

**INVESTIGATING LEVELS OF DIGITAL CLASSROOM
TECHNOLOGIES AND TEACHER'S USAGE OF TECHNOLOGY IN
SELECTED SCHOOLS IN LIMPOPO PROVINCE**

BY

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DECLARATION

I declare that this dissertation hereby submitted to the University of Limpopo for the degree of Master's degree in Curriculum Studies has not previously been submitted by me for a degree at this or any other university; that it is my work in design and in execution, and that all materials contained herein has been duly acknowledged.



Lekgothoane R.L.C

27 September 2020

Date

DEDICATION

This study is dedicated to my late mother Maria Mantjie Lekgothoane (born Mothiba) and my late father Solomon Moditi Lekgothoane for their everlasting love, support, and the belief they had on me, my late sister Berlinah Sejabaledi Lekgothoane, my late brother David Ramadi Lekgothoane and the late Ephraim Tshirudu Tshidumo. I further thank my sister Mavis Ramaesela Lekgothoane and Daniel Maredi Lekgothoane for the encouragement they had given me throughout this study and their incredible contribution.

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ABSTRACT

The emergence of Web 2.0 and Web 3.0 resulted with digital classroom technology that changed learning spaces into interactive digital spaces. Changes in classroom digital technology has caused education ministries to make a substantial investment in digital technology infrastructure and teacher training, to prepare teachers to venture into the 4th Industrial Revolution. The advent of tablet and smart phone technologies created a platform for schools within developing economies to change from traditional classroom practices to digital classroom technology.

The problem this study examined is the lack of classroom technology and connectivity, and teachers' circumstances that makes them fail to transition to digital pedagogies. The purpose of the study was to investigate the levels of digital classroom technologies and teacher's usage of technology in selected schools in Limpopo Province. This study was guided by three main research questions, namely, "What is the level of classroom digital technologies in schools? What is the teachers' perceived level of usefulness of using digital classroom technology? Do teachers possess competencies required to influence teaching and student learning?" The study is qualitative in nature and the interpretivism paradigm and a theory of technology acceptance model were used to guide in assessment of this phenomenon. The study was premised within the interpretivism paradigm and qualitative case study approach was used. Interviews and document studies were used to collect data from 4 teachers, 4 heads of department (HoD) and 4 principals, who were selected from four case schools that participated in Limpopo CoLab school project.

The findings of this study identified a low level of digital classroom technology integration in Limpopo project schools due to inadequacies of digital classroom technologies and lack of internet connectivity. Furthermore, teachers' resistance to transit from teacher-centred pedagogy to learner-centred pedagogy; a lack of adequate teacher training on digital classroom technology; and failure in the implementation of e-education policy by case schools were identified as challenges faced by Limpopo Project Schools.

The study concludes that schools that were serviced by Limpopo CoLab project lack digital classroom facilities to practice what were learnt during training. This study recommends the

Department of Basic Education provides Limpopo schools with school connectivity and digital technologies. This study further recommends that training of teachers on the use of digital classroom technologies should be made a priority.

Key words: Digital classroom technology, Digital learning, Limpopo Project School Project, Digital pedagogies, Traditional pedagogies

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LIST OF ABBREVIATIONS

DCT: Digital Classroom Technology

DoE: Department of Education

DBE: Department of Basic Education

FCL: Flipped Classroom Learning

HoD: Head of Department

ICT: Information Communication Technology

IT: Information Technology

MoU: Memorandum of Understanding

OER: Open Educational Resources

UL: University of Limpopo

VLE: Virtual Learning Environment

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CHAPTER 1 INTRODUCTION AND BACKGROUND TO THE STUDY

1.1 INTRODUCTION

In this introductory chapter, the researcher introduces the research topic and discusses the background to the study. The research problem, purpose of the study, research question and significance of the study are discussed in this chapter. Lastly, the researcher outlines the structure of the dissertation in the chapter.

