ICT adoption initiatives

2.4.1 Gauteng Department of Education: ICT and e-Education Strategy

In January 2015, the Gauteng Department of Education (GDE) launched phase one implementation of its ICT and e-Education Strategy. According to South African Government News Agency (SAnews) (2015), the launch was the first step in building a world-class education system in the Gauteng province by modernising education and improving performance. The ICT and e-Education Strategy implementation is scoped to reach all fifteen (15) Gauteng education districts. The SAnews (2015) and Mlambo, Rambe and Schlebusch (2020:3) postulate that close to R17 billion has been spent on the roll-out.

The ICT and e-Education Strategy is pillar 6 of the ten pillars of the GDE's education transformation (GDE, 2016).

1. Curriculum and Assessment Development
2. Teacher Provision and Support
3. Leadership and Management
4. Infrastructure Development and maintenance
5. Planning, finance and resourcing
6. ICT in Education
7. Social Cohesion
8. School functionality, including community involvement
9. Skills Development
10. Access to quality Early Child Development (ECD)

A breakdown of pillar six (6), ICT in Education, is as follows (GDE, 2016):

1. Connectivity: Connecting all schools to a GDE portal
2. Content: Digital teaching and learning resources available through a portal
3. Capacity: Training, support and ICT skills development as well as curriculum and pedagogy training
4. Infrastructure: e-Equipped schools and GDE offices with the availability of technical support in a secure environment
5. Support: Efficient technical IT-based support and management
6. Innovation: Management and monitoring of the study to identify and adopt feasible and useful innovations for best practice implementation

GDE (2016:13) argues that technology can transform classrooms through pedagogical choices and identified four (4) tech models that can be implemented in schools, represented in Figure 2.2:

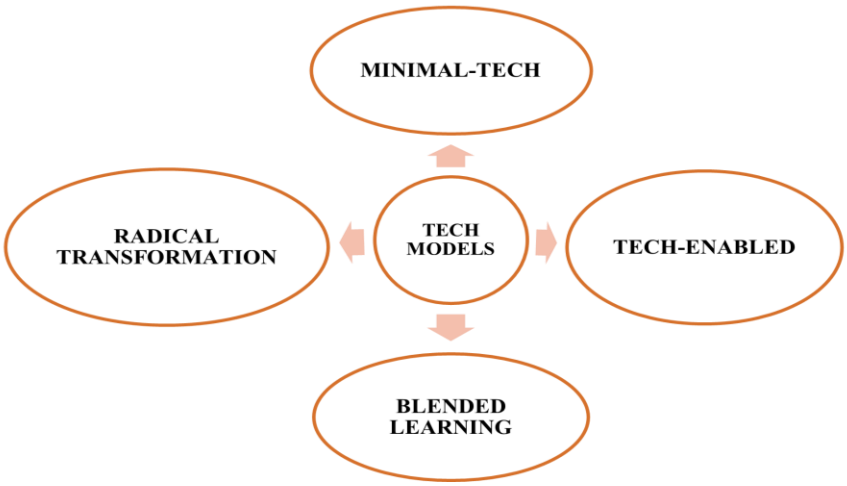


Figure 2.2: GDE's ICT and e-Education Strategy: Four tech models
Adapted from GDE (2016:13)

A breakdown of the different tech models is as follows (GDE. 2016:13):

- The Minimal-Tech model – using limited technology in lessons, e.g., using cell phones;
- The Tech-Enabled Learning model – introducing computers, software, and courseware into classrooms;
- The Blended-Learning model – divides the time learners spend in traditional classrooms (75% of the time) and computer-based learning labs (25% of the time);
- The radical transformation-model – uses complex algorithms to use data points to determine the specific skill needs and learning style preferences of learners to assign modules to them.

Gauteng Department of Education utilised a technology-based education model, Tech-Enabled Learning, as a first step in reaching its goal, which is Blended-Learning by 2019. The GDE (2016:16) describes Tech-enabled Learning as 'standard, high-quality teaching' with learning-engaged lessons. In contrast, Blended Learning is described as learner-paced learning, which allows teachers to have more '1-on-1 time' with individual learners.

To realise the goals of the ICT and e-Education Strategy, four enablers were identified by the GDE. The four (4) enablers are (GDE, 2016:15):

1. eContent;
2. Training;
3. Devices; and
4. Analytics.

eContent and **Training** are teacher-focused, **Devices** are learner-focused, and **Analytics** are establishment-focused. eContent includes eLessons which covers the instructional content, planning, and delivery, as well as an assessment and supplemental support. Training refers to pre-service training as well as basic ICT readiness training teachers must receive. Further training opportunities to boost professional development are available as teachers become ICT proficient. Moreover, the sharing of lessons and peer-coaching is also encouraged to develop ICT skills further.

Learners in no-fee paying schools are scoped to receive tablets for utilisation in the classroom and personal use to encourage independent learning, whereas Quintile 4 and 5 schools' learners were to bring their own devices. The Analytics-enabler proposes learner evaluation by tracking learner achievement and analysing results.

The implementation of GDE's ICT and e-Education Strategy was split into two (2) phases, both launched in 2015, dubbed the ICT in Education Project (GDE, 2016:34). Phase 1, launched in January 2015 and referred to as the Schools for the Future project (commonly called the paperless classroom project and the "Big Switch On"), was piloted at five (5) high and two (2) primary schools across the province. The seven (7) selected schools received a technological and structural transformation to overhaul the classrooms to create paperless classrooms.

Phase 2 of the ICT in Education Project was implemented in July 2015 and scoped for 2015 - 2016, focussing on the Grade 12 teachers and learners in 377 schools with matric (Grade 12) classes. Of the 377 schools, 22 schools were earmarked that fit into one of the following categories (GDE, 2016):

- Six (6) schools - *100% Pass Rate in Township schools-category;*
- Three (3) schools - *Special Intervention Schools*;
- Five (5) schools - *"Twinning" programme*; and
- Eight (8) schools - from formerly disadvantaged areas.

Notable successes of Phase 2 were, inter alia, the establishment of the school and district-based ICT committees; implementation of an ICT integrated matric revision programme; peer-to-peer coaching in surveyed schools; revamped and renovated schools and easy access to eContent. (GDE, 2016:41).

The implementation of Gauteng's ICT and e-Education strategy is having a positive effect on ICT use. Mlambo, Rambe and Schlebusch (2020:3) postulate that the "paperless project accelerated" the adoption rate of ICTs in Gauteng province. One of the lessons learnt from the GDE's Phase 1 was the establishment of governance structures at the provincial, district and school levels, which played an oversight role and alerted the various role-players if an intervention was needed. In 2016, the decision was made to postpone the roll-out of the 'paperless classroom project' to grade 11 classrooms. Reasons noted for the postponement were, inter alia, the theft of smart boards, learners damaging tablets and financial constraints.

Comparisons can be drawn between the GDE's Schools for the Future pilot project and the WCED's Model school initiative. Both implementation strategies aim to 'test' the overall ICT implementation strategy on a small scale. The technology provided to the phase 1 schools included LED TVs installed in classrooms, to be used as smart boards, as well as tablets for all secondary school learners (GDE, 2016). A total of 5 589 learner tablets and 241 teacher laptops were distributed. In addition, all seven schools received network connectivity, and e-Books were downloaded onto all learner and teacher devices. As in the case of the WCED's ICT initiative, the teachers also received training to deliver technology-based teaching and learning. Project management principles were adopted by GDE to ensure the timely execution of the project, and a dedicated project management team dealt with the day-to-day logistics of the project (GDE, 2016). This organisational model is comparable to the WCED e-Learning Strategy, whereby schools are coordinated and supported by e-Learning advisory teams at the district level and the WCED head office.

2.4.2 Malaysian Smart School Initiative

Ghavifekr and Rosdy (2015) stated that ICTs are considered one of the major transformers to Malaysia and the country's developmental future. In 1997, the Malaysian Ministry of Education launched its Smart School or *Sekolah Bestari* Initiative, intending to use ICT as a learning-enhancing tool. The Malaysian Ministry of Education set out the following policy goals (Ghavifekr & Rosdy, 2015; Lee & Thah, 2016):

- ICTs for all;
- ICT as teaching and learning tools; and
- Usage of ICTs to improve productivity, efficiency, and effectiveness of management systems.

Malaysian Smart Schools are technology-rich schools equipped with computer equipment, like computers, notebooks, printers, and facilities. Internet access was also provided to these schools. According to Ghavifekr and Rosdy (2015), as is the case in countries across the globe, rural Malaysian schools lack adequate ICT equipment and Internet access. Schools in rural areas were thus provided with School Access Centres (SACs), which are cyber or Internet cafés where learners can access learning material (Lee & Thah, 2016).

Three levels of technology integration were identified and implemented across eighty-eight (88) primary and high schools in the country in a pilot phase (Lee & Thah, 2006:2). The varying degrees of levels are (Zah & Ali, 2009; Lee & Soon, 2016:11):

- Level A, known as the Full Class Model, consists of 520 computers, five notebooks, six servers, and video conferencing equipment;
- Level B+ which is the Restricted Classroom Model consisting of 81 computers, two notebooks, three servers, and eight printers; and
- Level B, the Laboratory Model, consists of 37 computers, two notebooks, three servers, and four printers.

In 2005, after the initial Pilot Phase, the Malaysian Smart School Initiative (MSSI) was extended to all primary and high schools across Malaysia in an effort via the 'Making all schools smart' programme (Lee & Thah, 2016). The developments made in each phase, post the Pilot Phase, were informed by feedback and information from preceding phases. The advancement of ICT technologies since its inception also played an integral part in the development of the MSSI. Some of the major challenges identified during the Pilot Phase were the sharing of ICT infrastructure amongst different classes, the maintenance of ICT hardware, underutilisation of courseware due to lack of monitoring and support, and inadequate ICT competency and pedagogy training of teachers (Lee & Thah, 2016). In 2012, the Malaysian Ministry of Education drafted an Education Blueprint, scoped from 2013 – 2025, which cements the significance of ICT-based teaching and learning in the national education curriculum (Ghavifekr & Rosdy, 2015:175).

Comparisons can be drawn between MSSI, WCEDs MSI and other ICT-driven initiatives. A major comparable factor is that despite most Malaysian teachers having adequate access to ICTs, they still lack the motivation to use the technology provided (Ghavifekr & Rosdy, 2015:177).

In their study, Ghavifekr and Rosdy (2015) found that this can be overcome by allowing teachers adequate practical training and exploration time. In their study, Lee and Thah (2016:13) found that for teachers to utilise ICTs fully, they need adequate training, continual supervision and technical support. Furthermore, comparisons can be drawn between the 16 WCED Model schools and the 88 pilot schools, serving as invaluable learning tools from which recommendations for large-scale initiatives can be drawn.

2.5 Technologies used in teaching and learning

Umugiraneza, Bansilal and North (2018) postulate that teaching can be transformed when teachers integrate ICTs in teaching and learning. The meaningful way in which ICTs are selected, used and integrated ensures that the education needs of all learners are met. Mlambo *et al*. (2020) postulate that there is a disparity between the ICT integration and 'effective pedagogical uses' of ICTs in South African classrooms.

Being able to choose and then use the appropriate technology for a particular lesson can be especially daunting for a novice ICT user or integrator, even when surrounded by ICTs. This suggests that teachers are not just replacing non-technology tasks with technology but letting technology be instrumental in teaching and learning. According to Padayachee (2017), ICT integration should have meaning and relevance for teachers where a relationship exists between teachers' attitudes towards ICT and their use thereof.

ICTs, which can be as simple as using textbooks, blackboards, and posters, to incorporating more advanced types such as using the Internet, smartboards, whiteboards, laptops, tablets, Chromebooks, etc., are merely tools. Padayachee (2017) found that South African teachers use technology for teaching and preparation purposes and further postulated that teachers merely view ICTs as passive content delivery tools and not as pedagogical tools. Thus, teachers should be educated on integrating ICTs as pedagogical tools into the curriculum. Hence, these ICTs get meaning in the capable hands of technologically skilled and knowledgeable teachers. Samaradiwakara and Gunawardena (2014) posit that technology has minimal value unless utilized and that the use and acceptance thereof have significant theoretical and practical implications. Popular ICT hardware used for teaching and learning in schools is, inter alia, laptops, data projectors, whiteboards, interactive smartboards, smartphones, and document viewers (Mlambo *et al*., 2020; Padayachee, 2017).

2.6 Motivation and barriers to information and communication (ICT) use

Teachers' attitude toward the use of technology plays a crucial role in the acceptance and subsequent use of technology. Bladergroen *et al*. (2012:116) argue that teachers are "critical" to successful integration of technology in education and that teachers' motivations to use ICTs are essential to the successful implementation of ICT initiatives. However, acceptance and a positive attitude towards technology cannot be forced on a teacher or any person in general. People's feelings are deeply personal and require a good dose of extrinsic and, more importantly, intrinsic motivator factors. At the same time, it can be reasoned that barriers to ICT use can be a demotivator to the use of ICTs in teaching and learning.

Bladergroen *et al*. (2012) determined that teachers most viewed ICT as beneficial tools, making teaching easier and rendering easier access to knowledge. Furthermore, Chigona, Chigona and Davids (2014:1) identified the following motivating factors:

- Deriving satisfaction from ICT use;
- Teachers' expectations and responsibilities; and
- Feeling a sense of achievement.

Importantly, access to and availability of ICTs (which the MSI provided) does not guarantee the acceptance and use of ICT by a teacher. These barriers should, in theory, not be present within a Model school context, which is technology-rich. It can be theorised that the success of ICT initiatives depends greatly on the support and attitudes of teachers (Rana, 2012). Major barriers to ICT usage are lack of infrastructure, funding, and skills. Padayachee (2017) recommended upgrading teacher training for pre-service teachers and communities of practice for current teachers.

2.7 Theoretical framework

Ravitch and Riggan (2016) argue that a theoretical framework should be a more focused and refined integration of formal theory. The formal theory used in this research study is Koehler and Mishra's (2006) Technological Pedagogical Content Knowledge (TPACK) framework. The ability to use and integrate ICTs is a valuable skill needed by teachers. The TPACK framework may provide a methodical way in which teachers can develop and enhance the appropriate skills needed for technology integration (Kaplon-schilis & Lyublinskaya, 2015). Scherer, Tondeur, Siddiq and Baran (2018:1) concur that TPACK can facilitate the "meaningful

use of technology for educational purposes", as it sets out the knowledge domains needed by a teacher to use and integrate technology (Koehler & Mishra, 2006).

2.7.1 Technological Pedagogical Content Knowledge

Technological Pedagogical Content Knowledge builds on Shulman's (1987) construct of pedagogical content knowledge (PCK) by adding the aspect of technological knowledge (Kurt, Akyel, Koçoğlu and Mishra, 2014; Koehler and Mishra, 2009; Mishra & Koehler, 2008). According to Shulman (1987:8), PCK includes the content knowledge (CK) teachers should possess as well as the pedagogical knowledge (PK) they need to organise, present, and adapt knowledge to suit the diverse needs of learners.

However, PCK on its own does not sufficiently assist the teacher in technology-rich environments, nor does it provide adequate opportunities for teachers to develop technological skills. Mishra and Koehler (2008:4) assert that such skills are required by teachers to "operate particular technologies". Similarly, Brinkley-Etzkorn (2018:29) argues that the inclusion of technological knowledge allows for a better understanding and description of the skills and knowledge needed for efficient pedagogical practices in technology-enhanced settings. It can be deduced from this notion that TPACK is conceptualised as a way of thinking about the knowledge teachers require to effectively integrate technology effectively in their lessons (Kurt *et al*., 2014; Mishra & Koehler, 2008). Baran, Bilici, Sari and Tondeur (2017:2) concur by postulating that TPACK is accepted as a valuable framework for defining how teachers effectively integrate technologies in their classes.

Technological Pedagogical Content Knowledge (TPACK) is an amalgam of three knowledge types: Content Knowledge (CK), Pedagogical Knowledge (PK) and Technological Knowledge (TK). Content Knowledge (CK) refers to the subject-based content knowledge of a teacher. Teachers' content knowledge encapsulates their knowledge of theories and concepts, as well as their approaches and practices in developing learners' knowledge (Shulman, 1986). It can be argued that the main task performed by a teacher is teaching, which involves facilitating subject matter and skills to learners. Teachers can obtain their content knowledge in various ways, e.g., through college, technikon or university studies. Koehler and Mishra (2009) maintain that teachers without or with limited content knowledge can hamper learning. Content knowledge should thus be fluid, built on through years of experience and keeping up with changes in the curriculum.

Pedagogical Knowledge (PK) refers to a teacher's knowledge of learning and teaching theories, thus the various teaching and learning methods and processes. Pedagogical Knowledge involves knowledge of how learners learn, how to successfully manage a classroom, how to plan and implement lessons and how to access learners. Therefore, Mishra & Koehler (2008:6) maintain that PK requires a comprehension of "cognitive, social and developmental" learning theories and how teachers can apply these theories to their learners.

Technological Knowledge (TK) refers to teachers' knowledge of using and operating ICTs, hence their technological literacy. Mishra and Koehler (2008:3) suggest that technological knowledge encompasses simple and standard technologies such as textbooks, chalk, and the black or green board, as well as advanced technologies "such as the Internet and digital" technologies. As in the case of CK and PK, pre-service teachers can learn TK at tertiary institutions as part of their studies. However, TK skills can also be taught and/or developed at school as part of training courses, or it may be self-taught. Examples of TK school-based teachers might possess are knowing how to operate laptops, data projectors and smartboards, access search engines, use the Microsoft Package and Google Suite, etc. In an ever-changing digital environment, teachers' TK must also "evolve over a lifetime", constantly learning and adapting (Mishra & Koehler, 2008:4).

TPACK argues that content, pedagogy and technology are intertwined; connections, interactions, affordances, and constraints between and among them exist (Koehler & Mishra, 2006).

Koehler and Mishra (2006) argued that overlapping occurs between content, pedagogy, and technology, and this direct relationship between content, pedagogy and technology leads to interrelated knowledges. These knowledges are Technological Content Knowledge (TCK), Pedagogical Content Knowledge (PCK), and Technological Pedagogical Knowledge (TPK).

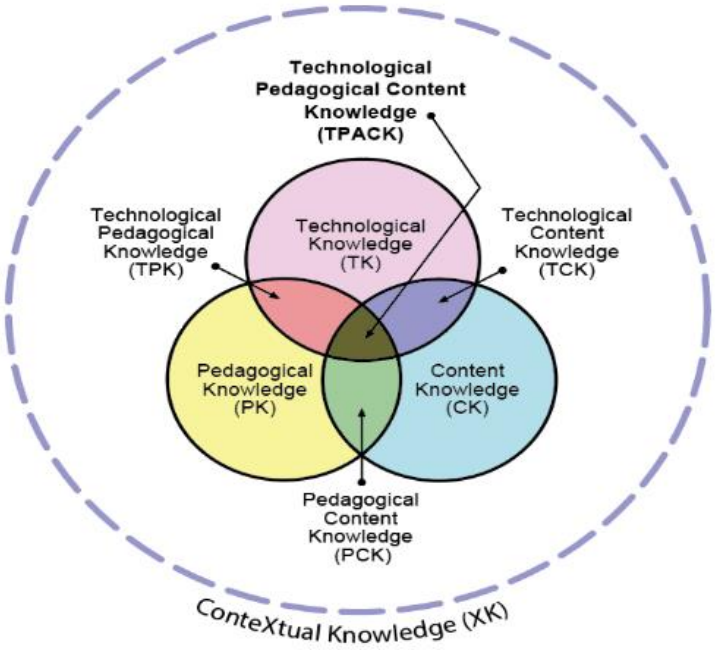


Figure 2.3: The TPACK framework
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Figure 2.3 represents the revised TPACK diagram with an added dotted line encircling the image. Mishra (2018:5) states that this outer dotted circle, dubbed **XK**, represents 'conte**X**tual **K**nowledge', which highlights the "organizational and situational constraints" in which teachers work.