1.2 BACKGROUND AND MOTIVATION

Educational institutions and schools in particular, need teachers who are competent in the use of digital classroom technologies (DCTs). The use of these technologies has the potential to make the work of the teacher more interesting and relevant in this digital age. The White Paper on e-Education (2003) states that every South African learner in the General Education and Training and the Further Education and Training bands will be information and communication technology (ICT)-capable by 2013. If used appropriately, technology can improve classroom practice and learning processes (Wilson-Strydom, Thomson & Hodgkinson-Williams, 2005). The adoption and integration of technologies in teaching and learning are challenging and complex processes for schools, particularly where there is limited previous experience in the use of ICTs to support teaching and learning (Umugiraneza, Bansilal & North, 2018). According to (Tanui, Kibbos, Walaba & Nassiuma, 2008), technology is a relatively new approach and should be included in the curriculum in all South African schools. The South African Department of Basic Education (DBE) highlighted the fact that ICT created new possibilities and dilemmas for teachers and teaching (Department of Basic Education [DBE], 2003), while “encouraging teachers to harness the new opportunities that made teaching more meaningful and rewarding” (Ramorola, 2010). In this study, a literature review relating to technology integration is

presented. The qualitative approach used in the research is described and, finally, the findings and conclusion regarding the level of use of DCT are put forward.

Both empirical and literature studies were conducted to assess principals', HODs and teachers' competency of DCTs and teachers' usage of technology in four selected Limpopo project schools. The Limpopo project school was established as a result of the collaboration between the University of Limpopo and the then Department of Telecommunications and Postal Services (now Department of Communication and Digital Technologies) aimed at meeting South Africa's technology-related goals, as set out in the National Development Plan. According to (Hussain, Wang & Rahim, 2013), availability and prudent use of pedagogical technologies improve chances of attaining good quality education because of their impact on learning.

The research responded to a growing academic concern that "there is minimal use of technology for teaching and learning by teachers" (Ndlovu & Lawrence, 2012), even in cases where such technology is available. The DBE highlighted the fact that information and communication technology can create new possibilities and dilemmas for teachers and teaching (DBE, 2003), while "encouraging teachers to harness the new opportunities that made teaching more meaningful and rewarding" (Ramorola, 2010). Currently, "young people used technology such as tablets and smartphones, for studying, playing games, seeking information and for communicating" (Punamaki, Wallenhuis, Nygard, Saarni & Rimpela, 2007). Technological innovations of the previous century, such as film, print, radio, television and cable television, which had been digitalised over decades, cannot be ignored by the South African education system (Gutnick, Robb, Takeuchi & Kotler, 2011).

These technologies made the work of the teacher very interesting and relevant in this digital age. If used appropriately, technology can improve classroom practice and learning processes. A study by (Shah, 2013) showed that technology is used in "teaching, learning and assessment to aid instructors in the delivery of pedagogic content and to enrich the learning experiences".

Blake (2009) stated that using technology in the curriculum stimulate and improved language preparation and student learning.

A study by (Armstrong, 2014) showed that, in essence, technology as a tool is credited as a principal factor that changed the role of learners into learning explorers and teachers into facilitators and guides, enabling “students to take control of their learning.” Despite the availability of technologies and the high demand by young people to use them, “teachers seem to be reluctant to use technology in their teaching” (Armstrong, 2014). According to (Marwana, 2008), “the failure by teachers to integrate technology in the classrooms” was due to lack of educational technology-related factors that were beyond teachers’ control (Mumtaz, 2000). Like many rural provinces, educational technologies found in rural schools in Kwazulu-Natal were “mostly used for management purposes and not for instructional purposes” (Umugiraneza et al., 2018). Rural schools are lagging behind in the integration of educational technologies in teaching and learning.

Salavati (2016) study revealed that the effective use of technology as pedagogical tools was able to “translate teaching into effective learning by providing learners with new possibilities for exploration.” The use of technologies, such as smart board technology, in the classroom enriched curriculum by making the classroom encounters more interesting and interactive. Learners’ learning experiences were enhanced by this technology because it allowed them to view pictures, diagrams, videos and charts on a huge screen in the classroom (Salavati, 2016). For example, “smart board technology in the classroom benefit teaching and learning by raising test scores, improving learners’ learning, enhancing literacy and boosting learners’ attentiveness” (Cox, 2012). The White Paper on e-Education (2004) encourages teaching and learning that recognised the notion that people learn differently using different learning styles and have culturally diverse perspectives. Lebona (2013) highlighted that ICT embraces inclusive education by providing opportunities, alternative methods of instruction and flexible assessments for learners who experienced barriers to learning.