Mishra and Koehler (2008:6-9) posit that TCK "refers to a teacher's ability to choose technologies best suited to the teaching and learning of the subject matter; PCK refers to a teacher's ability to discern between learning and teaching theories best suited to the needs of the subject matter and learners' needs; TPK refers to a teacher's ability to know how the usage of different ICTs can influence teaching and learning".

Teachers who possess TCK to understand how technology and content motivate and hinder one another. Understanding which ICTs are appropriate for a particular lesson or concept promotes learning and conceptualisation. Mishra and Koehler (2008) argue that teachers need to master their subject matter and understand how their choice of ICTs can influence the content taught. It is thus imperative that teachers receive ICT training as well as ICT integration training to build their TCK knowledge base.

Teachers with PCK can interpret their subject matter and represent it in several ways (Mishra & Koehler, 2008). Furthermore, they can build on learners' pre-knowledge and adapt teaching

methodologies when needed. Teachers who possess TPK comprehend how teaching and learning can change when supported by different ICTs (Mishra & Koehler, 2008). These are teachers who can select suitable ICTs to support their pedagogical practises.

The overlap of TCK, PCK and TPK gives rise to Technological Pedagogical Content Knowledge (TPACK, originally stylised as TPCK in 2006). Thompson & Mishra (2007:38) noted that an acronym change from TPCK to adding the 'A' to TPACK was necessary as TPCK was "consonant heavy and difficult to say". The acronym TPACK also emphasises the interconnectedness of Content, Pedagogy and Technology knowledge and the formation of an amalgamated unit and "Total PACKage" (Thompson & Mishra 2007:38).

The TPACK framework emphasises the need for pedagogical content, as well as technological knowledge and skills, to facilitate the usage of technology. This means that a teacher is less likely to use ICTs if they do not possess the necessary knowledge and skills to use and implement them. It can be theorised that subject content knowledge alone can also not ensure the use and implementation of ICTs. The "perfect convergence" of content, pedagogy and technology is the goal of e-Education (Padayachee, 2017). The TPACK framework will thus be useful in determining the levels of knowledge and understanding possessed by and necessary for teachers participating in this study to integrate technology into their practice effectively. Hofer and Grandgenett (2012) believe that TPACK can be developed through content-specific practicum courses. Practicum courses allow an instructor to model technology-enhanced learning activities with the course participants completing activities to illustrate or demonstrate what they have learned. Hofer and Grandgenett (2012) recorded findings supporting course participants developing an understanding of technology and shifting from thinking to using technology as a tool.

The TPACK framework does, however, present some limitations as it does not address the skills needed for ICT integration nor the attitudes and beliefs needed of the teacher participants towards effective ICTs integration in teaching and learning. Messina and Tabone (2013) posited that the beliefs of participants towards ICT could ensure that ICTs are adopted and used. Developing teachers' TPACK may lead to them progressing from accepting technology to adapting technology (Kaplon-schilis & Lyublinskaya, 2015). Teachers are more inclined to use ICTs if they believe they are proficient in integrating ICTs into teaching and learning. A teacher's TPACK informs their perceived behavioural controls and that a technologically

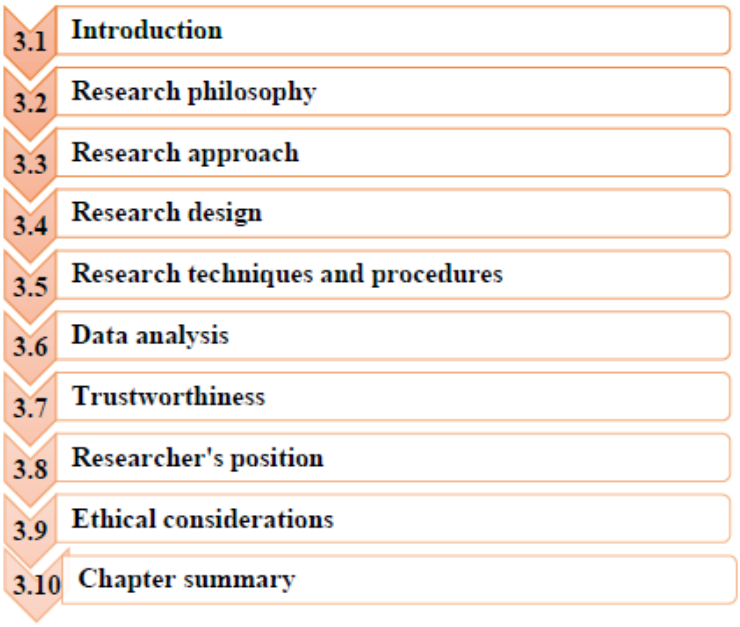
knowledgeable teacher is more likely to develop a positive attitude towards ICTs, use ICTs as well as foster beliefs of self-efficacy.

2.8 Chapter Summary

This literature review commenced by exploring e-Education within South Africa, mainly focusing on WP7's significance. Furthermore, as the site of this research study is located in the WCP, it was imperative to provide an overview of e-Education within the Western Cape by focusing on the Khanya Project and the present e-Learning Game Changer, which initiated the Model school initiative. The literature indicates that the lessons learnt from the Khanya project were invaluable as they lay the groundwork for future ICT initiatives. Furthermore, the literature provided the researcher with a focused view on the implantation of the e-Learning strategy in the Western Cape. The three (3) categories of schools were explored, and the resources provided to Universal, Enhanced and Model schools were highlighted.

It further explored other ICT adoption initiatives for comparative purposes by focusing on initiatives from the local Gauteng Department of Education and the international Malaysian Ministry of Education. Literature on both these initiatives indicates that pilot phase-rollouts are invaluable, but that teacher training and support are essential to securing a successful initiative. A technology-rich environment does not guarantee technology use and adoption. Exploration was done on technology use for teaching and learning, highlighting that the most common technologies used in schools are laptops, data projectors and whiteboards, but teachers need adequate training to adopt and use these devices. Furthermore, motivators and barriers to ICT use were explored, which stipulate that motivated teachers are more inclined to use technology, whilst barriers can de-motivate and hinder use. Lastly, a theoretical framework to underpin this study was identified, TPACK, which can facilitate the purposeful use of ICT in teaching and learning. Technological Pedagogical Content Knowledge is therefore influential in determining the knowledge levels teachers have or require for effectively integrating technology into teaching and learning.

CHAPTER 3: RESEARCH METHODOLOGY



Organisation of Chapter 3

3.1. Introduction

A research methodology provides a mind map which allows the researcher to "find out" how best to address research questions. Babbie (2015:6) describes methodology as the "science of finding out". This chapter delineates the research methodology employed to address the main and sub-research questions of this study, that is:

- to explore and understand the extent to which the implementation of the WCED MSI progressed teachers' technological knowledge and skills to use technology for teaching and learning;
- to determine to what extent and how technology, professional development, technical support and digital resourcing aspects contributed to teachers' use of technology for teaching and learning; and
- to determine specific factors of the professional development that contributed to teachers' TPACK development and use of technology.

The Research Onion is a metaphorical illustration depicting the elements of research methodology (Saunders and Tosey, 2012). The outer layers represent the design elements, and the inner layers depict the data collection and analysis considerations (Saunders and Tosey, 2012), Figure 3.1. The Research Onion thus represents the various decisions and reasonings a

researcher will have to make at the onset of developing a research methodology (Phair and Warren, 2021). Saunders, Lewis and Thornhill (2009:106) posit that these important outer layers must first be "peeled away" before dealing with the central layers; the idea is to work from the outermost layers inwards, like peeling the layers of an onion.

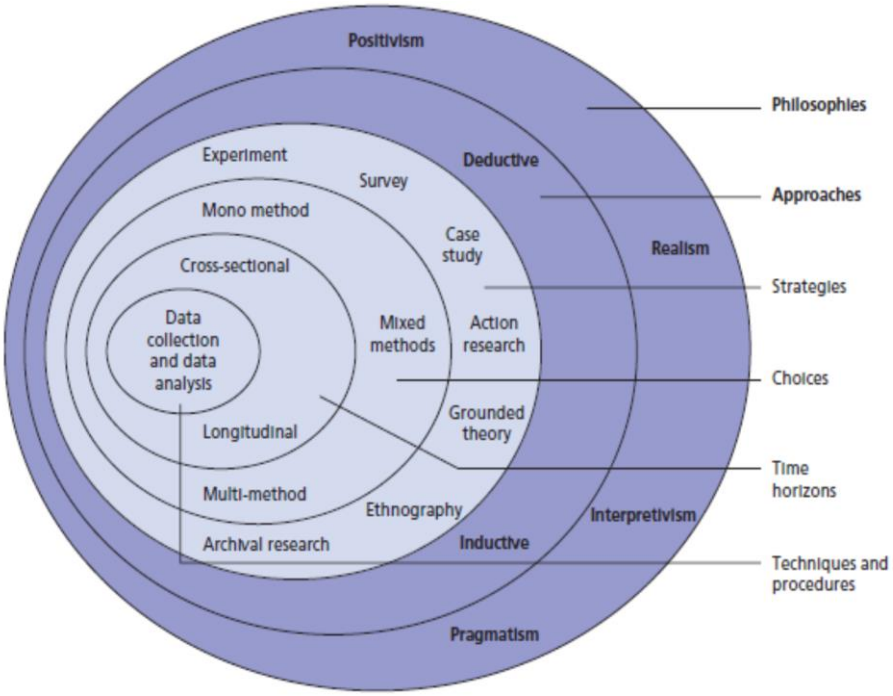


Figure 3.1: The Research 'Onion'

© Saunders, Lewis and Thornhill (2008), reproduced with permission.

Cohen *et al*. (2007:78) state that research strives for purpose, which will lead to determining the methodology and design. Figure 3.2 represents this research study's design choices.

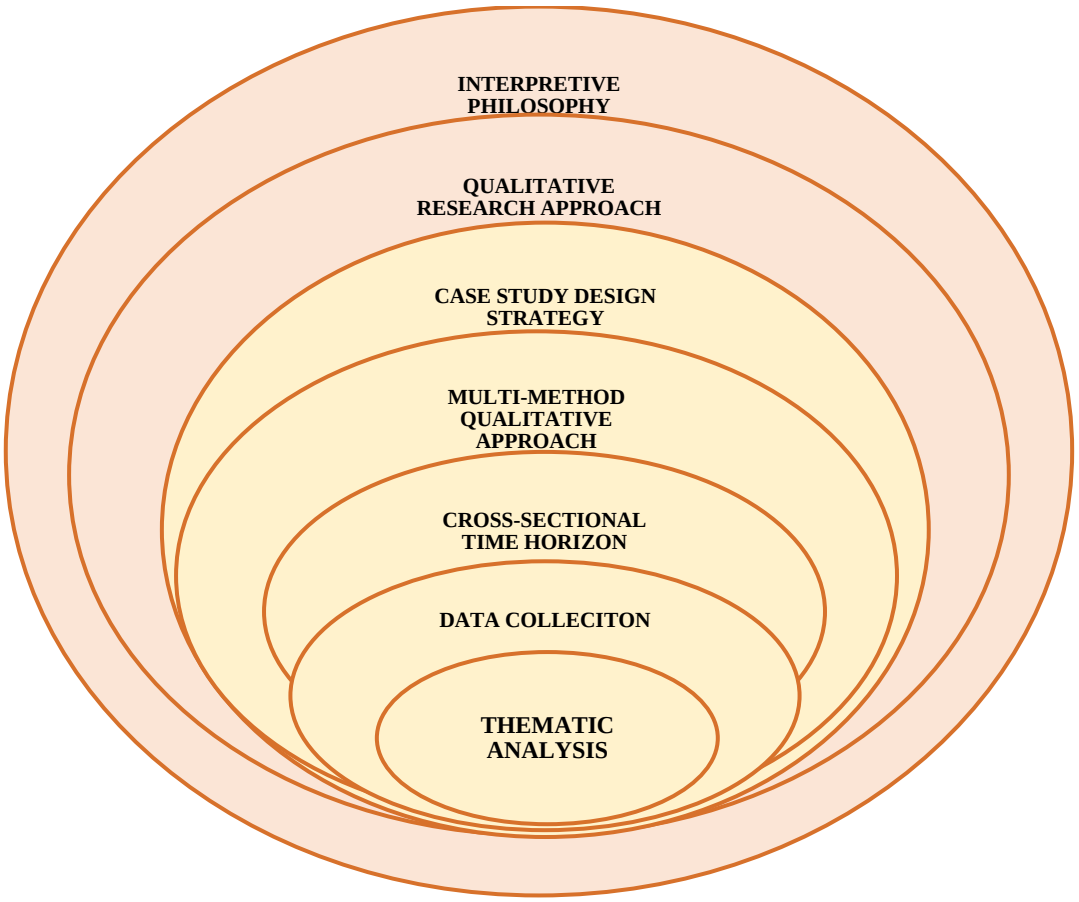


Figure 3.2: Research study design choices

3.2 Research philosophy

The study is located in an interpretive philosophy. It is a qualitative study that adheres to a case study design strategy. Saunders *et al*. (2009:107) maintain that research philosophy relates to the "development of knowledge and the nature of that knowledge". There are four (4) research philosophies, as indicated in Figure 3.1, the Research Onion: Positivism, Realism, Interpretivism and Pragmatism. The research philosophy adopted by a researcher comprises of the assumptions of the research's worldview, which will, in turn, underpin the research strategy and methods (Saunders and Tosey, 2012; Saunders *et al*., 2009:108). Furthermore, research philosophy can be described from two distinct viewpoints: ontological and epistemological (Phair and Warren, 2021:2). Saunders *et al*. (2009:110-112) state that ontology concerns the nature of reality, whereas epistemology concerns what accounts for acceptable knowledge in a study field. The research philosophies as identified by Saunders *et al*. (2009) are positivism, realism, interpretivism and pragmatism, ontology, which is the researchers' "view of the nature of reality", the epistemology, which is the researcher's "view regarding that constitutes

acceptable knowledge", and the data collection techniques most used are summarised in table 3.1, adapted from Saunders *et al*. (2009:119).

Table 3.1: An outline of the four (4) research philosophies

RESEARCH PHILOSOPHY	ONTOLOGY	EPISTEMOLOGY	FREQUENTLY USED DATA COLLECTION TECHNIQUES
Positivism	The nature of reality is external and objective	Only observable phenomena can provide credible data and facts	Structured, mostly quantitative approach with large samples.
Realism	The nature of reality is objective and exists independently	Observable phenomena can provide credible data and facts; insufficient data can lead to inaccuracies	Can be qualitative or quantitative approaches; chosen methods should suit the subject matter
Interpretivism	The nature of reality is socially constructed and subjective	Subjective meanings and social phenomena; the focus is on details of situation and reality behind details	A qualitative approach, small-scale samples with in-depth investigations.
Pragmatism	The nature of reality is external, and…. the view was chosen to enable the answering of the research question best	Either/both observable and subjective meanings can provide acceptable knowledge. The focus is on practical applied research	Mixed method designs, either quantitative or qualitative approaches.

This study adopted interpretivism as a research philosophy. Research paradigms can be used to help define research philosophies. According to Saunders *et al*. (2009:118), a paradigm as a "way of examining" phenomena from which understandings can be "gained and explanations attempted". Babbie (2015:31) describes paradigms as "fundamental frames of reference" that form the bases of theories and inquiry and provide logical frameworks for what is observed and understood, thus, trying to make sense of what is seen. A research paradigm can thus guide a researcher on how to conduct a research study and how the data should be interpreted. Furthermore, Kuhn (1962, in Patel, 2015:1) states that a research paradigm is "…the set of

common beliefs and agreements shared between scientists about how problems should be understood and addressed". There are various research paradigms. Cohen *et al*. (2007:33) identify the following:

- Normative, positivist studies;
- Interpretive; and
- Critical.

The ontology, epistemology and methodology of the three (3) research paradigms are set forth in Table 3.2:

Table 3.2: An outline of three (3) research paradigms

RESEARCH PARADIGM	ONTOLOGY	EPISTEMOLOGY	METHODOLOGY
Normative/ Positivist	The nature of reality is objective	Only observable phenomena are able to provide credible data and facts	Surveys, experiments, etc.
Interpretivist	The nature of reality is socially constructed and subjective	Subjective meanings and social phenomena; the focus is on details of situation and reality behind details	Case studies, interviews, phenomenology, ethnography, etc.
Critical	The nature of reality is external, and the view is chosen to best enable the answering of the research question	Either/both observable and subjective meanings can provide acceptable knowledge. The focus is on practical applied research	Critical ethnography, action research, open-ended questionnaires and interview, etc.

Given the above, this research study chose and applied an interpretive paradigm. Crotty (1998) states that there is no single reality; instead, the reality was created by individuals (participants), which is then interpreted.

An interpretive paradigm can be used as its main objective is to comprehend the subjective world of human experience (Cohen *et al*., 2007; 2017). Cohen *et al*. (2007:21) elaborate by stating that an interpretive research paradigm maintains that truths depend on the context of a situation and that there are no absolute truths, as is argued by a positivism paradigm. Therefore, an interpretive paradigm was deemed appropriate for this study as it provided the researcher with an understanding of how each participant experienced the Models school initiative. This paradigm allowed for a deeper look at participating teachers' use of ICTs, their TPACK and their uptake of ICTs for teaching and learning in their practice. Each participant's experience is intimately unique, and there is thus no single reality for all participants, but rather a reality created by each individual or participant.

3.3 Research approach

The second layer of the Research Onion represents the research approach, which can either be inductive, in which data is collected, and then a theory is developed as a result of data analysis, or deductive, in which a theory and hypothesis are developed, and a research strategy is designed to test a theory (Saunders *et al*., 2009:124).

An inductive, qualitative approach was used in this study. A qualitative research approach aims to discover, understand, and describe. Moreover, it enables the researcher to immerse themselves into the world of the participants they wish to study (Pettey, Bracken & Pask, 2017:84). The qualitative approach concerns itself with the exploration of phenomena, and in this study, the MSI presents itself as a phenomenon which warrants in-depth exploration. Mack, MacQueen, Guest, and Namey (2005:1) surmise that scientific research should, inter alia, consist of an investigation which aims to seek answers, use a set of predefined procedures, collect evidence, and produce findings and that qualitative research is "especially effective in obtaining culturally specific information…".

Qualitative research involves the following (Mack *et al*., 2005:1):

- Seeking answers to research questions;
- Systematically following procedures to answer research questions;
- Collecting data; and
- Producing findings.

Conversely, a quantitative approach is usually synonymous with (Saunders *et al*., 2009:482):

- Meanings derived from numbers;

- Data collection results are in numerical and standardised data; and
- Data analysis is conducted through the usage of statistics and diagrams.

According to Mack *et al*. (2005:3-4), the key difference between quantitative and qualitative approaches is flexibility, with quantitative usually being inflexible, which can be advantageous as it allows for a meaningful comparison between participant responses. Even though a quantitative approach has its benefits, the researcher chose to adopt a qualitative research approach as the quantitative approach aims to predict, control, or confirm. In contrast, a qualitative research approach aims to discover, understand, and describe (McMillan & Schumacher, 2014). Furthermore, the qualitative research approach assumes that 'multiple realities' are socially constructed (McMillan & Schumacher, 2014). The participants in this study each have their perceptions regarding the phenomena being researched, and their individual views or perceptions provided a collective insight into the phenomena.

This research study aimed: to explore and understand the extent to which the implementation of the WCED's MSI progressed teachers' technological knowledge and skills to use technology for teaching and learning. This will be achieved by determining to what extent and how technology, professional development, technical support, and digital resourcing aspects contributed to teachers' use of technology for teaching and learning; and to determine specific factors of the professional development that contributed to teachers' TPACK development and use of technology. The qualitative approach thus allows the researcher to investigate the participating teachers' use of ICTs, their TPACK and the uptake of ICTs for teaching and learning in their practice at the selected research sites towards answering the research questions.

3.4. Research design

Saunders *et al*. (2009:136) state that research design embodies the plan a researcher must have to answer research questions and research strategies; research choices and time horizons represent the process of research design. A research design's goal is thus to stipulate a plan for acquiring empirical evidence that will be used in response to research questions about the phenomena under investigation. A research design "describes the procedures for conducting a research study" (McMillan and Schumacher, 2014:28). These procedures include the *when, from whom,* and *under what conditions* the data are collected and analysed. Furthermore, a research design highlights the constraints a researcher can face, e.g., time, money and access to data or participants, as well as the ethical considerations (Saunders *et al*., 2009:137).

3.4.1 Research design strategy

There are several ways of doing research, Yin (2009:2) states the following examples: case studies, experiments, surveys, and economic and epidemiologic research. Yin (2009:2) further asserts that each of the above designs has advantages and disadvantages, depending on the following three conditions:

(i) the type of research question;
(ii) the control a researcher can exert over actual behavioural events; and
(iii) the focus on current instead of historical phenomena.

Considering the above contextual factors, the researcher chose to employ a case study design strategy which can be defined as a case examined over time, employing multiple sources of data (McMillan & Schumacher, 2014; Yin, 2009). Yin (2009:18) contends that case studies are empirical studies that investigate, in-depth, contemporary phenomena within "real-life contexts". Nisbet and Watt (1984:72, as cited in Cohen *et al.*, 2017:253) defined a case study as a specific instance frequently designed to illustrate a more general principle. Case studies allow the researcher to observe cause and effect in real contexts (Cohen *et al*., 2017), enabling the researcher to explain these "causal links" (Yin, 2009).
Baxter and Jack (2008), citing Yin (2003), determines that a case study should be considered for the following reasons:

(a) When the focus of the study is to answer the "*how*" and "*why*";
(b) When you cannot influence the behaviour of the participants;
(c) When you want to cover contextual situations relevant to the phenomenon under study;
(d) When there are unclear boundaries between the phenomenon and context.

Saunders *et al*. (2009:146) postulate that case study strategies are often used in explanatory exploratory research, which may require various combinations of data collection techniques, such as interviews, observations, questionnaires, or document analysis. Subsection 3.5.3 discusses the data collection instruments used in this research study, and 3.5.4 presents data collection techniques used in the study. Explanatory research studies a problem or situation to describe the various relationships between variables, whereas exploratory research studies a problem or situation in order to seek understanding (Saunders *et al*., 2009:139-140).

In this exploratory study, the case investigated is the selected Model school implementing the e-Learning strategy in the West Coast Education District of the WCED. The researcher argues

that a case study design strategy is most suited for this research study as it allowed for an in-depth exploration of the participating teachers' use and uptake of ICTs and their TPACK development.

3.4.2 Research choices

Research choices represent the fourth (4th) layer of the Research Onion and refer to the number of research approach methods a study will employ. Research approach choices can either be the quantitative and/or qualitative approach, or a combination of research approaches a research study will have (Phair and Warren, 2021; Saunders and Tosey, 2012). Saunders *et al*. (2009:151) refer to three (3) choices: mono method, mixed methods, and multi-method. As referred to in Chapter 3.3, there are two types of research approaches: quantitative and qualitative. The research approach employed in the study determines the data collection techniques and data analysis procedures.

Figure 3.3 highlight the research choice options a study can have:

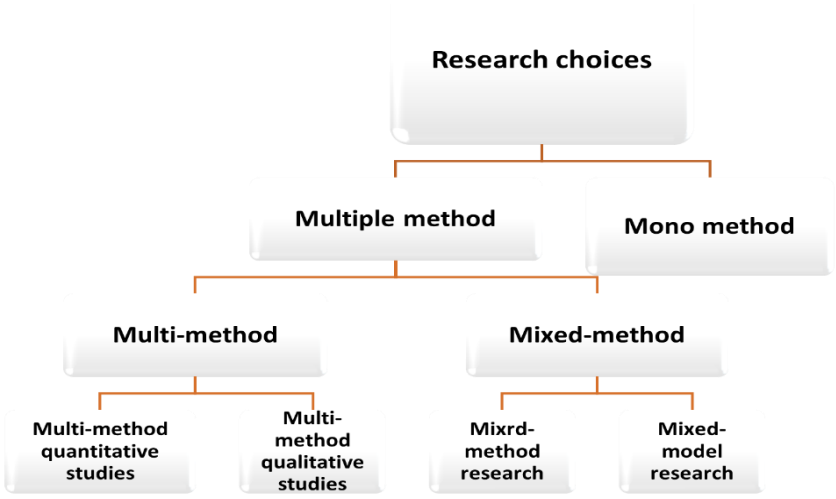


Figure 3.3: Research choice options
Adapted from Saunders *et al*. (2009:152)

The first choice is determining whether a study will be a mono method or multiple method. Mono method means a study will either have a quantitative or qualitative approach. Conversely, a multiple-method approach can either be multi-method or mixed-methods. Multi-method, which allows the researcher to make use of a wider range of approaches (Phair and Warren, 2021) and data collection and analysis methods, can be subdivided into multi-method quantitative and multi-method qualitative.

By choosing to use a multi-method approach, the researcher can choose to employ combinations of either quantitative or qualitative data collection techniques and analysis methods. When adopting multi-methods, a researcher chooses not to mix quantitative and qualitative research approaches and data collection and analysis methods (Saunders *et al*., 2009:152). However, with the mixed-method approach, which can be subdivided into mixed-method research and mixed-model research, the researcher chooses to use both the quantitative and qualitative approaches. Mixed method research uses both quantitative and qualitative data collection techniques and data analysis methods, either parallel (at the same time) or sequential (one after the other), but chooses not to combine them (Saunders *et al*., 2009:152). Contrastingly, mixed-method research uses a combination of quantitative and qualitative approaches and their data collection techniques and data analysis methods. This can allow the researcher to take quantitative data and turn it into a narrative that can be qualitatively analysed and take qualitative data and turn it into numerical codes which can be statistically analysed (Saunders *et al*., 2009:153).

This study chose to employ a multi-method qualitative approach with three (3) qualitative data collection techniques (questionnaire, semi-structured interviews, and document analysis). The three (3) different data collection techniques allowed the researcher to triangulate the data for cross-checking purposes and corroborate this research study's findings, therefore, ensuring trustworthiness.

3.4.3 Time horizons

According to Saunders *et al*. (2009:155), time horizons, which represent the firth (5^{th}) layer of the Research Onion, can be cross-sectional, studying a phenomenon at a particular time, essentially taking a "snapshot", or longitudinal, studying change and development over a period of time. The nature of a research study, the research question (Saunders *et al*., 2009:155), aims and objectives, as well as the research constraints, are decisive factors when determining the time horizon of the research study (Phair and Warren, 2021).

When a researcher uses a cross-sectional time horizon, a study is conducted at a certain point in time. A cross-sectional study produces a "snapshot" of a population at a given point in time (Cohen *et al*., 2007:2012; Saunders and Tosey, 2012:59). Whereas with a longitudinal time horizon, a researcher chooses to collect data over numerous points in time, which can be over several weeks, months or years (Phair and Warren, 2021:14). Cohen *et al*. (2007:211) state that longitude refers to studies that can be conducted over a period of time. A longitudinal time

horizon is especially beneficial when researching changes and progression of a study over a period of time (Phair and Warren, 2021; Saunders *et al*., 2009).

This research study uses a cross-sectional time horizon using a case study strategy. Saunders and Tosey (2012:59) contend that a case study can be considered cross-sectional if it allows the researcher to address a problem at a particular point in time, whereas, when addressing a problem necessitates collecting data over an extended period, a longitudinal study should be considered.

3.5 Research techniques and procedures

The innermost layer of the Research Onion is research techniques and procedures, representing the methods used to collect and analyse research data (Saunders *et al*., 2009:595). Phair and Warren (2021:15) describe the practicalities a researcher will have to consider when deciding on appropriate research techniques and procedures:

- The site and population selection and the participant sampling method that will be used;
- The type of data that will be collected, the data collection instruments and the data collection method; and
- The data analysis method which will be employed to respond to research questions.

3.5.1 Site selection

According to McMillan and Schumacher (2014:377), the chosen site should be "suitable for the research problems" and achievable with the researcher's resources in terms of time, skills and mobility.

The site of this research study is a high school (grades 8 to 12) located in the Saldanha Bay Local Municipality on the West Coast of the Western Cape Province. This site was purposely selected as the school is classified as one of the sixteen Model schools in the Western Cape. The school is equipped with learner devices, and all classes are transformed into SMART classrooms. In this school, teachers have received or have access to a laptop, an eBeam and a data projector. All classrooms were initially transformed into Smart classrooms, but due to a high break-in and vandalism rate, the school decided to assign the devices to teachers. Thus, teachers must set up the devices each morning and remove them at the end of the school day. The teachers at the school also received ICT training which aimed at equipping them with the

knowledge on how to implement and integrate ICTs into their educational practises and learners' learning. The selection of this Model school was further informed based on proximity, as it is located close to the researcher's residence and accessible as participants can easily access the principal, which acts as a quasi-gatekeeper, can be liaised with, and it is the researcher's place of work

At the time of this study, the school had a population of 44 teachers and 1393 learners ranging from Gr 8 – 12. The selected school is a quintile 4, a public, ordinary school in the West Coast Education District. Schools in SA are categorised into five quintile groups for funding purposes (Van Dyk & White, 2019). Van Dyk and White (2019:51) state that the quintile ranking is constructed around the unemployment and literacy rate of a school's surrounding community. A Quintile 1 ranking is an indication of an impoverished school, and a Quintile 5 ranking is an indication of an affluent school. It should be noted that even though this school is ranked as a quintile 4 school, it is situated in a historically disadvantaged neighbourhood.

The school was, therefore, deemed suitable to provide unique insights into the effects of the Model schools' professional development initiatives on teachers' use of ICTs for teaching and learning in their practice. Furthermore, conducting a research study at this school was instrumental in responding to the main and sub-research questions of this study.

3.5.2 Population and participant selection

A population represents the total number of people at a site from which data can be obtained (Cohen *et al*., 2007). As factors like the researcher's expenses, time and accessibility can prevent data collection from the whole population, a sample is usually selected (Cohen *et al*., 2007). A sample is a finite group of participants drawn from the target group (Cohen *et al*., 2007; Martínez-Mesa, González-Chica, Duquia, Bonamigo, Bastos, 2016:326). Mack *et al*. (2005) state that collecting data from a whole population is not always necessary but that a sample of a population can similarly lead to valid findings. Martinez-Mesa *et al*. (2016) and Cohen *et al*. (2007:100) proposed four important factors that researchers should consider concerning sampling:

- the size of the sample;
- representativeness and parameters of the chosen sample;
- access the researcher has to the sample; and

- the strategy used for sampling.

The sampling methodology in this study was purposive. In purposive sampling, the researcher selects participants from an existing population, with people from the broader population either included or excluded (Mack *et al*., 2005; Cohen *et al.*, 2007; McMillan & Schumacher, 2014). The selected participants will be a representation of the population as a whole. The final sample was six (6) practising teachers at the research site.

The researcher chose not to opt for probability or simple random sampling. Probability sampling randomly draws a sample from a wider population and is often used in randomised controlled trials (Cohen *et al*., 2007:110). Martinez-Mesa *et al*. (2016:328) state that with probability sampling, everyone has an equal opportunity of being selected as a participant. Probability sampling was not appropriate for this study as the researcher purposely chose to exclude a group of people from the population. According to Martinez-Mesa (2016:329), simple random sampling entails the random selection of participants from a whole population using a table of random numbers. With simple random sampling, each member of the broader population has an equal probability of being selected for a study, and each member is completely independent of the next (Cohen *et al*., 2007:110). Purposive sampling is thus appropriate for this study as it allowed the researcher to group participants according to a pre-selected criterion relevant to specific research questions (Mack *et al*., 2005).

As a school population consists of teachers with varied years of employment, the researcher chose to set a criterion to exclude teachers. Therefore, a single criterion (prerequisite), which pre-qualified a prospective teacher-participant, was applied:

- The prospective participant must have been employed since 2017 at the selected school.

This criterion is justified as teachers employed for the duration of the initiative will be able to provide information-rich data, whereas teachers not employed since 2017 will be limited in their responses. It can be reasoned that the participants who adhere to this criterion could provide insight into how the MSI implementation affected their development of TPACK as well as factors which supported or hindered the adoption and use of ICTs. These teachers would have also had some ICT training and will thus be able to provide insight into their TPACK (development) and their TPACK integration (practices) into teaching and learning. Cohen *et al*. (2007:105) maintain that "where there is heterogeneity … a sample must be selected … that

respects that heterogeneity". The researcher chose not to factor in age, gender, subject specialisation, or management position but is, however, of the opinion that participants should be information-rich. Therefore, after considering the above contextual factors, six (6) teachers were purposefully selected to determine the participants' use of ICTs and their TPACK for teaching and learning in their practice. The researcher chose to exclude administrative staff, support staff, parental SGB members, and learners as they fall outside the scope of this research study.

3.5.3 Data collection instruments

An integral part of the planning for educational research involves determining and designing the most suitable data collection instruments (Cohen *et al.*, 2007:91). Cohen *et al*. (2007:116), Mack *et al*. (2005:2) and McMillan and Schumacher (2014:369) posit that there are numerous data collection methods and instruments available for qualitative data collection. Examples of data collection methods and instruments are questionnaires, semi-structured individual or group interviews, audio-visual materials, and observational and documentary data. As noted in Chapter 3.4.2, this research study makes use of the multi-method qualitative approach. Three (3) qualitative data collection techniques, a questionnaire (Appendix D), semi-structured interviews (Appendix E), and document analysis, were selected to gather data, which allows for the triangulation of data for cross-checking and corroboration purposes.

Cohen *et al*. (2007:320) propose that questionnaires should have a clear purpose, only include what is needed and ask the most appropriate questions to meet the aim of the study. The questionnaire contained biographical questions, the prerequisite question, and questions relating to teachers' TPACK. A validated TPACK instrument, compiled by Schmidt *et al*. (2009), was adapted and used.

The reasoning for administering the questionnaire online concurs with the reasons given by Cohen *et al*. (2007:229-230):

- Reduction in costs due to lack of paper and printing;
- Respondents can complete the questionnaire in the comfort of their homes or self-chosen setting;
- Respondents can respond at a time that is suitable for them; and
- Human error is reduced as data is entered and processed online.

The reasoning for using the questionnaire as a data collection instrument is as follows:

- To gather biographical data – Questions 1 – 6 and 8;
- To select participants conforming to the prerequisite – Question 7;
- To determine the technology provided, as well as the technology used by prospective participants – Questions 9 - 10;
- To gain insight into the teachers' TPACK and how or if they are integrating TPACK into their teaching and learning – Questions 11-24; and
- To determine the willingness of respondents to participate further in the study – Question 25.

Interviews enable interviewers and interviewees to discuss their points of view on a specific topic (Cohen *et al*., 2007:349; Saunders *et al*., 2009:318). Cohen *et al*. (2007:349) further postulate that interviews are flexible data collection tools that allow for verbal and non-verbal communication. Therefore, the researcher opted for a semi-structured interview guide approach. Semi-structured refers to interviews where there is a "given agenda", and the questions are open-ended (Cohen *et al*., 2007:97). According to Saunders *et al*. (2009:320), semi-structured interviews usually have a set of questions that are to be addressed, but that the sequence of questions can be changed based on the conversation flow between the researcher and respondent. Semi-structured interviews with open-ended questions are especially useful as it allows for digressions, the exploration of new avenues and probing (Cohen *et al*., 2007). In addition, an interview guide specifies the questions in advance, with the interviewer deciding the sequence and working of questions beforehand. Table 3.3 outlines the strengths and weaknesses of an interview guide approach (Cohen *et al*., 2007:353):

Table 3.3: Strengths and weaknesses of an interview guide approach

STRENGTHS	WEAKNESSES
1. Increases comprehensiveness of data collected. 2. Logical data gaps can be anticipated and closed. 3. Interviews maintain a conversational tone.	1. Important topics may unintentionally be omitted. 2. Lack of interviewer flexibility regarding sequencing and wording may result in different responses, reducing comparability.

3.5.4 Data collection

The research approach chosen by a researcher and the research questions should guide which methods of data collection are most appropriate (McMillan & Schumacher, 2014:369). According to Saunders *et al*. (2009:146), a case study design requires triangulation of data sources to cross-check the data. Therefore, triangulation refers to the usage of numerous data collection techniques. The researcher chose to employ a multi-method qualitative approach with multiple data collection strategies, which included a questionnaire, individual semi-structured interviews, and document analysis, as discussed in Chapter 3.5.3.

To gather data, an online questionnaire (Appendix D) was developed on Google Forms, which is an electronic form that can be sent to participants. The link to the electronic form was sent to all teachers forty-four (44) at the selected site via WhatsApp, except the principal, who does not teach any classes. Twenty-five (25) teachers completed the questionnaire, of which thirteen (13) did not meet the criterion set, which resulted in a final sample of six (6) eligible participants. This decision was further informed by the willingness of teachers who volunteered to participate in the study.