The White Paper furthermore highlighted the fact that the DBE believed that developments in ICT created access to learning opportunities; improved the quality of learning and teaching; and delivered lifelong learning. The Professional Development Framework for Digital Learning (2018) highlighted the goal of attaining the educator competencies required for planning and facilitating digital learning, which would form the basis for a teacher's needs-analysis and planning for professional development in terms of digital learning. The framework stated that teachers who use digital tools and resources for learning could direct the learner's ambitions to achieve good results. The DBE (2004) highlighted the fact that their e-Education policy represented a roadmap for the achievement of national education goals, which provided for the introduction of modern technologies into schools in order to enhance the quality of learning and teaching. The e-Education policy expected that planning to institute teacher development should take place at school level. The policy suggested that school educational managers and administrators should promote the use of ICT at their own institutions. The Electronic Communications Act No. 36 of 2005 promotes the convergence of the broadcasting signal distribution and telecommunications sectors and the legal framework for convergence of these sectors; to make new provision for the regulation of electronic communications services, electronic communications network services and broadcasting services; to provide for the granting of new licences and new social obligations; to provide for the continued existence of the (Universal Agency and the Universal Service Fund RSA, 2005).

The researcher was motivated by lack of teacher competency in using DCT in teaching and learning which is one of the factors involved in resistance of teachers towards change in the 21st century. Keengwe, Onchwari & Oigara, (2014) highlighted that technology is being widely used in schools and the most important question is how to best implement technology, rather than whether technology will be used.

1.3 RESEARCH PROBLEM

This study sought to investigate the levels of classroom technology adoption in secondary schools in the Capricorn District; and to investigate the perceptions teachers in this district had towards the adoption of digital technologies for teaching and learning. Furthermore, this study sought to investigate the barriers teachers and schools faced in their attempts to adopt technology in teaching and learning.

The problem is serious to the extent that there are schools where teachers continue to use textbooks and chalkboards, without complementing chalk-and-talk approaches with digital technology in their teaching. Blake (2009) highlighted the fact that “teachers use chalkboards and textbooks instead of technology in their teaching and learning even in cases when appropriate technologies were available.” Consequently, the performance of learners in such classrooms was compromised.

The DBE provided some schools with “computers to strengthen teaching and learning and to redress past inequities’ (Ndlovu & Lawrence, 2012). A study by (Thaba- Nkadimene, 2017) showed that 21st century learners could not continue to be taught in a traditional classroom manner if the goal of basic education was to develop learners who are innovators and problem-solvers. Thaba-Nkadimene (2017) contends that there is a “need to give learners and teachers an opportunity to be creative.”

In support of problems of the implementation of digital classroom pedagogy (DCP) by schools, (Lim, Zhao, Tondeur, Chai & Tsai, 2013) revealed gaps in educational uses of technology; namely, less usage of technology in schools compared to how much today's students use technology outside school. It was further indicated by these authors that the level of E-Tech provision versus performance of learners and teachers was not established (Lim et al., 2013). The focus of this study was on investigating the level of implementation of DCT in selected schools in Capricorn, Limpopo Province. Furthermore, this study set out to establish the level

of school connectivity and the availability of digital technology to allow teachers to venture into digital learning spaces.

1.4 PURPOSE OF THE STUDY

This study sought to investigate the levels of classroom technology adoption in secondary schools in the Capricorn District; and the perceptions teachers in this district had towards the adoption of digital technologies for pedagogical purposes. Furthermore, this study sought to investigate the barriers teachers and schools face in their attempts to adopt technology in teaching and learning. In an attempt to attain these purposes, this study formulated three research questions as reflected below.

1.5 RESEARCH QUESTIONS

- What is the level of classroom digital technologies for teaching and learning?
- What is the teachers' level of usefulness of using digital classroom technology?
- Do teachers possess competencies required to influence teaching and student?

1.6 SIGNIFICANCE OF THE STUDY

Academically, the study will contribute towards educational knowledge related to the value of school resources and infrastructure, and the impact of such resources on the quality teaching and learning. This study will initiate a debate about the use of DCT among all stakeholders in Limpopo Province. The status of school resources is made public through this study, so that everyone knows what is happening in our schools, and the conclusions drawn offers policy makers information in order to fast-track norms and standards for infrastructure in rural public schools. Furthermore, the circumstances under which teachers are working, and are expected to produce good results, will be exposed. This should promote good working conditions for

teachers. Resource-related information was examined, which should help parents make the decision to choose the best school for their children.