The reasoning for using WhatsApp was:

- The researcher could contact prospective participants in a private capacity and not as a colleague; and
- Have greater control over following up on the 44 respondents;

Once the participants were selected (details set out in Chapter 3.5.2), they were invited via email to an interview (Appendix E). The semi-structured interviews with participants allowed the researcher to gain an understanding of how participants construe events affecting their lives (McMillan & Schumacher, 2014). Due to the COVID-19 pandemic and to adhere to the necessary safety distancing protocols, participants had a choice: an online interview using an online communication platform, e.g., Microsoft Teams, or a face-to-face interview at the venue of their choice. All six (6) participants opted for a face-to-face interview in the researcher's classroom at school after school hours. The principal was duly informed of this arrangement and did not object. After arranging the date and time, the first participant requested the interview schedule upfront. The interview schedule was emailed to all participants the day before the arranged interview to ensure fairness and reliability. All the interviews lasted between 25-45 minutes. The steps taken during the interviews, indicated in figure 3.4, were as follows:

Figure 3.4: Interview preparation process

During the interview, the intent of the study was continually highlighted, and the participants were advised that all information would be kept confidential and anonymous. Moreover, participants were discouraged from using or stating any information that may lead to exposure, e.g., mention of names, schools or people and sought their consent to redact names should a slip-up occur. All interviews were conducted in English, as it is the main language of official communication at this dual-medium school (Afrikaans and isiXhosa are spoken colloquially), with Afrikaans being used minimally during the introductions stage of two interviews. The decision to conduct the interviews in English was not taken lightly. The multi-lingual and multi-cultural disposition of the school was taken into consideration, as well as the capabilities of the researcher. The researcher is fluent in Afrikaans, but their isiXhosa is limited to a few words. Bailey (2008:129) postulates that translation adds an "additional layer" of interpretation as words or phrases may be directly translated and so lose their meaning or nuance. For fairness, reliability of the research findings, and not to disadvantage a participant whose home language fall outside of the researcher's capabilities, the decision was thus made to conduct the interviews in a language the participants and the researcher are familiar with and as previously mentioned, is the official communication language of this school.

The audio of the interviews was transcribed verbatim into a written format. Transcription is the process of taking, inter alia, audio or video data and converting it into text, thus preparing the data for "visual review" for "closer study" (McMillan & Schumacher, 2014:398; Bailey, 2008). The transcripts were sent to the participants via email or WhatsApp, depending on the choice of the participants, to check and validate accuracy. They were informed that they might add, remove, or request edits or adaptations to the text. One participant requested an adaptation to

a part of their transcript, which was then applied. The interview transcripts were also made available for member checking by fellow researchers, the supervisor, and the co-supervisor of this research study.

The third data collection technique used in this research study is document analysis. Document analysis may be beneficial to researchers for the following reasons (Cohen *et al*., 2007:201):

- Reaching inaccessible people or subjects;
- Limited or no reactivity from a writer(s) of documents;
- Some documents may be written by skilled professionals and contain invaluable information and insights.

In this study, it was not possible to reach out to the developers of some of the documents, and some information was only available in certain documents. However, documents may also be biased and contain selected data. Cohen *et al*. (2007:201) state that while there are copious amounts of documentary data sources, not all are written exclusively for research, which may raise questions of reliability and validity. Documents may also be inaccessible to researchers, which may limit a study (Cohen *et al*., 2007:202).
The documents used in this research study are:

- WCED Vision for e-Education;
- WCED Media releases, circulars, minutes of meetings and speeches;
- DoE and WCED policy documents;
- WCED e-Learning roadmap;
- GDE and WCED ICT Strategies;
- WCED Game Changer documents; and
- Other WCED ICT-related documents.

3.6 Data analysis

Qualitative data analysis is mainly an "inductive process whereby specific data is arranged into categories and patterns through coding, categorising, and interpreting data" (McMillan & Schumcher, 2014:395). Babbie (2015:22) states that inductive reasoning shifts from the specific to the general, from specific observations to discovering patterns, whereas deductive reasoning shifts from the general to the specific, from expected patterns to observations that can test if a pattern occurs. This qualitative research study yielded pages of transcripts and notes

which had to be purposefully, systematically, and carefully studied, analysed, and interpreted to elicit empirical findings and suggest recommendations.

A Computer-Aided Qualitative Data Analysis Software (CAQDAS), ATLAS.ti 8, was used for the qualitative data organisation and analysis. Although the large amount of data yielded from data collection can become overwhelming to researchers, this can be circumvented by utilising CAQDAS as an analysis tool, by uploading transcripts and then analysing it through formal coding (Baxter and Jack, 2010:12; Rosala 2019:3).

Benefits of CAQDAS include, but are not limited to (Baxter & Jack, 2010:12; Rosala, 2019:4):

- Raw data is available for independent inspection,
- Comprehensive analysis,
- Improvement of reliability as it allows tracking and organising data sources, and
- Shareable project file.

Whereas drawbacks include but are not limited to

- It is time-consuming,
- It can be expensive (if trial versions are not used and licenses are bought),
- Multi-person analysis can be hampered,
- Learning and understanding the software is a requirement, and
- It can feel restrictive if used on its own.

Data analysis commences during the data collection process and continues throughout the study; it is thus "ongoing" (McMillan & Schumacher, 2014:395). The researcher applied thematic analysis to analyse the data collected from the questionnaire and semi-structured interviews. Thematic analysis allows for the gaining of significant insight into the participants' perspectives of the factors that promoted or hindered their use of ICTs, and the effects of the training on their TPACK development and classroom practices. The framework for analysis of the data was thus informed by the constructs of TPACK.

Braun and Clarke (2006:6) maintained that thematic analysis is a method used for "identifying, analysing, organizing, describing, and reporting patterns (themes)" that can be discovered within sets of data. Rosala (2019) defines thematic analysis as the systematic breakdown and organisation of information-rich data to find themes. Thematic analysis can highlight important aspects of the qualitative data and allow the researcher to uncover themes effortlessly (Rosala, 2019)

Braun and Clarke (2006:15) suggest a six-phase process of thematic analysis which begins with looking for "patterns of meaning" and ends with reporting the content and meaning of the patterns or themes. The six phases are set out in figure 3.5 below, followed by a descriptive delineation of how the phases were utilised in this study.

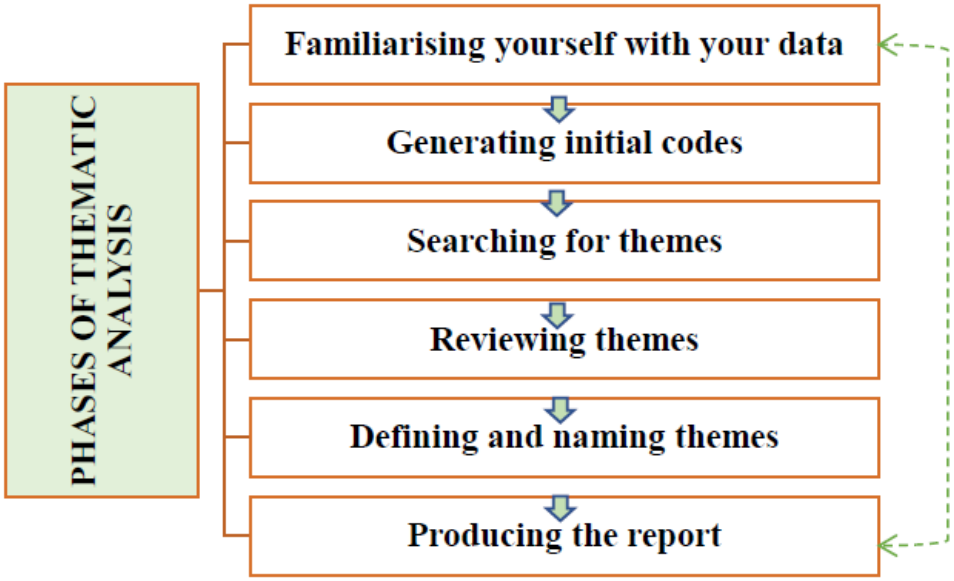


Figure 3.5: Phases of thematic analysis
Adapted from Braun and Clarke (2006:35)

Rosala (2019) proposes a variation of the six (6) different phases: gathering all data, reading all the data from start to finish, coding the text based on topics, creating new codes that encapsulate prospective themes, taking a brief hiatus and returning to the analysis later, and finally, assessing your themes for a good fit.

A description of the six-phase thematic analysis implemented in this study is as follows:

- The interview audio recordings were transcribed, and initial ideas were written down;
- Initial coding of data was applied to each interview transcription done on ATLAS.ti 8, which is Computer-Aided Qualitative Data Analysis Software (CAQDAS);
- As codes arose, potential themes emerged, which were then reviewed to gain an overview of the entire data;
- The continued analysis resulted in defining each theme which facilitated the naming of preliminary themes; and
- The final step was extracting examples to generate empirical findings to use in this thesis.

From the onset of the research, various used codes were used, e.g., T1 (teacher 1) and P1 (participant 1), to refer to teachers. This was done to ensure the anonymity of the participants. Data coding begins by *identifying data segments*, which is a text that is "comprehensible by itself", and then analysing these segments to *produce codes* (McMillan & Schumacher, 2014:398). Codes are words or phrases that act as a label or tag for a segment of text (Rosala, 2019:5). A code, which can be descriptive or interpretive (Rosala, 2019:6), is a description of words, quotations, or phrases to make sense of data. *In vivo* coding was also applied to segments of text, and the data was further analysed by identifying relevant quotations. The data obtained from the questionnaire (Appendix D) was organised according to the selection criterion and then analysed. The raw data obtained from the interviews (Appendix E) was organised and transcribed verbatim into written text and thematically categorised. Data organisation helped to separate data into a few workable units (McMillan & Schumacher, 2014).

Data was organised as follows: (a) Type of data collected: questionnaire, interviews, and documents analysis, (b) Determining which participants opted in to be part of the study, (c) Type of ICT use: users (P 1 – 3) and non or minimal users (P 4 – 6). Furthermore, data commenced by initially coding according to the research and sub-research questions, then according to individual questions on the interview schedule and then by assigning codes. Initial codes, such as ICT use, ICTs, training, feelings (positive, negative), and technical support, were generated from the data by focusing on the key concepts that evolved from the questionnaire answers and the transcripts. During the coding process, major and minor codes were identified, which evolved into categories and sub-categories. Minor or vague codes were deleted or re-coded, which was continually done to refine the coding process.

After determining codes, relevant quotations were identified, memos and notes were assigned to the data, and, for efficiency, code groups were formed. Finally, thematic analysis was implemented to distinguish between the similarities and differences in participant responses to gain a better insight into the participants' perspectives. This was done by using tags to identify and categorise the individual observations and quotations obtained from the data, to *discover related themes*. Themes are essentially patterns which establish relationships amongst data (McMillan & Schumacher, 2014:406).

Rosala (2019:2) states that themes will start to emerge when corresponding findings frequently occur across different participants and/or data sources. Therefore, the code groups were further analysed and themed, which formed the basis of the *research findings*. All the relevant data were then exported to Excel for easier access.

3.7 Trustworthiness of the research

Cohen *et al*. (2007:148) maintain that trustworthiness in qualitative research is akin to reliability in quantitative research. Trustworthiness in qualitative research should ensure cohesion between what researchers are recording as data versus what transpires at the research site (Cohen *et al*., 2007:149). Nowell *et al*. (2017:1) state that researchers should ensure that data is accepted as trustworthy if the data analysis was "conducted in a precise, consistent, and exhaustive manner". Cohen *et al*. (2007:149) recommend the following as criteria for trustworthiness:

- Fidelity to real life;
- Context- and situation-specificity;
- Authenticity;
- Comprehensiveness;
- Detail;
- Honesty;
- Depth of response; and
- Meaningfulness to the respondents.

Methodological triangulation was achieved by employing cross-validating of the multiple data sources. This study used a questionnaire, semi-structured interviews and data analysis. Credibility, transferability, dependability, and confirmability form the qualifying criteria for qualitative research (Elo *et al*., 2014; Korstjens & Moser, 2018). Therefore, the credibility of a research study can be ensured by triangulation and member checks (Korstjens & Moser, 2018).

The strategy of member check involves the feedback of data, analytical categories, interpretations, and conclusions to members (participants) (Korstjens & Moser, 2018). Trustworthiness was ensured by transcribing transcripts verbatim. Furthermore, a member and participant checking strategy was employed by continually conducting accuracy checks during data collection.

3.8 Researcher's position

The researcher's role in this study is one of a complete insider (McMillan & Schumacher, 2014) because of having an established role at the selected site. The researcher is permanently employed as a post-level 1 teacher; therefore, subjectivity and bias may arise due to the researcher's positionality at the selected site. Subjectivity and bias, which may arise within this qualitative study, must be countered. Cohen *et al*. (2007:150) stipulate, inter alia, the following sources of bias that can arise within research study interviews:

- Attributes of both the interviewer and respondents;
- The substantive subject matter of the interview questions;
- The attitudes, beliefs, and expectations of the interviewer;
- The proclivity for the interviewer to seek answers to support their own preconceived perceptions;
- Interviewers misinterpreting what respondents are saying;
- Respondents misunderstanding the interview questions.

Furthermore, the researcher is part of the school's ICT committee, which may be considered a conflict of interest. This may inhibit engagement with the participants as they might perceive that their responses to questions may reveal their lack of ICT integration and may therefore feel pressured to give "correct" answers in order to please or impress. To circumvent this, it was carefully explained that this research is a personal study and not on behalf of the school or WCED. Furthermore, it was emphasised that the focus is on the need to hear the participants' viewpoints, not affirming what the researcher thinks or knows. Finally, participants were duly informed that participating in this study is entirely voluntary and that they may decline to partake or withdraw from the study at any given time.

Countering subjectivity and bias can further be ensured by including participants in verification and reliability checks. Participants were allowed to verify the transcripts of interviews and any other personal communication between the researcher and participants. Interview transcripts were also subjected to a member check by fellow researchers, the supervisor and the co-supervisor of this study, and all the transcribed interviews were read and reread. This was done to verify that no data was omitted or captured erroneously. All participants were allowed to rectify errors that may have arisen and determine if aspects of the transcripts had to be deleted or replaced.

3.9 Ethical considerations

Before commencing the research, ethical clearance was obtained (Appendix A) from Cape Peninsula University of Technology (CPUT), and subsequently, the WCED granted permission to conduct research (Appendix B). Verbal permission was also obtained from the principal, acting on behalf of the school management team (SMT) and the School Governing Body (SGB) of the selected school. As the researcher is permanently employed at the selected site, the principal acted as a quasi-gatekeeper by providing access to the participants. However, all participants were contacted and engaged in the researcher's private capacity, in person and via WhatsApp and email. It was explicitly stated that this research study is a private study conducted by a master's student at CPUT, not on behalf of the school, WCED or DBE.

The well-being of the research participants should be a researcher's primary priority whenever research is conducted (Mack *et al*., 2005). Due to the COVID-19 pandemic and to minimise the physical contact between the researcher and the other parties involved, the participants were informed electronically, via email and WhatsApp, about the research. All the participants were afforded the option of an online or an in-person interview. All participants opted for face-to-face communication, and it was ensured that all COVID-19 safety protocols (sanitizing hands and stationery, sitting 1m apart, wearing masks) were observed.

Each participant was given a choice to participate in the study (Appendix C). Participants were assured that they could withdraw from the study at any time without prejudice. Throughout the data collected, teachers' participation was verbally confirmed. Participants were guided through the consent form, and signed consent was obtained. All participants were informed about the aims, the kind of data to be collected and how the data will be used, the right to withdraw at any stage, as well as implications of the research project. They were also given time to ask questions and raise issues they might have.

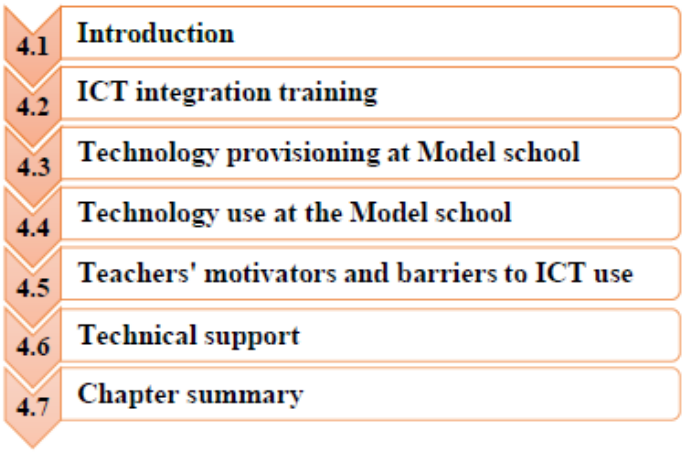
Confidentiality and anonymity are of the utmost importance in research. All research data was therefore anonymised through a coding system that will be used for the dissemination and publication of the dissertation. Participants were also discouraged from using or stating any information that may lead to exposure, e.g., mention of names, schools, or people. Data in soft copy was passworded, storage devices were stored under lock and key, and only the researcher and supervisors had access to data. Hardcopies were kept in an area only known to the researcher, and any duplication of data was duly disposed of by shredding and incineration.

3.10 Chapter Summary

This chapter delineated the methodology and design of this research study. Saunders *et al*.'s (2009) Research Onion was used as a methodological mind map. Interpretivism as research philosophy is the "worldview" the researcher chose to adopt. Furthermore, an interpretivist paradigm was chosen and applied as there is no singular reality but rather the reality crafted by the participants of this research study. The motivation was provided for the case study design, and the research approach which was employed is qualitative. Moreover, this research study chose a multi-method qualitative approach as three (3) qualitative data collection techniques (questionnaire, semi-structured interviews, and document analysis) were employed.

Furthermore, a description of the site, a Model high school situated in the WCD of WCP, was provided, as well as the reasoning behind the purposely selected six (6) participants from a population of forty (40) teachers. A breakdown of the data collection process and six-phase thematic analysis was provided, which highlighted how codes were generated and themes discovered. These themes form the basis of the empirical findings, which will be discussed in Chapter 4. The steps taken to ensure trustworthiness were outlined by stressing the importance of methodical triangulation and member checks. The researcher's position as a complete insider was stated, and the steps taken to counter subjectivity and bias were verification and reliability checks. In conclusion, ethical considerations were discussed by indicating how ethical clearance was obtained and the participants' well-being, confidentiality, and anonymity were ensured.

CHAPTER 4: EMPIRICAL FINDINGS AND DISCUSSION



Organisation of Chapter 4

4.1. Introduction

Chapter 1 introduced the main research question of this study, which is:

- What are the contributing factors to teachers' TPACK development in the WCED's Model school initiative?

And the sub-research questions are:

- How did the aspects of technology provisioning, technical support and ICT integration training contribute to the use of technology within the Model school?
- What specific aspects of professional development supported teachers' TPACK development in their practice of using the technology for teaching and learning at the Model school?

In Chapter 3, the research methodology was delineated, the data collection methods (document analysis, a questionnaire and semi-structured interviews) and how the data were thematically analysed. This chapter objectively presents and discusses the findings of the study.

The following presents a summary of the themes, subthemes and categories uncovered through thematic data analysis:

- **ICT integration training** highlight the ICT integration training teachers received from ICT champions and the WCED. Subthemes uncovered were, inter alia, the training received, professional development, and TPACK.
- **Technology provisioning at the Model school** delineates the hardware provided to the teachers at the Model school. The subthemes uncovered were, inter alia, the impact of MSI and pre-and post-MSI roll-out.