In a period of global crisis, where humanity is threatened by the corona virus or COVID19, schools and universities were left with one option, that of embarking on virtual learning or online learning. The issue of social distancing and how COVID19 infects people has made digital learning using virtual learning or online learning a priority. This study offers insights into the level of preparedness of case schools and participating teachers, heads of department (HoDs) and school principals in transiting to virtual learning.

1.7 STRUCTURE OF THE DISSERTATION

This study comprises five chapters, which are outlined as follows:

Chapter 1 offers an introduction to, and background of, the study; the research problem; the purpose of the study; research questions posed; and the significance of the study.

Chapter 2 presents the literature review, which comprises the introduction, definition of concepts, DCT studies, DCT trends, the differences and similarities between ICT and DCT, flipped classroom and virtual learning, e-resources and open educational resources, focus area, the role of theory in the study, technology acceptance theory, change theory, social constructivism, integration of the three theories, role of theory in the study and chapter summary.

Chapter 3 outlines the research design and methodology. This chapter centers on the philosophical underpinnings of the entire study. The chapter provides a detailed explanation of the research design and the methods used. This chapter is composed of an introduction, theoretical framework, qualitative research approach, research design, population and sample, sampling techniques, data collection methods, data analysis, ethical considerations.

Chapter 4 deals with the school profiling data where school infrastructure, teachers and learners amenities together with teachers profiling were discussed.

Chapter 5 provides data analysis and presentations wherein qualitative data were presented and discussed. It comprises of the qualitative findings from principals, HODs, teachers and document study.

Chapter 6 provides the summary, recommendations and conclusion. This chapter discussed key findings of the study coupled by recommendations. Furthermore, conclusion and implications for further research was offered.

1.8 CHAPTER SUMMARY

The chapter commenced with introduction and background of the study. This was then followed by background to the study, research problem, purpose of the study and research questions. The significance of the study and the structure of the study were also discussed in this chapter.

CHAPTER 2: LITERATURE REVIEW

2.1. INTRODUCTION

This chapter is centred on a review of the literature pertaining to the levels of DCT digital classroom technologies and teachers; usage of technology in selected schools in Limpopo Province. The important concepts, namely, digital classroom, (ICT), pedagogy, flipped classroom, virtual learning and e- resource were defined. The literature is further discussed on crucial areas of digital classroom technology; namely, an explanation of what digital classroom is about; the benefits of digital classroom technology; the challenges of digital classrooms; and migration of teachers to digital technology. Educational technology trends that comprised the following, DCT trends, ICT trends, flipped classroom trends, virtual learning trends, e-resource trends, and open education resources trends are discussed. The last part of this chapter focuses on the theoretical framework, where change theory; social constructivism and technology acceptance theory are discussed and a chapter summary is provided.

2.2. DEFINITION OF CONCEPTS

2.2.1 Digital Classroom

Digital classroom technology is important in this study because it impacts learner- pedagogy and learner-engagement for learning and teaching process. Digital classroom technology is defined as a classroom in which teaching and learning is done by means of computers and tablets to provide students with information (Montrieux, 2015). Ramez (2016) defines digital classroom as the classroom that is technologically empowered with content that is used in digital format, sufficient computing devices in the classroom and students completing their work using these computing devices. Panworld Education (2017) defined digital classroom as a classroom that could be utilised in online sites, programs, teaching tools, services and technologies, like study aids built for at-home use, which empowered students to be more

interested in learning. This study adopted (Liang, Liu, Wang, Chang, Deng, Chou, Ko, Yang & Chan, 2005) definition of digital classroom technology, which highlighted the notion that a digital classroom is a classroom that is technologically empowered with all of the following: the content in use is digital; there are sufficient computing devices in the classroom, e.g. Google, iPod's etc.; and students complete part of their work using computing devices.

2.2.2 Information communication technology (ICT)

The definition of ICT is provided by the (University of Australia, 2016) highlighted ICT as the retrieving, processing, transmitting, protecting and storing of data. On the other hand, (Badimele, 2006) defined ICT as the scientific method of storing and processing information and, correspondingly sharing, exchanging, sending and moving such information from one place to another. Aribasala (2006) defined ICT as the super highway through which information is transmitted and shared by people all over the world, converting the world into a global village. Michalsons (2014) highlighted that ICT stands for information of data in electronic format that should be communicated using voice, telecommunications and broadcasting which include software and hardware. The study, adopted the definition of ICT offered by (Mohamed, 2015) who stated that ICT is an umbrella which consists of communication devices and applications consisting of: network software and hardware; satellite systems; television; radio; computers; and cell phones.

2.2.3 Hardware and Software

Resources are objects or persons communicating the teaching and learning. Khoza (2016) highlighted that resources are divided into hardware (machines or tools used in teaching), software (materials used with hardware), is a collection of codes installed onto your computer's hard drive and ideological-ware (ideas that motivate people to use hardware/software). Some examples of hardware are computers, laptops, and mobile phones. Some examples of software

are application software (Microsoft office, the internet and LMS), file management software, and operational software.

2.2.4 Pedagogy

Sonwalker (2011) defined pedagogy as the methodology and the process of presenting content in the context of learning strategies which connected cognitive processes. A definition of pedagogy is provided by (Cohen & Bhatt, 2012) as the art of science, teaching principles, methods and approaches of various considerations to ensure the success of teaching processes, because it considers an individual difference in selecting the correct approach, meeting the need of the students and their potentials. Anderson (2009) defined pedagogy as a factor determining how teachers operate, think and how it affects the expectations and lives of students. The Cambridge Dictionary (2017) also defined pedagogy study as activities of teaching: e.g. learning, assessment, curriculum delivery and teaching methods. Webster (2017) defines pedagogy as the profession of teaching, science and art which provided teachers and facilitators with creative lesson tools for classroom instruction and online education. The study has adopted (Steve- Wheeler, 2013) definition of pedagogy, namely, the methodology that leads people to a place where they can learn for themselves; creating environments and situations in which people can draw on innovation and creativity from themselves, and interpret the world their own way, to realise their full potential as human beings.

2.2.5 Flipped classroom

Halili & Zainuddin (2015) defined flipped classroom is an element of blended learning and it is the reverse of the traditional classroom where learners do not listen to the lessons delivered in the classroom but outside the classroom through online video. They further highlighted that teachers record themselves explaining the subject to learners and use YouTube videos to share with learners to be watched outside the class. Mazur's (2009) definition of flipped classrooms indicates that students first gain exposure to new resources outside classroom through video lectures and use class time to discuss, they then assimilate knowledge and debate what they have learned at home in the classroom. Flipped Learning Network (2014) defines flipped classrooms as a form of blended learning in which learners watch visual videos at home, and homework is done in the classroom, with the guidance of teachers. At the same time, learners solve problems and discuss questions.

Aksoy (2014) defined flipped classrooms as a form of blended learning in which students learn content online by watching video lectures and use Skype, usually at home, and homework is done in the classroom with teachers and students discussing, debating and solving problems. Ghanavati, Sohrabi, Ramezani, Keshavarzi & Pourbairamian (2019) definition of flipped classroom (FC) was adopted in this study as a 'reversed' or 'inverted' where learners receive material few days before the scheduled class through online lectures, videos or even read textbooks at home and take part in online discussions.

2.2.6 Virtual learning

Van Beek (2011) defined virtual learning as learning provided by teachers working remotely by specially designed software delivered to students through computers or the internet through supplementary instruction provided by teachers. He further stated that students no longer need to share a classroom with a teacher to learn when using virtual learning.