- **Technology use at the Model school** outlines the various hardware, software, social media, etc. used at the Model school. The subthemes uncovered were, inter alia, ICT use, ICT hardware received or technology provisioning, and reasons for device preference or aversion.
- **Teachers' motivators and barriers to ICT use** outline the factors motivating and hindering ICT use at the Model school. The subthemes uncovered were, inter alia, factors that motivate ICT use and barriers to ICT use.
- **Technical support** highlights the technical support teachers received from ICT champions and the WCED. The subthemes uncovered were technical support and professional development.

4.2. ICT integration training

Data collected and analysed from both the questionnaire and the interviews provided insights into the ICT integration training the participants received. Regarding ICT integration training, the study found that all participants acknowledged having undergone training but had forgotten the dates when it occurred. Figure 4.1 summarises the training participants received from either WCED, its affiliates or the ICT champs programme:

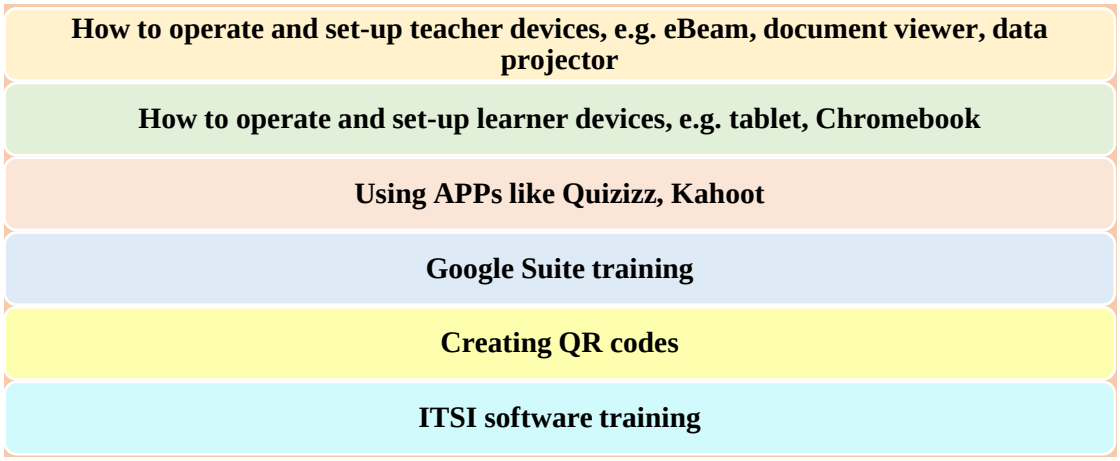


Figure 4.1: Training participants received

The training focused on developing teachers professionally and equipping them with the skills needed to navigate learning and teaching in a changing and, probably for most, challenging environment. Anecdotally the researcher, as a complete insider in this study, can recall that some teachers were resistant to training, especially as it would take up their valuable free time. However, in the semi-structured interviews it became apparent that the participants found the

training valuable. For example, participant 3 noted how beneficial the training was to her and how it motivated her use of ICTs:

> *"And before anything the training also, I wasn't so eager to learn about new apps, new stuff that I can use for my learners. So, after the training, that made me very excited, and I was … I wanted to learn more, I wanted to know more."*

The participants stated that none of the training was subject-specific but more of a general nature. Participant 1 stated the following:

> *"It was mostly a general idea of how to use the device in the classroom but not subject-specific."*

The aim of these training sessions was thus to attempt to bridge the ICT proficiency gap which existed among the staff members. However, even though the training was more general in nature, it still proved fruitful. Participant 3 noted how she benefited from the training:

> *"I could go back to the other subjects and see what type of questions they used, what type of quizzes they created, and then I could work from there and create quizzes related to my subject."*

The participants have, however, stated that ongoing subject-specific training, organised by various subject advisors, is provided at the district level. Participants 1 and 4 have stated that they are currently (2021) partaking in ICT training organised by the WCED.

One of the kinds of knowledge of TPACK is technological pedagogical knowledge (TPK). Mishra and Koehler (2008:9) contend that TPK refers to the knowledge a teacher possesses to know how, and a myriad of ICTs influences teaching and learning. TPK refers to a teacher's ability to know how using different ICTs can influence teaching and learning. Figure 4.2 is a representation of the responses participants had to the following question on the questionnaire: *Do you believe you have the necessary pedagogical skills to integrate technology into your lessons?*

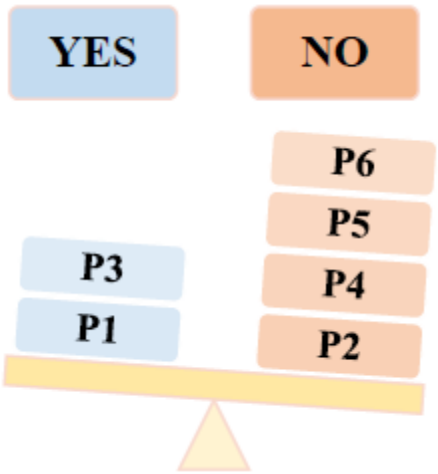


Figure 4.2: Participants' self-efficacy: pedagogical skills

Participants 1 and 3 stated that they have the pedagogical skills needed to integrate technology into their lessons. Participant 1 felt that anyone could apply pedagogical skills to improve their lessons, and participant 3 stated that even though they feel they have the necessary skills, there always exists a need to learn more. Four (4) participants (P 2, 4, 5 and 6) stated that they do not believe they have the necessary pedagogical skills to integrate technology into their lessons, with participants 4 and 5 stating that they require more training. Even though the participants received training, they still believe that more ongoing training should be provided, especially if new ICT hardware and software are introduced into schools. Participant 2 shared the following:

> *"But I am quite on par with solving things myself at the moment, most of it, but as soon as new technology comes in, you will get a little bit more…need more support in it."*

Moreover, participant 2 stated that training sessions should be followed by practice sessions to conceptualise what was taught. The need for training can also depend on the self-efficacy beliefs of participants. Only two participants stated that they have the technical skills to use available ICT hardware and the necessary pedagogical skills to integrate technology into their lessons.

Figure 4.3 represents a diagrammatic representation of responses to the following question on the questionnaire: *Do you believe you have the necessary technical skills to use the available ICT hardware?*

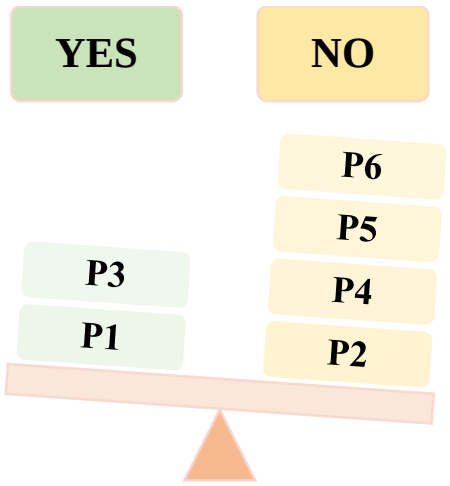


Figure 4.3: Participants' self-efficacy: technical skills

The ICT champs were crucial in training educators at this Model school. Participant 4 felt that the training of the ICT champs was beneficial even to a minimal use of ICTs like themselves and that the ICT champs elicited confidence in her own abilities:

> *"So, because of the fact that we had our champions, we were confident enough to call them to ask for help. Because if I hadn't had anybody to have, I wouldn't, I wouldn't use it; I would just go back to my basic blackboard."*

> *"I feel more confident, even though I don't use it; I only just use the data projector. But at least I know that we have staff ... on our school grounds, that can actually assist me if there's anything that I'm stuck on."*

All the participants agreed that these ICT champs played a pivotal role at this Model school as they provided training after school and over weekends. Participant 1 preferred the Saturday training session over the afternoon classes for the following reason:

> *"I can remember the committee members trying a lot of those. But it's after school, that last hour, between two and three. You're not really open to learning new stuff. I know we had Saturday classes as well. I think we learned a lot more there than directly after school. We're getting up there in age, so yeah, we're getting tired too much. So yeah, but I, the Saturday classes was more exciting, more memorable for me, than the afternoon. I know they tried a lot."*

The training and guidance provided by the ICT champs resulted in many other teachers developing and honing their ICT skills, thus enabling them to assist others. Participant 6 noted:

> *"With my colleagues, or I think the relationship that we had, or we have with, with our colleagues made it easy; the anxiety went away. Because you knew that you can knock at any door, and with a lot of staff members here, who are gurus in technology, you*

know that you … it's only one block away, not even a block, a classroom next door, where you can just knock in and get some assistance. So, it made me excited."

The questionnaire posed the following question: *Have you attended any additional ICT training (apart from the Model School Training) since 2017?* This question was posed to determine which participants received additional training, which may have increased the TK and TPK. Figure 4.4 indicates the participants who attended additional training since 2017 (MSI implementation):

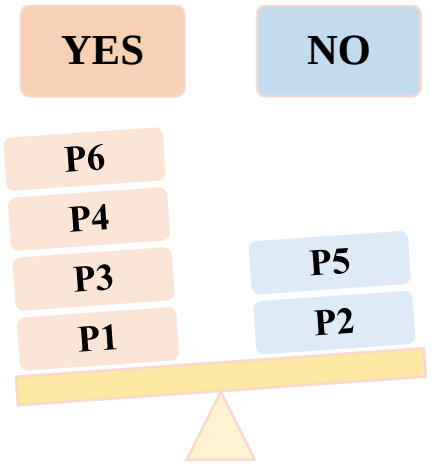


Figure 4.4: Additional training received by participants

Participant 4 initially indicated on the questionnaire that she did not receive additional training. However, during the interview, she indicated that she was at the time receiving WhatsApp integration training. She stated the following regarding the training:

And I've recently joined this WhatsApp course. So, that basically and the fact that everything is turning to technology, we are using it every single day, every single hour, every single second of each day, every one of us. So, that is basically something that the learners can enjoy."

Participant 1 stated that she is also receiving the same training; she explained the following regarding the training:

"Okay. It's the certificate in online English language teaching. So, the specific focus is getting us to use WhatsApp and video conferencing as … for our lessons. To use those platforms whenever we have a lockdown like we had last year, so just in case we don't get face-to-face interaction anymore, we can use WhatsApp and video conferencing as a backup. But it's specifically WhatsApp and video conferencing in language."

The Model school training was focused on teacher professional development by developing and honing invaluable ICT skills. The e-Learning Game Changer (WCED, 2016) specified that teacher training and development in ICT would be fundamental in school and, therefore, in Model schools. The purpose of the ICT integration training is equipping teachers with the necessary ICT (TPACK) integration skills, which include teacher readiness and professional development (WCED, 2016). Furthermore, Van Wyk (2011) postulated that ongoing training is essential in ensuring the optimal use of technology facilities as well as securing the future success of technology in education.

From the data gathered, it can be postulated that the WCED, its affiliated service providers and the school's ICT champions provided training. These training sessions provided teachers with technical skills to set up and operate teacher and learner devices. The training also focussed on the utilisation of various applications which can be used in teaching and learning. WCD district officials also played a pivotal role by providing training to ICT champs, who then, in turn, trained the Model school teachers. However, whilst the training proved useful, most participants still believed that they lack the technical and pedagogical skills needed to use ICTs in lessons.

4.3 Technology provisioning at the Model School

The data collected through the questionnaire, document analysis and interviews provided insight into the ICT hardware provided to Model schools and specifically to teachers and learners. The ICTs distribution of the participants of this Model school is outlined in table 4.1. A tick (✓) indicates devices received, and a cross (x) indicates when a teacher did not receive a device.

Table 4.1: ICT hardware received (Smart classroom package)

		LAPTOP	DOCUMENT VIEWER	eBEAM	DATA PROJECTOR	WHITEBOARD
PARTICIPANTS	P1	✓	✓	✓	✓	✓
	P2	✓	✓	✓	✓	✓
	P3	✓	✓	✓	✓	✓
	P4	✓	✓	✓	✓	✓
	P5	✓	x	x	x	✓
	P6	✓	✓	✓	✓	✓

The sixteen (16) Model schools are distinguishable from Universal and Enhanced schools due to their teacher and learner devices allocation. All Model schools were provided with computers, data projectors, whiteboards, document viewers, and eBeams, as proposed by the Western Cape Government (2017:17). This provisioning was supported by document analysis (Western Cape Government, 2019) as well as by the participants. The devices are allocated to teachers as part of a Smart classroom package, which can be installed in a classroom or managed by the teacher. It can be inferred that devices can be reassigned when teachers permanently depart the school because they were assigned to specific teachers for a specific classroom. However, due to a device shortage and the growing teaching population, new teachers have not been given devices. It is unknown whether the WCED will give new teachers devices when they start working at this school. It is also not immediately evident who is responsible for replacing lost or damaged property. All but one participant (P5) received all the ICT hardware. During the semi-structured interview, participant 5 was asked why she was not provided with all the ICT hardware; the following response was received:

> *"I did ask, but unfortunately, I didn't get one."* She proceeded with: *"They just promised me that they are going to give it to me, but up to today … even though they gave it, they took it back, and you have to sign if you need it."*

Participants reported and confirmed that the school also received tablets for learners in Grades 8 - 9 and Chromebooks for learners in Grades 10 – 12. Therefore, in theory, the device allocation ought to encourage ICT use at this institution. However, ICT availability does not always equate to utilisation. Therefore, technology use after the MSI implementation will be covered in 4.4.2, and the most used devices will be covered in 4.4.3.

4.4 Technology Use at the Model School

Data collected from the questionnaire and the interviews provided insight into technology use at the Model school. Apart from the Smart classroom package, data collected from the questionnaire indicate that smartphones, document viewers, Chromebooks, tablets, and interactive boards are also used within this Model school. In the questionnaire, the participants were asked to describe how they use any ICT hardware for teaching. Table 4.2 presents their responses:

Table 4.2: ICT hardware usage in teaching

	P 1	P2	P3	P4	P5	P6
Description of how you use any ICT hardware for teaching:	Most learners prefer visual stimuli I try to include pictures, diagrams, and any visual aids in my lessons.	Giving notes for learners; Play curriculum-based videos; PhET simulations; Use an interactive whiteboard	I usually use it for revision by creating quizzes on Kahoot.	Daily by giving notes	A laptop helps me to do my paperwork and also keep my data (notes and planning)	Project lessons in class

It can be surmised that teachers at this Model school are currently using ICTs for lesson planning, administration, lesson presentation, setting up assessment tasks, informal assessment, lesson research, file sharing, and communication. This will be elaborated on in section 4.4.2, whereas 4.4.1 will deal with technology use before the Model school implementation.

4.4.1 Technology use before Model school initiative implementation

To determine the technology or ICT use before the MSI implementation, the following question was posed to all participants: *Tell me which technology you used in your teaching pre-2017/the Model school implementation.* From the data collected, laptops were predominantly used for personal use, lesson planning (MS Word) and recording of marks (Excel). ICT use before the Model school implementation was thus minimal. Participant 1 stated the following regarding her ICT use:

> *"…we mostly used our laptops for research purposes, for communication, emails from the subject advisors from WCED. And most of all, for the recording of our marks and assessments. So that's what I used it for."*

Participant 2 stated that a data projector was used, and many other respondents noted that they did not use any ICTs. Participant 2 stated the following:

> *"I was only showing supportive material, like videos that supports my lesson."*

A possible reason for participant 2's early ICT integration may be a result of their classroom having a smartboard installed before the Model school initiative. Participants 3 and 4 stated that they used traditional teaching methods before 2017, relying mainly on textbooks, notes and the chalkboard.

Their responses are as follows:

Participant 3:

> *"I made copies for learners, and then they used the textbooks."*

Participant 4:

> *"Absolutely nothing. We used our blackboard and textbooks, and that was it. So, no technology was used."*

Participants stated that the chalk or blackboard and textbooks were typically used in teaching and learning and for lesson preparation purposes. Teachers may have also used their laptops for lesson planning and administrative tasks. From the data analysed, it can thus be determined that the actual device usage for teaching was thus minimal. There were also no learner devices at the school before the MSI implementation. Anecdotally it should also be noted that the school had several laptops and data projectors that were donated to different subjects. It can thus be argued that some teachers were using technology before the MSI implementation. The minimal ICT integration corresponds with the minimal ICTs available before the Model school implementation.

4.4.2 Technology use since Model school initiative implementation

Both the questionnaire and the semi-structured interview had questions on the technology used by teachers at the Model school. Data analysis indicates that there has been an increase in ICT use since the Model school initiative's inception. Question 10 on the questionnaire posed the following questions: *Please indicate if you use any of the following devices in your teaching.* Figure 4.5 displays the data gathered:

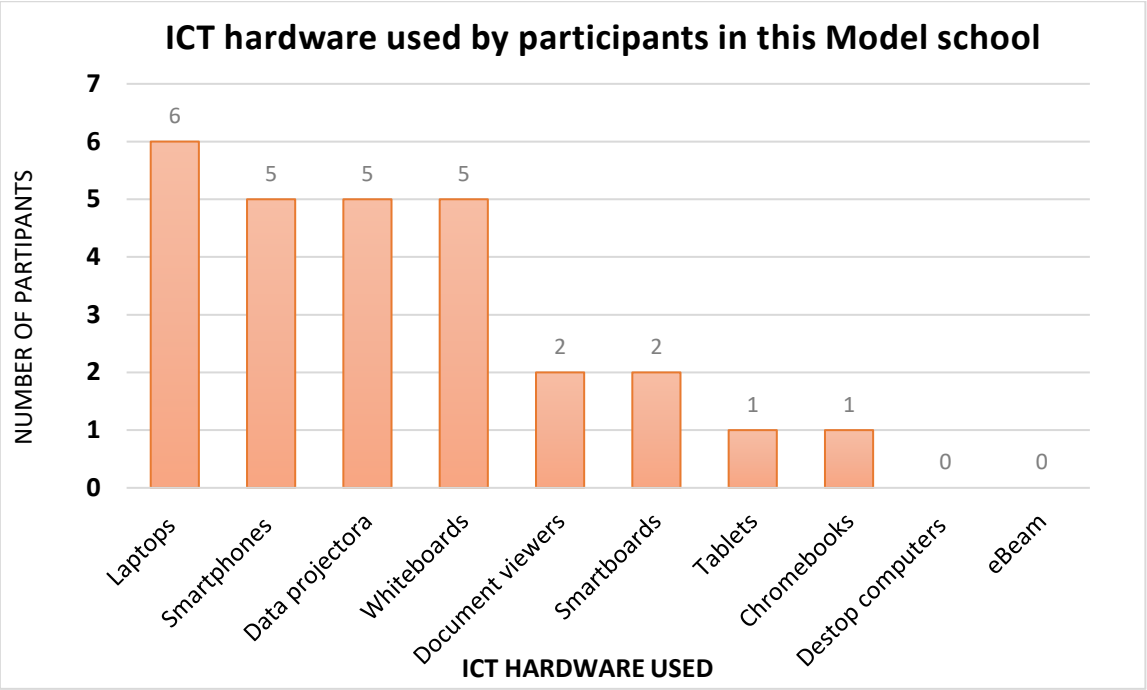


Figure 4.5 ICT hardware used

Results in Figure 4.5 show that all the participants use laptops to aid their teaching. In addition, the five participants who received data projectors used them in conjunction with the laptop and whiteboard. This finding is in line with Padayachee (2017), who found that laptops, smartphones, and data projects are more commonly used in teaching.