Kannan (2016) defined virtual learning as a set of learning and teaching resources that enhance the learning experience of students by using the internet and computers in the process of

learning. Furthermore, virtual learning transforms the way learners learn, and has the ability to improve learner achievement, educational access and the effectiveness of the school. Virtual learning uses computer software and the internet to deliver learning to learners. Rapanta, Botturi, Goodyear, Guàrdia & Koole (2020) highlighted that through virtual, learning and teaching is provided by the teacher, but the teacher is not physically present with the learners, learners interact with teachers through internet. Teachers interact educationally by using appropriate social networking sites in their classroom instruction, which are perfect for virtual learning. Thomas (2010) stated that in virtual learning, teachers adopt learner-centred pedagogy that supports interaction and collaboration amongst learners. Virtual learning allowed learners to be actively involved in their own processes of learning through active inquiry and discovery. The study adopted the definition by (Fry, 2010) who contends that virtual learning is an e-learning education system which is web based but which modelled on conventional face-to-face education, providing access to homework, course content and assessments which are linked to external resources.

2.2.7 E-Resource

Kenchakkanavar (2014) defined e-resource as an electronic resource which requires computer access or any electronic product that delivers a collection of data referring to full text bases, electronic journals, image collections, other multimedia products and numerical, graphical or time based which may be delivered on CD ROM, on tape, through Internet and so on.

Johnson, Evensen, Gelfand, Lammers, Sipe, & Zilper (2012) defined Electronic resources as materials which require computer access through a personal computer, mainframe, or hand held mobile device that may be accessed remotely through the Internet.

Dhanavandan & Tamizhchelva (2012) defined an electronic resource as a resource which requires electronic product that delivers a collection of data, be it text referring to full text bases, electronic journals, image collections, other multimedia products and numerical, graphical or

time based, as a commercially available title that has been published with an aim to being marketed.

Ashikuzzaman (2014) defined an electronic resource as information, usually in a file, which can be stored in the form of an electrical signal, not on a computer, which comprises e-books, websites, e-journals, online databases, portable computer database, CDROMs and diskettes.

This study adopted the definition of an e-resource provided by (Tan, 2016), who defined an e-resource as materials in a digital format that can be accessible electronically. Examples are: Adobe Acrobat documents (pdf), WebPages (htm, .html and asp), electronic books (e-book), electronic journals (e-journal) and online databases. E-resource is a short term for electronic resources. E-resources are collections of information in electronic or digital format, which are accessed by an electronic device, such as mobile phone or computer. E-resources are published resources in electronic format, such as encyclopaedias, pamphlets, e-books, e-journals and databases, describing all the information products that a library provided through a computer network. Electronic resources are regarded as mines of information that are explored using modern technology. The e-resources are available in a variety formats and they help to support students in their learning since they provide information quickly. Computers and related e-resources played a vital role in education.

2.2.8 Open Educational Resources (OER)

Atkins, Brown & Hammond (2007) defined open educational resources (OERs) as teaching and learning resources that are located in the public dominion; or have been released under an intellectual property licence that permits their free use; or are adapted for use for a different purpose by others. OER includes full courses, course materials, tests, software, streaming videos, modules and textbooks, and any other tools, materials or techniques used to support access to knowledge. UNESCO (2012) defined open educational resources as teaching, learning and research materials in any medium, digital or otherwise, which resided in the public

dominion or have been released under an open licence that permits no-cost access, adaption, use and redistribution by others, with no or limited restrictions. Open licencing was built within the existing framework of intellectual property rights, as defined by relevant international conventions, which respect the authority ship of the work. The OECD (2007) defined open educational resources as resources that are freely available which anyone could use for learning and teaching. Examples of OERs are: courses, including massive online open courses MOOCs (MOOCs), teaching materials, lectures and assignments. OERs are available in an array of formats compatible to most obviously images, text, video and audio. This study adopted the definition of OER of the Butcher (2015) who stated that OERs are teaching and learning materials which are available online for everyone to use, whether they are students, self-paced learners or instructors. Examples of OERs are: course modules, full courses, syllabi, lectures, homework, quizzes, assignments, lab activities, classroom activities, games, pedagogical materials, simulations and many more resources, contained in digital media collections from around the world.

2.3 FOCUS AREAS OF THE STUDY

As mentioned in the previous chapter the focus areas of this study embody the following: digital classroom technology, benefits of digital classroom technology, and challenges associated with digital classroom adoption, curriculum delivery, and migration of teachers to technology. Below follows a detailed discussion of each focus area.

2.3.1 What digital classroom technology is?

The term digital classroom refers to a “technology-enabled classroom where learning by the learners and their interactions with the instructor, the content and their peers are supported

through the strategic use of information and communication technologies” (HLWIKI, 2018). Eady (2013) defines digital classroom technology as digital processing systems that encourage active learning, knowledge construction, learners’ inquiry and exploration by facilitating remote communication and data sharing among learners and teachers both locally and internationally. Ramez (2016) defined a digital classroom as a “classroom that is technologically empowered with content that is used in a digital format, sufficient computing devices in the classroom and students completing part of their work using these computing devices.”

Digital classroom technology enhances the effectiveness of teaching, learning and assessment. Therefore, the use of DCT promotes and empowers curriculum implementation by decreasing the time teachers and learners spend on performing activities. Digital technology has the ability to enhance relationships between teachers and students, and the power to change teaching by ushering in a new model of connected teaching. This model helps teachers to be connected with their students, resources, professional content and systems to help them improve their own instruction and learning. The use of DCT is addressed by (Ntobovuyo, 2006) who said that digital classroom technology offers a variety of benefits, for example, achieving the needs of learners; offering teaching, learning and assessment materials; promoting the independence of learning among learners; offering teacher professional development’ and promoting teachers and schools’ networking. DCT also enhances motivation in terms of engagement at different levels of teaching and learning. Digital classroom technology has the ability to promote relationships between teachers and students. Adesina (2015) confirmed that digital technology contributes to the improvement of teaching and learning.

Twenty-first century technology can promote learner -centred pedagogy and student engagement during the interactions between a digital cohort of teachers and learners. Hasselbring & Glaser (2000) highlighted the fact that digital classrooms facilitate a student’s ability to make personal connections with others and provide opportunities to focus on attaining the required skills without fear of being stigmatised.

Meador (2017) valued digital classroom technology as imperative to improving teaching and learning professionally as an instructional planning tool to enhance the use of the internet in the teaching profession. The rationale for having a digital classroom is guided by the fact that it impacts learner-centred pedagogy and learner engagement in learning and assessment, so that teachers know the level of understanding of learners. Knish & McLean (2012) added value to the notion of a digital classroom by saying that digital technology encourages a learner-centred pedagogy; active exploration; collaboration between learners and teachers' exploratory inquiry-based learning; critical thinking; and creative, analytical and informed decision-making. Meador (2017) valued the impact of the internet on the teaching profession as an entrance to the improvement of teachers, professionally, as an instructional tool to enhance learning in the classroom.

In support of a digital classroom, (Alemu, 2015) argued that classroom technology provides the catalyst for rethinking teaching practice, developing the kind of citizens required in an information society, improving educational outcomes, and enhancing and improving the quality of teaching and learning. Learners should be able to apply classroom concepts to their daily lives. Parker (2019) stated that through digital classroom technology, learners are actively involved in the process of learning through active inquiry and discovery. Students undertake inquiry with the guidance of the teacher since learning is learner-centred. Digital classroom technology makes learning and teaching more effective.

Digital technology is phenomenal in making learning and teaching easy and interesting. Many schools are using digital classroom technologies, such as tablets, internet and laptops, to connect learners with a variety of digital services and resources. Digital classroom technology encourages active learning, exploration, knowledge construction and inquiry-based learning, which allows for communication and data sharing taking place between learners and teachers in various schools. Digital classroom technology changes the role of learners into learning explorers and the role of teachers into facilitators who guided learners to take control of their

learning (Armstrong, 2014). DCTs enable learners to interact with each other online and to participate in virtual group work, which includes messaging, texting and email.

Ministries of education across the globe have ventured into educational technology; where digital technologies are used in administration, teaching and learning across the globe. Finland, Singapore, Sweden, the Netherlands and Norway were declared leaders in the use of digital classroom technology (Crotti, 2014). Msila (2015) stated that, all over the world, there has been an attempt to transform classrooms into 21st century classrooms with the aid of digital technology. She further highlighted the fact that districts have been training teachers to use digital technology in classrooms in order to ensure that their schools are on the right path to globalisation. In Gauteng, the MEC announced that, from 2015, tablets would be issued to teachers and learners since traditional way of teaching would be phased out by the use of digital technology. A need for schools to move towards digital classrooms was supported by (Adesina, 2015) who highlighted the notion that digital classrooms contribute to an improvement in teaching and learning, (Omotoso, 2006) confirmed that the use of digital devices transforms the learning environment and (Gutnik et al., 2011) confirmed that the use of ICTs contributed to an improvement in the lives of learners, how they acquire information and how they disseminate information.