Participant 5, who was not issued a data projector, must be creative in showing learners YouTube videos by using either a laptop or a smartphone:

> *"I just download the video to my laptop, and the problem is my class doesn't have WI-FI. So, I download it or else I just give it on my phone, then I just play it by group by group. Because the phone is too little that they can't see since I don't have the data projector. Then, if it's a laptop, even then, I just show them by groups, one at a time."*

Five (5) of the six (6) participants use the laptop in conjunction with data projectors and whiteboards or smartboards to project lesson notes. Participant 1 stated she uses the laptop for paperwork (administrative tasks), and she uses ICTs as a visual aid as many learners in her class are visual learners, thus reacting better to visual stimuli.

Participant 1:

> *"Most learners prefer visual stimuli; thus, I try to include pictures, diagrams, any visual aids in my lessons."*

Participants 2 and 3 explained how they used their ICT hardware concerning digital resources like PHET simulations and Kahoot, which will be discussed in 4.4.4. Moreover, participants have noted which devices they use most in their teaching, outlined in 4.4.3. Smartphones are also used for communication purposes in conjunction with social media; this will be discussed in 4.4.4. The adoption and use of devices in a technology-rich environment are in line with Mlambo *et al*. (2020), who postulate that teachers in Gauteng province who benefited from the GDE's ICT in Education Strategy have a higher ICT adoption rate compared to other provinces. Chigona, Chigona, Kayongo and Kausa (2010:21) argue the need for 'well-appropriated technologies' as this can enhance curriculum delivery. Scherer *et al*. (2018) posit that selecting appropriate technology for lessons can be daunting for novice ICT users. It should be noted that all the participants noted that they do not use the eBeam. Participant 1 stated that the other devices were easy to use, except for the eBeam. Concerning the learner devices, only one participant noted that they use both the tablet and Chromebook in their teaching and learners' learning. The other participants' apparent aversion to using the learning devices will be discussed in 4.5.2, which is a barrier to ICT use.

4.4.4 Most used devices in the Model School

During the semi-structured interviews, participants were posed with the following question: *Of the technology devices/tools (state the different ones that you know of) that you received, which do you use the most for teaching/learning? Why these ones, and why not the others?* The data gathered in Figure 4.5 shows that laptops and data projectors are the most used teacher devices. Participants stated the following reasons to support the notion that certain devices are used more than others in their teaching:

Participant 2:

> *"I can confidently use those ones. I'm more confident in using those ones, that is why."*

Participant 4:

> *"I don't know the other technologies as well; I'm still a bit behind when it comes to that. And then I feel at ease with the data projector."*

Only participant 3 indicated in the questionnaire (Figure 4.6) that she actively uses both Chromebooks and tablets with her learners. However, she found the Chromebook more user-friendly and has easier control over learner activity. The extract from Participant 3, who teaches

in both the GET and FET band, provides clarity on her preference and use of Chromebooks over tablets:

> *"The tablet, that was… the learners had more access to Facebook and stuff on the tablet. And I could on the tablet, I felt like I, no sorry, on the Chromebook, I felt like I had more …I could control the learners better because I could see if the learner tried to go out of the grid that I use. And if they were on Facebook, or they went on WhatsApp because the apps isn't downloaded on the Chromebooks, but the apps was downloaded on the tablets. So that's why I felt, I felt more comfortable using the Chromebooks."*

Participant 2, who has used the learner devices in the past, stated the following:

> *"I first thought it was, but since we've worked with them, I came across a lot of them … they are not that good quality. Because we had these devices, they broke down quite easily, they … the charging problems and things like that. So, there's a lot of, how can I say, failures in there."*

Given the above, it will seem as if participants use devices they are more at ease and comfortable with. Even though not all participants utilise the learner devices, it should be noted that they have preferences regarding learner devices. The Chromebook appears to be the most preferred learner device employed by teachers. Only Grades 10 – 12 were allocated Chromebooks, with Grades 8 and 9 being allocated tablets. Another probable reason why the Chromebook appears to be preferred over tablets can be the quality of the devices. Participants noted that the Chromebook was a better-quality device as the tablet was prone to breakages.

4.4.5 Digital resources, applications, social media, and cloud services used in this Model School

The questionnaire and the semi-structured interviews had questions on digital resources, social media, and APP use at the Model school. All the participants have stated that they use some form of digital resources in their teaching and learning. Figure 4.6 depicts the digital resources used by participants, with the most popular or used digital resources being PowerPoint presentations, WhatsApp, and YouTube.

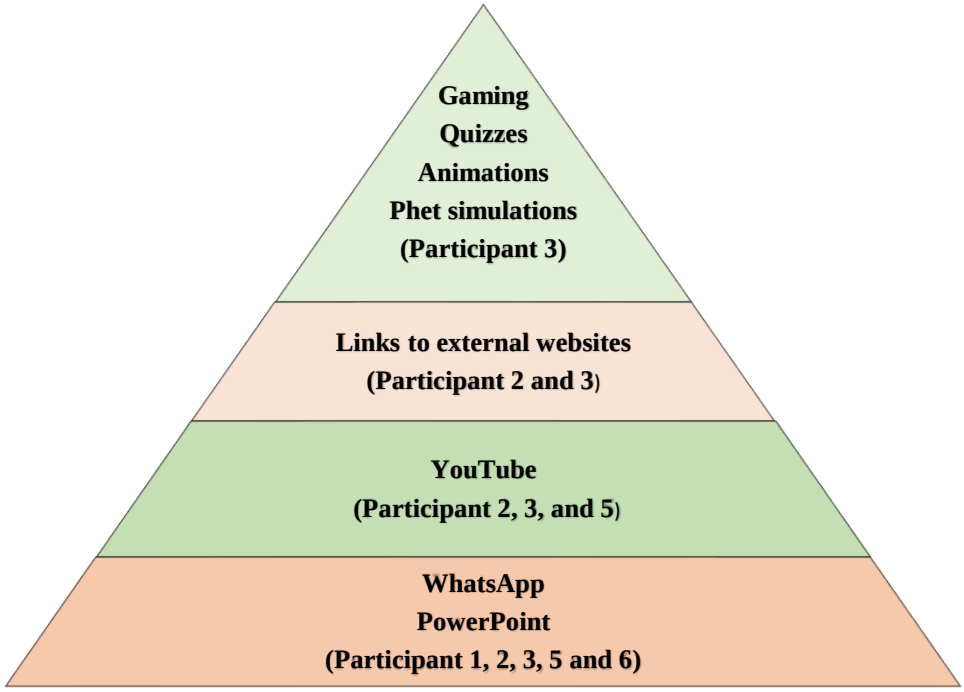


Figure 4.6: Digital resources, applications and social media used

PowerPoint presentations are a visual slide-sharing aid application that allows the sharing of notes, animations, and videos. WhatsApp is a social media app which allows teachers to communicate and share notes and videos with learners. YouTube allows for video sharing and can be used by teachers to share original videos or other creators' educational videos.

Participant 3 has the following view on using YouTube videos in teaching:

> *"Yes, I feel very comfortable integrating those stuff into my lessons. Like I've said, and it's also there's a lot of videos on YouTube that I usually make use of …"*

According to participant 5, some learners also used the learner devices to access YouTube videos applicable to their subject matter:

> *"They can use it to find some more information, and projects, they could do that and their assignments. So, they download even the videos when they don't understand the mechanism for maths or physical sciences, so, they download the video on YouTube and see how it works, and they use it."*

The applications least used by participants in their teaching are Google forms, Kahoot and Quizizz. One participant was using these digital resources for learning consolidation and revision purposes. These resources made learning fun and interesting and proved invaluable to the teachers and learners, as noted by participant 3:

"I use Kahoot just to see where my learners are and if they understand the work. So, we're basically using it for review time, revision. And the nice thing about Kahoot specifically is that we create little competitions in the class."

Participants 1 and 3 stated that WhatsApp became increasingly popular during the COVID-19 pandemic when both learners and teachers worked from home. Participant 1 said the following in their questionnaire response:

"WhatsApp - connect with learners, due dates for assignments as well as an opportunity to ask questions. YouTube - introduction to lessons."

Participant 3 said the following in their semi-structured interview:

"... especially with this whole COVID pandemic, like last year, when we couldn't get to our learners, we had to make use of social media. And that was also a time when I saw how, how we could actually use this, the social media for the right reasons."

Participants 1 and 5 have stated that they have been using WhatsApp as an extension of the teaching and learning aids. Participant 1 used it by allowing learners to record themselves doing oral presentations and uploading them on the WhatsApp platform as a video, thus taking advantage of the platform's video-sharing capabilities. Participant 1 stated the following regarding their WhatsApp use:

"I did use video presentations for oral, right, ... for the reason being; it saves time for me, I don't have to use two to three weeks in class. They uploaded, but they did it via WhatsApp. Yeah, some of them did a PowerPoint presentation, and they still came and presented in class in front."

Participant 5 noted the following in their questionnaire:

"I use WhatsApp as learning and teaching at home."

Moreover, participants 1, 5 and 6 used WhatsApp to connect and communicate with learners and to have discussions with learners about the work.

Participant 1:

"WhatsApp mainly to connect with learners, reminding them of tests, due dates for assignments as well as an opportunity to ask questions if unclear about anything."

Participant 5:

> *"More especially when we have maybe a class, then I just announce, or else they have questions, then they ask questions about it, and then we discuss it in WhatsApp."*

Furthermore, participant 6 noted the following in their questionnaire response regarding their WhatsApp use:

> *"I create a class chat group and record lessons then post them on the group. Learners give their responses and even ask questions."*

The questionnaire further requested participants to select the cloud services they use and state what they use them for. Figure 4.7 presents the cloud services used by participants, listed from most to least common:

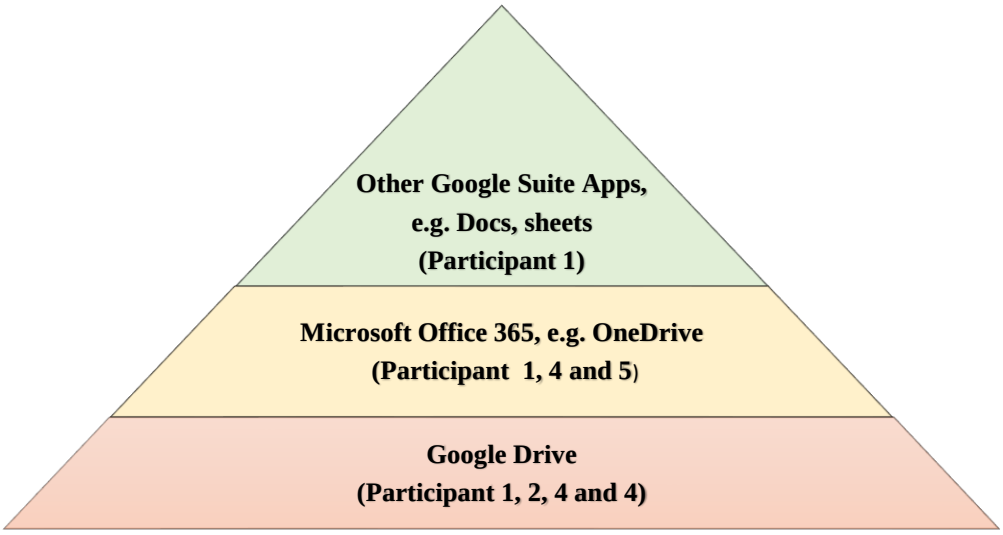


Figure 4.7: Cloud services used.

Participant 3 stated the following during the semi-structured interview regarding their use of Google Docs:

> *"I usually ask my language learners to type their final essays on google docs. I also create my own templates for them to work on and make use of my format."*

The use of social media platforms such as WhatsApp and Facebook as communication tools has become increasingly crucial in schools. At this Model school, teachers use WhatsApp as the main communication tool to remain in contact with learners, with teachers having WhatsApp groups for their registered classes and/or subject groups. In addition, Facebook is

used as a general communication tool with learners, parents and guardians as the school has a Facebook page which posts regular updates.

Only Participant 2 has indicated that she uses Google Drive as a data basis for learners to access. At this Model school, Google Drive is the most used Google Suite cloud services APP, as it is utilised by four of the six participants. It can thus be surmised that the other participants are using Google Drive either for personal storage or as part of a subject team. Three of the six participants indicated that they use Microsoft Office 365. Google Suite Docs are the least used cloud service. A possible reason for Google Docs not being fully utilised is that participants might have found the training insufficient, as reported in 4.2. Another possibility is that using Microsoft Word is easier and that the participants might find Google Docs challenging to learn and thus deem it redundant.

4.5. Teachers' motivators and barriers to ICT use

During the interviews, the participants were asked the following questions*: Explain what motivates you to use technology in your teaching; Explain what hinders (is a barrier to) your use of technology in your teaching.*

4.5.1 Motivators

Motivators named by participants are the excitement and eagerness to learn the use of ICTs in teaching elicit in learners; having a vast number of resources available; the ability to engage and work with learners at any time (especially during the COVID-19 pandemic); ICTs making teaching and learning easier; and the training and support offered by the ICT champs and committee.

ICT use has intrinsically motivating properties. For example, participant 3 stated that using ICTs in her teaching gives "satisfaction". Moreover, it has a positive impact on learners and their learning:

> *"I think just the fact that the learners was eager to learn and I could show them stuff that I explained to them; I could show them videos, I could let them engaged with me through the devices. So, I think that's what motivates me."*

Furthermore, the impact ICT integration has had on learners can also serve as a powerful motivator, as postulated by participant 3:

"And like I also said, I can see that my learners, they are understanding the content much better. So, I would say that I actually failed my learners before I was using technology."

Participant 1 had the following sentiments:

"I have to keep my lessons exciting. I don't want to be the teacher [that they say] I don't want to go to. Like what 'chalk and write.' But I want my lessons to be exciting. I want them to, … most of our learners are visual learners. So, I think they will remember more if they see something rather than just writing or me just talking about it."

Participant 5 stated the following regarding how beneficial ICTs are during the COVID-19 pandemic:

"It has helped them because now technology is used in school, more teachers use it. And due to the time of COVID, it was more effective to us... Especially if they get a lot of work to go home with to do the work and then now, they use the devices; also they are connected to the internet. So, do they work on their own…"

The identified motivators played a pivotal role in the use and adoption of ICTs in this Model school. Schunk and Meece (2012:8) postulate that while early behavioural theories described motivation as responses elicited by stimuli or driven by habit, the mere perception of progress and goal attainment can also sustain motivation and self-efficacy. In addition, Bladergroen *et al.* (2012:113) found that teachers believed the benefits of ICT use leads to an increase in productivity and offer relief from administrative duties.

4.5.2 Barriers

Participants highlighted various barriers to ICT use during the semi-structured interviews. These included the lack of knowledge, lack of practice, load-shedding, ill-discipline of learners, scarcity of resources in their language of teaching and learning, vandalism, lack of subject-specific training, and lack of sufficient learner devices and lack of control functionality on tablets. Learner disciplinary issues were a fact raised by most participants. Learners using the devices for non-educational purposes and ill-discipline hindered the use of both the tablet and Chromebook so severely that most teachers have stopped using these devices.

Participant 1 shared the following impact learner misuse of devices had on teaching and learning:

"…We had high hopes that it would have a positive impact, keeping them in touch with development, digital development. But I think now the time has passed, well, I perceive it had a more negative impact on them… They used it more for YouTube, to google YouTube and download songs and listening and all of these. So, it's not for the educational purpose as it was supposed to be… They are using it; they are wasting time and not using it for research purposes…"

Similarly, participant 2 stated that:

"The type of learner that we are facing every day. They are not really motivated to use it the way that I envision them to use it. So, I think it's, that is what the hinders me mostly, and they are not dedicated in discipline."

"The learners were very excited about but unfortunately, they … for them, it was a tool that they use totally differently from schoolwork, academically, curriculum-wise. So, they didn't use it optimally, but … some of them did. So yeah, all in all, I think they didn't use it quite as the way they're supposed to do to use it."

Participant 3's description of how learners could access social media on tablets (discussed in the most used devices, Section 4.4.3) reverberates this sentiment. Another common barrier to ICT uses in this Model school is load-shedding. Load shedding is power outages, which can cause disruptions to electricity flow for up to 2½ hours at a time and can hamper ICT-focussed lessons immensely.

This is evidenced by the extract from Participant 1, who said:

"Even if I just use it as an introduction, maybe, as I said, just a photo of something. I try not to rely too much on the digital content or the devices, just in case we've got Eskom (load-shedding)."

To emphasise the above observation, Participant 5 had this to say:

"I was so happy; at the same time, I was so frustrated. Why I'm so frustrated is that the learners they are using the devices not in a good purpose. In class, they are so disruptive, but only a few. So actually, I was happy because now we reach the curriculum and also the learners then get what they want to."

Participant 4 statement summarises the effects of both load-shedding and vandalism:

"Well, firstly, load shedding, yes. And then vandalism, because if they vandalise the Wi-Fi and systems and then that is a very … it's quite a problem."

Finding resources in teachers' language of choice can also hinder ICT use. Most resources are available only in English which can severely hamper Afrikaans or isiXhosa language teachers. As participant 6 stated:

> *"The only thing at the moment is googling stuff if I need some information; I struggled a bit with the language, isiXhosa. I don't get everything there, like, for instance, we're doing cartoons, we're doing advertisements, it's few advertisements that you get there. You have to create your own … cartoons. You will find English cartoons there, but you look at the picture and try and get some correct wording. It's only that."*

Common barriers to ICT use are usually a lack of resources or Internet access and lack of funding for projects with power failures, poor network coverage, and the negative impact ICTs have on learner discipline coming in at a close second (Padayachee, 2017). The first three are barriers teachers of this Model school do not have, but they do however have the last three barriers in common. Bladergroen *et al*. (2012) posit that learners from a socially disadvantaged background can often have low technical skills, combined with not having access to technology at home to practice acquired skills. Furthermore, Chigona *et al*. (2014) found that learners with limited ICT skills can negatively impact the teaching and, consequently, learning process. In their study on the GDE's Big Switch On project, Matwadia (2018) found that learners' "off-task" use of tablets resulted in the deterioration of the quality of learning and caused disciplinary issues in class. This study found that at this Model school, these "off-task" uses are learners logging on the social media sites whilst learning should be taking place. Chigona *et al*. (2010:23) maintain that irregular electricity supply can be a barrier to the usage of ICTs as it impacts the operation of ICT facilities.

4.6 Technical support

Data collected and analysed from the semi-structured interviews provided insights into the technical support the participants received. During the interviews, the following question was posed to participants: *What technical support did you need most to do your job and use the ICTs? If yes, was it useful/helpful? If not, how did it make you feel, and what did you do without this support?* All participants concurred that technical support was provided to them on a continuous basis. The technical support offered is presented in Figure 4.8:

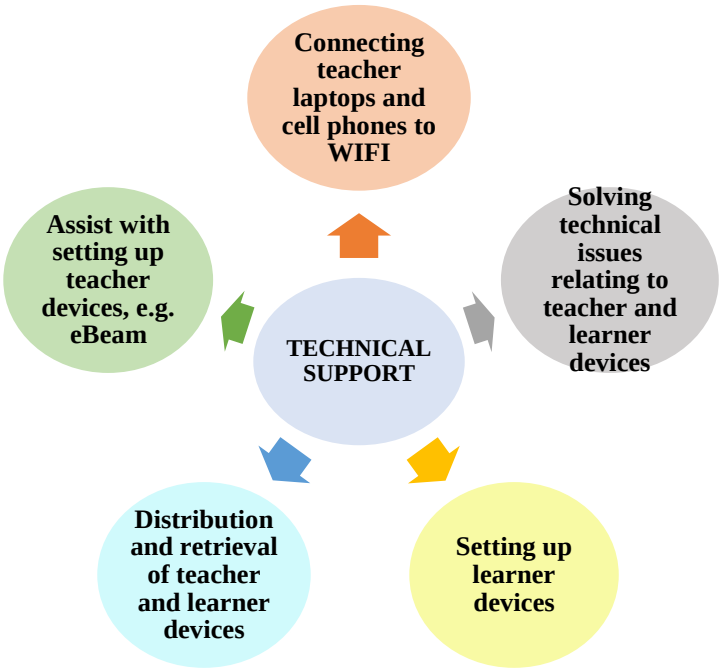


Figure 4.8: Technical support offered

Participant 1 said that while the WCED may have offered some support, the ICT champions primarily offered support at school level. The principal identified teachers who are technologically and digitally literate as ICT champions or champs. These teachers assist with the installation of ICT hardware and software and offer technical assistance to teachers and learners. The ICT champs are also the communication link between the school and the district's e-Learning advisor(s). Participant 1 shared the following regarding the technical support provided by ICT champs:

> *"ICT champions, we had [name redacted] that we could always ask. [Part of sentence redacted as discussed with participant] We had more than enough persons who could help us. And I could say, I can say that never had they turn their back on us and say you're here too often. No problem was too little, to minimum for them to help us. So always open."*

Along with providing technical assistance, the support offered by the ICT champs also empowered teachers. The following question was posed to participant 2: *So, do you think the technical support that you got, you think it was useful, was it helpful?* She responded with the following:

> *"Yes, it was very useful because now I can do it myself."*

Only one participant, participant 3, felt that they believe they have the necessary technical skills to use available ICT hardware and to troubleshoot any issues that may arise. They responded with the following:

> *"Yes, … I feel very comfortable."*

Participant 2 felt partially equipped to handle any technical issues that may arise and stated the following:

> *"I'm not going to say 100%. But I am quite on par with solving things myself at the moment, most of it, but as soon as new technology comes in, you will get a little bit more, need more support in it."*

It can be postulated that having technical support available at this Model school proved invaluable to the participants. Any technical matters can be fixed at a much faster rate as there is no waiting time for outside support to arrive. It also eased teachers who might have felt overwhelmed with the rapid changes enacted by the MSI implementation. Technical support also empowers and professionally develops teachers as they are trained to perform these tasks themselves. Notwithstanding the technical training the participants received, their minimal technical skills may be a result of inadequate or too little training or their reliance on support offered by the ICT champs.

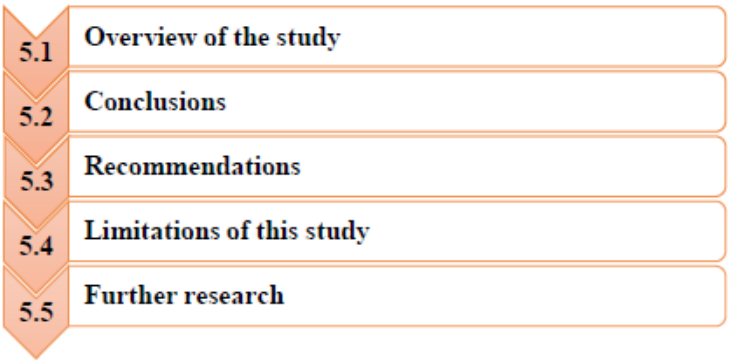
4.7 Chapter Summary

At the onset of this research study, the aim was to answer the main research question: *What are the contributing factors to teachers' TPACK development in the WCED's Model school initiative?* Data were collected and analysed to answer this question. Chapter 4 identified the following findings: ICT integration training proved invaluable to the teachers at this Model school, but subject-specific training is needed; technology provisioning at the Model school ensured that teachers were provided with a Smart classroom package which increased technology use after the MSI implementation, and most used devices can be linked to their ease of use; Microsoft PowerPoint is the most used application, WhatsApp is the most used social media, and Google Drive is the most used cloud service.

Motivators to ICT use are excitement to learn, access to various resources, ability to engage with learners at any time, ICTs facilitating teaching and learning, and the technical support and training offered by ICT champs. Barriers to ICT use are teachers feeling they lack knowledge

and practice, the effect of national load-shedding, ill-discipline of learners, lack of resources in Afrikaans and isiXhosa, vandalism of classrooms and devices, lack of subject-specific training, a lack of sufficient learner devices and a lack of teacher-control functionality on learner tablets. The final finding discusses the technical support provided by ICT champs and the ICT committee. Findings of this nature can provide invaluable insights to Model schools as well as other schools implementing an ICT policy. Furthermore, these findings can be of value to the WCED as well as other relevant stakeholders involved in the implementation of initiatives comparable to Model schools.

CHAPTER 5: CONCLUSIONS, RECOMMENDATIONS AND LIMITATIONS



Organisation of Chapter 5

5.1. Overview of the study

Chapter 1 outlined that this research study aims to explore and understand the extent to which the implementation of the WCED's MSI progressed teachers' technological knowledge and skills to use technology for teaching and learning. Two objectives were identified to support the main aim. Firstly, *to determine to what extent and how technology, professional development, technical support, and digital resourcing aspects contributed to teachers' use of technology for teaching and learning*. The second objective was *to determine specific factors of professional development that contributed to teachers' TPACK development and use of technology*.

The aim and objectives were in response to the main research question: *What were the contributing factors to teachers' TPACK development in the WCEDs' Model school initiative*? The sub-research questions were: (a) *How do technology provisioning, technical support and ICT integration training contribute to the use of technology within the Model school? (b) What specific aspects of professional development support teachers' TPACK development in their practice of using the technology for teaching and learning at the Model school?* Chapter 1 further provided a delineation of the research methodology, defined the key terminology, and highlighted the contribution of this study to other schools, the WCED and other relevant stakeholders.

Chapter 2 presented a detailed literature review exploring e-Education in South Africa. The chapter further analysed e-Education in, specifically, the Western Cape by focussing on the Khanya Project, the WCED e-Learning unit, The WCED Game Changer and the implementation of the e-Learning Strategy. In addition, a brief overview of ICT adoption

initiatives in Gauteng and Malaysia was explored. Furthermore, technologies used in teaching and learning were discussed, as well as motivations and barriers to ICT use. Finally, a delineation of this study's chosen theoretical framework, TPACK, is also provided in Chapter 2.

Chapter 3 delineated this research design and the methodology used. This study adopted an interpretive philosophy utilising a qualitative research approach. A case study design with a cross-sectional time horizon was used with a multi-method qualitative approach with three data collection techniques, namely: a questionnaire, semi-structured interviews, and document analysis. Purposive sampling was employed to select participants, using a pre-selected criterion. Thematic analysis, using ATLAS.ti 8, was used to analyse the collected data. Chapter 3 further details how trustworthiness was ensured in this research study, as well as the researcher's position and ethical considerations.

Chapter 4 This study was conducted at a selected Model school, and the data collected and analysed from the six teacher-participants were used to establish empirical findings and draw conclusions. This chapter identified the following findings: the importance and impact of ICT integration training at this Model school; the technology provided to this Model school and how it is used; the motivators and barriers to ICT use; and the technical support provided by ICT champs and the ICT committee. Chapter 4 thus identifies and discusses the empirical findings, and **Chapter 5** will discuss the conclusions, recommendations, and limitations of this research study.

5.2 Conclusions

The following conclusions drawn are structured to answer, essentially, the main research and sub-questions and are presented as follows:

Main research question:

- TPACK development of teachers at the Model School

Sub-research question 1:

- Adoption and use of ICTs
- Impact of MSI on learners and learning

Sub-research question 2:

- Impact of MSI on teachers' professional development.

5.2.1 Conclusion - TPACK development of teachers at the Model School

Main research question: *What were the contributing factors to teachers' TPACK development in the WCEDs' Model school initiative?*

Section 4.2 outlines the training received by participants, which were, inter alia: setting up and operating learner and teacher devices, accessing and using software applications and Google Suite training. Based on the collected and analysed data, the participants thus possess the basic knowledge to use these ICTs. Whether the participants of this research study possess adequate content and pedagogical knowledge falls beyond this study's scope, but reasonable inferences can be drawn from the data gathered and analysed by looking at the participants' years in teaching and some of the answers they provided. The researcher can, however, determine whether the Model school implementation provided or improved their technological knowledge, and make reasonable inferences on whether their TCK, TPK and subsequently their TPACK were established or improved. The contributing factor to teachers' TPACK development was the ICT skills training they received which helped to develop the teachers' technological knowledge and skills base to use technology pedagogically.

Mishra and Koehler (2008:1) argue that teachers who possess technological pedagogical content knowledge (TPACK) are creative, flexible, and adaptive in their approach to integrating ICTs into their curriculum. It can also be argued that to have TPACK, teachers must first have content, pedagogical and content knowledge. Essentially these "expert" teachers (Mishra & Koehler, 2008:10) can simultaneously select and integrate technologies, their pedagogical methods, and their content knowledge into their lessons, from the planning to the facilitation phase. Furthermore, TPACK describes the understanding teachers should possess on how these three knowledge bases interact to "produce effective discipline-based teaching" with ICTs (Koehler, Shin and Mishra, 2011:17). Another contributing factor was the ongoing technical support teachers received. The support was not only limited to technical matters; it provided teachers with an on-call support team who could advise and mentor. Constant access to technology and WI-FI connection also proved invaluable and motivated ICT use.

Mishra and Koehler (2008:10) argue that TPACK developments are akin to developing a new literacy. As discussed in Chapter 2, TK refers to skills teachers need to use ICTs. ICT teacher training should be continuous and have a hands-on approach (Mlambo *et al*., 2020), thus developing and enhancing teachers' TPK and TCK and promoting TPACK development.

Umugiraneza *et al*. (2018:11) concur, stating that continuous professional development is essential to helping teachers integrate freshly acquired technological knowledge into their pedagogical knowledge to develop their TPACK.

5.2.2 Conclusion - Adoption and use of ICTs

Sub-research question 1: *How do technology provisioning, technical support and ICT integration training contribute to the use of technology within the Model school?*

Section 4.2 stated that participants believed that training sessions should be followed by practice sessions to conceptualise what was taught and that training should be more subject-specific. In Section 4.4.2 and Figure 4.5, it was determined that laptops and data projectors are the most used devices of the participants as they feel more at ease and comfortable when using them.

In Section 4.5.1, it was stated that there are several factors motivating teachers' use of ICTs in this Model school. Participants indicated that they use ICTs in their lesson planning and administration, and as noted by Chigona *et al*. (2010), ICTs significantly decrease time spent on administration, thus freeing up time to focus on their core duties, which is teaching. The WCED (2012) determined that in 2012, seven years before the MSI implementation, the technology used by teachers was primarily limited to, inter alia, the usage of data projectors and interactive boards in conjunction with traditional teaching methodologies. In Chapter 4.3, it was stated that the Western Cape Government (2017:17) proposed the provision of laptops, data projectors, whiteboards, document viewers and e-Beams to Model school teachers and this allocation was confirmed by document analysis (Western Cape Government, 2019) and by the participants of this study.

Chigona *et al*. (2010:21) define ICT adoption as a process beginning with ICT acquisition and ending with its use in teaching and learning. ICTs have widely been heralded as tools to "bridge the digital divide" (South Africa, 2004) between affluent and historically disadvantaged schools. However, this divide can also be closed if the ICTs provided are optimally "adopted and integrated" into the pedagogical practices of a school (Chigona *et al*., 2010:21). The DoEs WP7 (2004:14) envisaged that e-Education should transcend from merely the development of computer literacy and ICT operation skills to the following:

- The application of ICT skills to access, analyse, evaluate, integrate, present, and communicate information;

- Creating knowledge and innovating information through the adaptation, application, design, invention and authoring of information; and
- Functioning in a knowledge-based society through the usage of appropriate technology and mastering communication and collaboration skills.

The mounting cost of increased investment into ICT initiatives also warrants investigations into whether these technologies are eventually adopted and used, and as noted by Bladergroen *et al*. (2012:116), questions should be raised if these investments are leading to "improved education outcomes".

It can be concluded that teachers use devices that are accessible and easy to use. All the teacher participants noted that they did not like using the eBeam, which renders a surface like a whiteboard interactive, as it takes time to set up. In fact, from personal experience and participant responses in Section 4.5.2, it should be noted that none of the devices is left in any of the classrooms as the school has a high break-in rate and vandalism. Teachers are thus required to set up their laptops and data projectors every morning and disassemble them at the end of the teaching day.

5.2.3 Conclusion - Impact of Model school initiative on learners and learning

Sub-research question 1: *How do technology provisioning, technical support and ICT integration training contribute to the use of technology within the Model school?*

In Section 4.5.2, it was established that most participants believe that learners are using the devices for non-educational purposes. Furthermore, it was established that learners' ill-discipline is such a severe barrier to the use of both the tablet and Chromebook that most teachers have stopped using these devices. The decision to temporarily pause learner device usage resulted from teachers becoming increasingly exasperated with ill-discipline negatively impacting learner-device usage.

Consequently, and despite learners and their ICT usage experiences falling beyond the scope of this study, the data collected from the teachers provide some insight into the effect the MSI has on learners and learning at this school. Furthermore, it can be argued that teachers' technological knowledge and skills to use technology for teaching and learning, which they gained as part of the Model school initiative, will essentially impact learners as they are on the receiving end of teaching and learning. ICT competent teachers who integrate technology into their lessons can provide much-needed visual stimulation to learners. Making lessons fun and

interesting can have positive effects on learner results. In the technology-rich environment we live in, with learners having access to smartphones and devices and social media like WhatsApp, Snapchat, TikTok, etc., it is especially important to engage with learners through ICTs.

The WCED's Vision for e-Education (2012) proposed that an ICT-enriched environment can promote learner-centred e-Learning. In addition, WP7 (2004:14), enacted by the DOE, postulates that the successful integration of ICTs has the potential to develop critical higher-order thinking skills (comprehension, reasoning, problem-solving and creative thinking), thus enhancing the employability of learners.

Conclusions can thus be drawn that the learner devices received, as confirmed by the data collected in semi-structured interviews, tablets for Grades 8-9 and Chromebooks for Grades 10-12, were aimed to empower learners to use technology effectively and innovatively (Western Cape Education Department, 2012:8). It can be argued that learners were not adequately prepared for the influx of ICT devices and their use within the school set-up. Chigona *et al*. (2014) found that the lack of learner preparation was an oversight within the Khanya Project implementation process, and it can be argued that such oversight within this school's MSI implementation process was also made. In Section 5.3.2 of this Chapter, recommendations will be proposed to address this issue.

5.2.4 Conclusion - Impact of Model school initiative on teachers' professional development

Sub-research question 2: *What specific aspects of professional development support teachers' TPACK development in their practice of using the technology for teaching and learning at the Model school?*

Section 4.5.1 stated that teachers at this Model school indicated that their ICT use results in a satisfactory feeling. This is in line with Chigona *et al*. (2014:4), whose findings indicate that teachers derive "professional satisfaction" from using ICTs in their teaching practices. As alluded to in previous chapters, the WCED offered ICT integration training to, inter alia, teachers (Western Cape Government, 2019) for professional development purposes (WCED, 2016). Furthermore, the WCED's ICT training aimed to equip teachers with the necessary ICT (TPACK) integration skills, including teacher readiness (WCED, 2016). The training developed teachers' ICT usage skills as it focused on the operation of teacher and learner devices.

Furthermore, the training focused on cultivating the general pedagogical technological skills of teachers but lacked a subject-specific component. A positive factor which encouraged teachers during the MSI transition period was the ongoing technical support and training teachers received from the assigned ICT champ and ICT committee.

Both the WCED's eLearning Strategy (2012) and the now-defunct Khanya Project (2002) aimed at the professional development of teachers. However, even with the training and technical support provided, some of the barriers to ICT use, as stated in Section 4.5.2, were, inter alia, lack of knowledge, lack of practice and lack of subject-specific training. Furthermore, as stated in Section 4.6, only two of the six participants believe they possess the necessary technical skills to use available ICT hardware and the essential pedagogical skills to integrate technology into their lessons.

The DoE's WP7 (2004:16) envisioned that ICT usage has the capacity to "enhance educational reform" by empowering teachers to shift from traditional, educator-centred, task-orientated, rote-learning based education approaches to teaching and learning to an inclusive and ICT-integrated environment. An environment in which learners are working in collaboration with teachers. It can be postulated that the MSI implementation played an essential role in teachers' professional development by providing hardware and associated training. However, it may have failed to develop sustaining ICT use and adoption and fostered a reliance of teachers on ICT champs. Furthermore, it failed to equip teachers with learner-ICT-management skills. It can thus be concluded that ICT-based professional development, which includes training and technical support to teachers, should thus aim to empower teachers to adopt and use ICTs, manage learners' ICT usage, and solve their technical issues instead of fostering dependency.

5.3 Recommendations

The recommendations from this study may provide leads to the areas that could be maintained and those that could be enhanced in the implementation of the MSI in the selected school and for technology-driven intervention in general.

5.3.1 Recommendation 1 – Establish Model school communities

The need to establish Model school ICT communities of practice can be argued. Model schools or teachers should also learn from each other. The sixteen schools selected as Model schools share unique circumstances of being technology-rich and receiving training, and subsequently,

discourses amongst these schools and teachers might alleviate some common issues they might share.

Communication and collaboration amongst teachers in Model schools and other Model schools can lead to a greater understanding of integrating ICTs as pedagogical tools, solving technical issues and dealing with learner-misbehaviour.

5.3.2 Recommendation 2 – Increased focus on learner training

To achieve the goal of technology-savvy and responsible learners, emphasis must be placed on training and equipping learners with the necessary skills to use technology for learning meaningfully. Considering the above, a multi-faceted training approach is proposed to educate Model school learners on safe and responsible technology use.

5.3.3 Recommendation 3 – Subject-specific training programme

The Model school-specific training lacked a subject-specific component which might have been an initial barrier to the pedagogical affordances ICT hardware and software can provide.

It is recommended that subject-specific training programmes be conducted to assist and guide teachers in choosing technologies for lesson planning and facilitation. These sessions can be provided at school-level by:

- ICT champs and/or committee members;
- ICT-competent teachers who are willing to share; and
- subject heads, the first recipients of information, who filter it down to their subject team.

Furthermore, it is recommended that technology-rich schools should have ICT champs and committees as they were proven invaluable sources of training and technical support at this Model school.

5.4 Limitations of the study

Research studies typically have limitations, allowing for reflection on the research findings and conclusion (Saunders *et al*., 2009:538). Some aspects, such as the WCEDs Model school selection process, are unclear. The reasoning for selecting this school as a Model school is thus not publicly known. Being privy to this information would have provided the researcher with

the rationale behind the WCED's selection process of the sixteen Model schools. A significant constraint to data collection by document analysis was the small number of publicly available WCED documents on the MSI implementation. A small sample can limit generalisation as this study focused on the viewpoints of six (6) unique perspectives within a single Model school. However, the findings of this single case study could be used to generalise to Models schools with similar features to this site.

Data for this study was collected during the COVID-19 global pandemic, and various challenges were faced, such as:

- Direct observations were impossible due to face-to-face restrictions, which would have been an invaluable data collection method;
- Long lockdown periods with no formal schooling – teachers might have adapted their teaching methodology and were more inclined to use social media and ICTs for teaching.

5.5 Further research studies arising from this study

This study took a "snap-shot" view of the MSI implementation at one high school. Further research to complement and deepen this study should focus on:

- All sixteen (16) Model schools can be researched to determine the success or failures of the initiative on a greater scale.
- Various aspects can be explored and compared at Model, Enhanced and/or Universal schools, including but not limited to impact on teachers' TPACK development, learner ICT development, the overall effect on learner results, etc.

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APPENDICES

Appendix A: CPUT Ethics clearance certificate

Cape Peninsula University of Technology

Cape Peninsula University of Technology

Private Bag X8, Wellington, 7654
Jan van Riebeeck Street, Wellington, 7654
Tel: +27 21 864 5200

P.O. Box 652, Cape Town, 8000
Highbury Road, Mowbray
Tel: +27 21 680 1500

FACULTY OF EDUCATION

On the 30th of September 2021 the Chairperson of the Faculty of Education Ethics Committee of the Cape Peninsula University of Technology granted ethics approval **(EFEC 1-9/2021)** to M. Kock for research activities related to a M. Ed degree.

Title:	Teachers' use of technology at a technology-rich Model school in the Western Cape Province

Comments:

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

Date: 30th of September 2021

Dr Candice Livingston

Chair of the Education Faculty Ethics committee and Research coordinator (Wellington)

Faculty of Education

Appendix B: WCED Approval Letter

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: 20210921-6088
ENQUIRIES: Mr M Kanzi

Mrs Marilize Kock
19 Bruydegom Street
Saldanha
7395

Dear Mrs Marilize Kock,

RESEARCH PROPOSAL: TEACHERS' USE OF TECHNOLOGY AT A TECHNOLOGY-RICH MODEL SCHOOL IN THE WESTERN CAPE PROVINCE.

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 **28 September 2021 till 31 March 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. The approval of your research request does not imply a promise of any data from the WCED. Should you require data, you will have to request it from the participating schools where it will be possible to secure parental consent.
11. Please note that POPIA prohibits the sharing of personal information without parental consent.
12. A brief summary of the content, findings and recommendations is provided to the Director: Research Services.
13. 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: 28 September 2021

Appendix C: Letter of consent: Participants

LETTER OF CONSENT:

PARTICIPANTS

***For office use only	
Date submitted	
Meeting date	
Approval	P/Y/N
Ethical Clearance number	

Faculty of Education

Participant informed consent form

CONSENT TO PARTICIPATE IN A RESEARCH STUDY

Participant category (please tick as appropriate):

Principal		*Deputy Principal*		*HOD*		*Teacher*		*Lead/Master teacher*	

You are kindly invited to participate in a research study, conducted by **Mrs Marilize Kock**, a MEd student from the Cape Peninsula University of Technology. The findings of this study will contribute towards her masters thesis.

Selection criteria of this research study:

You were selected as a possible participant in this study because:

- **You are a teacher at the Model school chosen as a site for this study.**
- **You have been employed during the period 2017 to 2019 of the Model school implementation.**

The information below provides details of this study to help you decide whether you would want to participate.

Title of the research:

Teachers' use of technology at a technology-rich Model school in the Western Cape Province.

This research study explores the Western Cape Education Departments' (WCED) implementation of an ICT driven e-learning strategy. The focus of this study is on the Model school initiative which was implemented in 2017. This was done at sixteen (16) schools (1) primary (1) high school in each of the eight educational district, across the Western Cape Province. This research is beneficial as it can provide empirical evidence regarding technical, professional development, personal and methodological aspects related to a technology-driven intervention. Please note that no incentives will be offered to participants of this study.

Procedures (duration)

If you volunteer to participate in this study you will be asked to do the following things:

1. **Participants will be asked to complete a questionnaire (approximately 15-20 minutes).**
2. **Based on researcher's selection, you will be requested to participate in an interview (approximately 60 – 90 minutes).**

Right to withdraw/ voluntary

You are invited to contact the researcher should you have any queries about the research before or during the study. Your participation can be withdrawn at any time without you having to give a reason.

Confidentiality and anonymity

Your confidentially and anonymity as a participant will be ensured as no names or identifying characteristics will be used, only codes known to the researcher. All research study related data stored on the researcher's laptop will be secured by a password only known to the researcher.

Potential risks, discomforts or inconveniences

Possible data costs will be incurred by participants as the questionnaire and interviews will be conducted online due to the COVID-19 pandemic.

Please complete the following table before participating in the research.

(Please tick (✓) the appropriate block)		
Statement:	Yes	No
1. I understand the purpose of this research study		
2. I understand what the research requires of me as a participant.		
3. I volunteer to take part in this research study.		
4. I know that I can withdraw from this research study at any time.		
5. I understand that there will not be any form of discrimination against me as a result of my participation or non-participation.		
6. Any comment(s):		

Please sign this consent form. (A copy of this form is available on request)

Participant signature	Date

Researcher:	**Contact details:**
Marilize Antonize Kock	kockmarilize@gmail.com

Contact person(s):	
Dr Osman Sadeck (supervisor)	Email: osadeck@gmail.com
Mr. Moses Moyo (co-supervisor)	Email: MOYOM@cput.ac.za

Appendix D: Data collection instrument 1: Questionnaire (Developed on Google Forms)

QUESTIONNAIRE

Dear participant My name is Marilize Kock, a MEd student at CPUT. I am conducting a research study on "Teachers' use of technology at a technology-rich Model school in the Western Cape Province" as part of my degree programme. I am requesting you to assist me by completing this questionnaire, the initial stage in selecting the participants for the study. Please answer each question to the best of your knowledge. Your candid responses will be greatly appreciated. Your identity will not at any time be associated with your responses and will be kept completely confidential. There are no risks or personal benefits for participating in the study. The results of this study will benefit schools and practicing teachers. Upon completing the study, the report of the findings will be made available in the university library and to the school.

1. Enter primary email address you want the researchers to contact you with:

2. Enter your contact number:

3. Enter your Surname and Name (optional)

4. Please select your gender:

- Female ☐
- Male ☐
- Prefer not to say ☐

5. Please select your age range:

- below 26 years ☐
- 26 to 30 years ☐
- 31 to 35 years ☐
- 36 to 40 years ☐

- 41 to 45 years ☐
- 46 to 50 years ☐
- 51 to 55 years ☐
- 56 to 65 years ☐

6. Your number of years in teaching:

- Less than 2 years ☐
- 2 to 5 years ☐
- 6 to 10 years ☐
- 11 to 15 years ☐
- 16 to 20 years ☐
- More than 20 years ☐

7. Have you been teaching at this school since 2017:

- Yes ☐
- No ☐

8. Please indicate in which phase/s you teach:

- GET (Grades 8 and 9) ☐
- FET (Grades 10 to 12) ☐
- Both GET and FET ☐

9. Please indicate if you own or have access to any of the following:

	Yes	**No**
Laptop	☐	☐
Desktop computer	☐	☐
Tablet	☐	☐
Smartphone	☐	☐
Internet access at home	☐	☐
Internet access at school	☐	☐

10. Please indicate if you use any of the following devices in your teaching:

	Yes	No
Laptop	☐	☐
Desktop computer	☐	☐
Smartphone	☐	☐
Tablet	☐	☐
Document reader	☐	☐
eBeam	☐	☐
Chromebook	☐	☐
Data projector	☐	☐
Whiteboard	☐	☐
Smart board/Interactive board	☐	☐

11. Please give a brief description of how you use any of the above ICT hardware for teaching:

12. Please indicate if you use any of the following DIGITAL RESOURCES in your teaching (Please select all that are relevant):

- Videos ☐
- Links to YouTube ☐
- PowerPoint presentations ☐
- Simulations, e.g. PhET simulations ☐
- Gaming ☐
- Podcasts ☐
- Animations ☐
- Link to external websites ☐
- Screen casts ☐
- Online quizzes / assessment ☐
- Other ☐

If you selected 'other' please indicate the type:

18. Have you attended any additional ICT training (apart from the Model School Training) since 2017:

- Yes ☐
- No ☐

19. Do you believe you have the necessary technical skills to use the available ICT hardware?

- Yes ☐
- No ☐

20. Please explain your response to technical skills in the above question.:

21. Do you believe you have the necessary pedagogical skills to integrate technology into your lessons:

- Yes ☐
- No ☐

22. Please explain your response to pedagogical skills in the above question:

23. Do you know how to select specific software or hardware to use to teach your specific subject(s) effectively:

- Yes ☐
- No ☐

24. Please explain your response to software or hardware selection in the above question:

25. Please indicate if you would be willing to participate in the study if you are selected as a participant. (Your participation will be voluntary, and you can withdraw at any time without prejudice)

- Yes ☐
- No ☐

Appendix E: Data collection instrument 2: Interview schedule

INTERVIEW SCHEDULE: TEACHERS

MAIN RESEARCH QUESTION:

What were the contributing factors to teachers' TPACK development in the WCEDs' Model school initiative?

Interview questions (Model school initiative implementation):

1. How was the Model school initiative introduced to you?
Response: .....

2. What impact do you think the Model school initiative has had on the learners/learning at this school?
Response: .....

3. Before the Model school initiative implementation, how do you feel about using technology (ICTs) in your teaching?
Response: .....

4. After implementation, and roll-out of the technology, how do you feel about using technology (ICTs) in your teaching?
Response: .....

5. Explain what motivates you to use of technology in your teaching.
Response:.....

6. Explain what hinders your use of technology in your teaching.
Response:.....

SUB-RESEARCH QUESTION 1

How did the aspects of technology provisioning, technical support and ICT integration training contribute to use of technology within the Model school?

Interview questions:

1. Tell me which technology you used in your teaching pre-2017/the Model school implementation.
Response:……..

2. Of the technology devices/tools (state the different ones that you know of) that you received, which do you use the most for teaching/learning? Why these ones and why not the others?
Response:……..

3. Do you think the technology devices were APPROPRIATE choices for developing e-learning at this school (E.g., were they of good quality, enough devices)
Response:……..

4. What technical support did you need most to do your job and use the ICTs? If yes, was it useful/helpful? If not, how did it make you feel and what did you do without this support?
Response:……..

5. What specific training did you get on how to operate / use the devices – solve own technical devices in the classroom? Was it useful, did you have to use it?
Response:……..

SUB-RESEARCH QUESTION 2

What specific aspects of professional development supported teachers' TPACK development in their practice of using the technology for teaching and learning at the Model school?

Interview questions:

1. Teacher training was provided as part of the Model school initiative implementation strategy. Please tell me about the WCED ICTs training you received. Were any of the ICTs training you received subject specific – was it about how to use the devises only - was it pedagogical?
Response: ……

2. Did you learn how to create resources, or did you only have to use ITSI or other programs?
Response: ……

3. What has changed (since the Model school implementation) in the way you use technology in your teaching? (Follow up: Why has this changed…why has this not changed…does it make you feel good/happy/competent, do you find the children benefit, is it of benefit to you?)
Response: ……..

4. After the Model school initiative training:
4.1 To what extend do you feel you understand the pedagogical affordances (what/how they can be utilized for teaching and learning) of the different technological devices that are available? Did you know this before the Model school training?
Response: ……..

4.2 To what extend do you feel you understand the pedagogical affordances (what/how they can be used for teaching and learning) of the different technologies such as social media, LMSs, video, simulations, Kahoot, Quizzes, etc? Did you know this before the Model school training?
Response: ……..

4.3 To what extend do you feel you can plan lessons that appropriately integrate the use of ICTs to enhance teaching and learning in your subject? Do you know how to select technology and methods of integration, and did you know this before the Model school training?
Response: ……

4.4 To what extend do you feel you can plan lessons at the different levels of SAMR and Blooms taxonomy to enhance teaching and learning in your subject? Did you know this before the Model school training?
Response: ……

4.5 To what extend do you understand what TPACK is and about? Did you know this before the Model school training? To what extend do you understand what SAMR is and about? Did you know this before the Model school training?
Response: ……..

Appendix F: Digital certificate for Turnitin submission

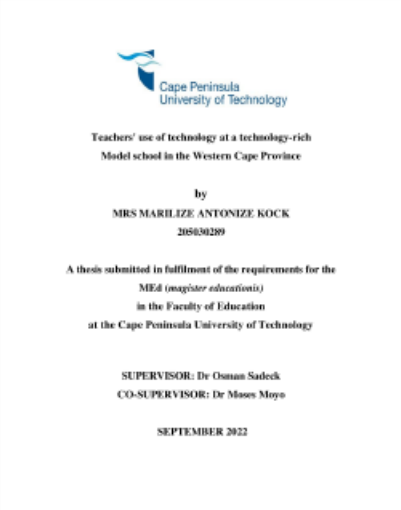
turnitin

Digital Receipt

This receipt acknowledges that Turnitin received your paper. Below you will find the receipt information regarding your submission.

The first page of your submissions is displayed below.

Submission author:	Marilize Kock
Assignment title:	Thesis submission 2
Submission title:	MEd Thesis
File name:	MEd_Thesis_Mrs_Marilize_Kock_205030289.docx
File size:	1.78M
Page count:	120
Word count:	30,530
Character count:	173,762
Submission date:	11-Oct-2022 05:31PM (UTC+0200)
Submission ID:	1917307514



Cape Peninsula University of Technology

Teachers' use of technology at a technology-rich Model school in the Western Cape Province

by

MRS MARILIZE ANTONIZE KOCK

205030289

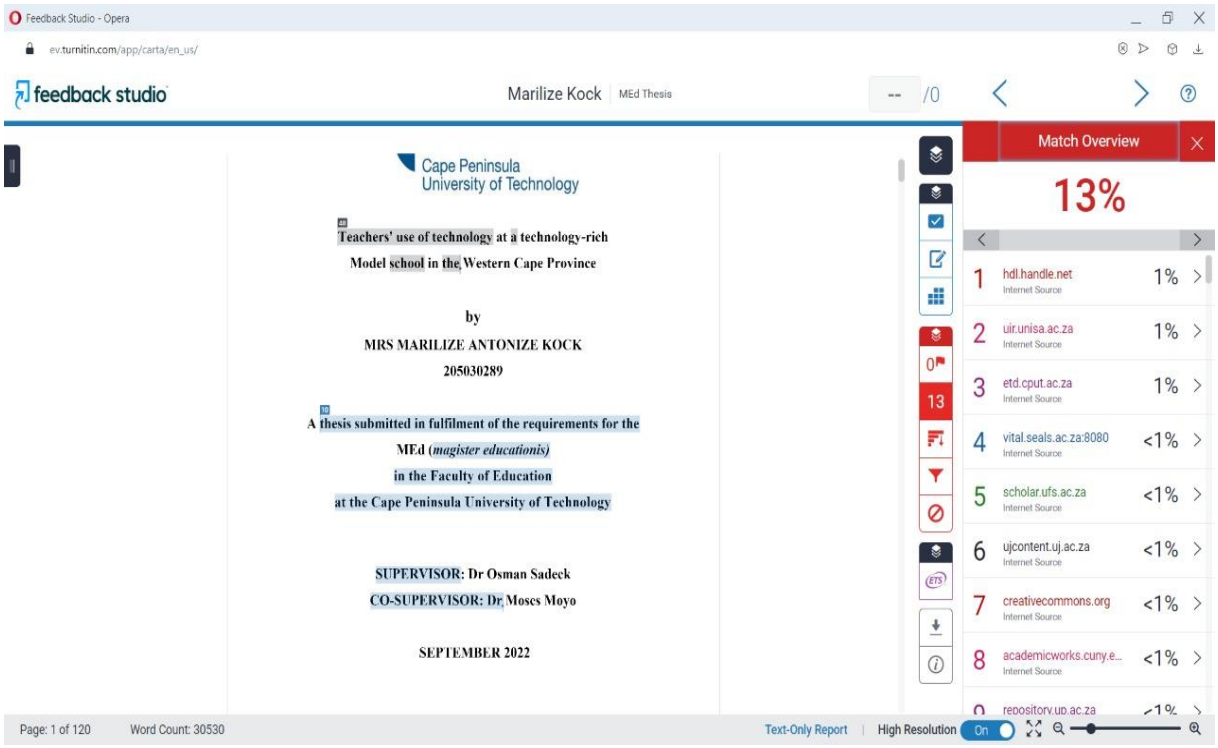
A thesis submitted in fulfilment of the requirements for the MEd (*magister educationis*) in the Faculty of Education at the Cape Peninsula University of Technology

SUPERVISOR: Dr Osman Sadeck

CO-SUPERVISOR: Dr Moses Moyo

SEPTEMBER 2022

Appendix G: Turnitin Similarity Report



Appendix H: Glossary

Adoption	A process beginning with ICT acquisition and ending with its use in teaching and learning.
Applications (also referred to as software applications)	Also called APPs. A computer program of software, with a specific purpose, can be downloaded on a device.
eAdmin	Various digital administrative resources to minimise the manual administrative tasks of teachers and principals.
eCulture	Promotes a change in how ICTs are viewed and used in schools by teachers and learners
eInfrastructure	Infrastructure installed to connect schools to the internet
eLearning	Using ICTs (hardware and software), e.g., devices, tools, resources, social media and applications to access information, for interaction between teachers and learners, for collaborative learning and the production of materials and resources.
ePortal	A cloud-based, up-to-date and Curriculum and Assessment Policy Statement (CAPS)-aligned (Western Cape Government, 2019) learner and teacher resource
eTechnology	The ICTs used in classrooms, i.e., the teacher and learner devices distributed
ICT	Information Communication Technology – a combination of networks, hardware, and software as well as the ability to communicate, collaborate and engage with others to enable the processing, management and exchange of data, information and knowledge.
ICT integration	Refers to ICTs being fully integrated into teaching and learning, whereby teachers and learners are using hardware devices and/or software
Model school/s	This category of schools was earmarked to integrate e-Learning into their teaching and learning practice as per the province's e-Learning Strategy
Smart classrooms	Technology-rich classrooms with WIFI connectivity, laptop/desktop computer, data projector and whiteboard with eBeam/interactive whiteboard
Social media	Can be websites or computer programs for communication and/or online sharing purposes.
Software	Computer programmes that allow for the access, retrieval, storage, organisation, manipulation, and presentation of information electronically.
Technology	Also called ICTs, including hardware devices such as laptops, Chromebooks, tablets, data projectors, eBeams
Technology use	Using ICTs/technologies for teaching and learning