2.3.2 Benefits of digital classroom technology

The increase in the use of digital classroom technologies in schools (Department of Education, 2002; Jimoyiannis & Komis, 2007) offer benefits to teaching and learning spaces required in the 21st Century. “A large amount of research has shown that the use of ICT in education can increase students’ motivation and deepen understanding, promote active, collaborative and lifelong learning, offer shared working resources and better access to information, and help them to think and communicate creatively” (Jimoyiannis & Komis, 2007).

Digital classrooms facilitate “learners’ abilities to make personal connections in order to focus on requisite skills without fear of being stigmatised” (Hasselbring & Glaser, 2010). OECD (2020) stated that tools, such as e-books, apps, websites, and Google help the students to learn at their own pace. The availability and accessibility of ICT and e-books offers teachers and learners an opportunity to interact with learning materials with ease. There are multiple benefits to teachers provided by the use of digital classrooms, namely, “to promote workplace soft skills, such as critical thinking, and to promote independent research and cross-technology proficiency” (Sabin et al., 2016). Evans (2008) and Adeboya (2016) outlined the following benefits of DCTs, namely, “technology allows students to vary their study location and to study on the move,” Adeboya further stated that technology offers “self-directed learning; learning when it is convenient; the affordances stretch to accessing courses online and offline, allowing for easier communication, faster access, better and more comfortable studying, enables quick and easy feedback from supervisors; faster communication with classmates, lecturers and supervisors; and for the storage of course materials.” Digital classrooms allow learners to be actively involved in their own process of learning through active and creative inquiry. According to (Hasselbring & Glaser, 2010), digital classroom technology facilitates the students’ ability to make personal connections in order to focus on attaining required skills. Digital classroom technology has changed the world into global village by impacting on the social life of teachers, as well as impacting on teaching and learning (Adesina, 2015). Learning has changed from a teacher-centred pedagogy to a learner-centred pedagogy. Technology encourages active participation in the classroom since learners give feedback about the subject, while the teacher motivates and guides them.

Furthermore, (Ghavifekr, 2015) highlighted that ICTs transform education from traditional methodologies and approaches to a flexible learning system. ICTs encourage learner centred pedagogy, which is active and exploratory, facilitating collaboration between teachers and learners, creativity, decision-making and critical thinking. Ngesi (2018) highlighted the notion that ICT devices, such as mobile technology, helps to relate what was done in a school to what

learners do after school programs at home. ICT can be used as an effective tool to serve teaching and learning. Internationally, the following countries have introduced ICT systematically into the education: Chile, Costa Rica, India and Singapore. These are the four leading countries with respect to the implementation of ICT in schools (World Bank Group, 2018). ICT enhances learning and teaching and transforms learners into explores and teachers into facilitators (Salavati, 2016).

2.3.3 Challenges of digital classroom technology

Ngesi, Landa, Madikiza, Cekiso, Tshotsho & Walters (2017) highlighted that there are challenges teachers face when using digital classrooms, ranging from the non-availability of adequate resources to the inadequate access to digital devices.

Adesina (2015) revealed that the “non-availability of adequate resources and inadequate access to digital devices” is primary challenge faced by South African public schools. Adesina (2015) further highlighted the challenge of low computer literacy among teachers and an inadequate electricity supply in schools. These challenges discourage schools and teachers from venturing into the realm of digital classrooms.

Dhir, Yossatorn, Kaur. & Chen, (2018) highlighted that teachers and learners face media fatigue as a situation when using social media and might suffer from mental exhaustion after experiencing various technological, informative and communicative overloads through their participation and interactions on the different online social media platforms. Two forms of fatigue are considered, namely, fatigue due to social networking site (SNS) and mobile instant messaging (MIM) use.

Fuglseth & Sorebo (2014) stated that teachers who spend too much time on determining and planning technology sources in the classroom in learning-teaching processes, suffered from high-level techno-stress and teachers who took education on technology, had low levels of techno-stress. Teachers experience higher techno-stress when they use technological devices

they couldn't trust during hardware problems in the classroom, and low level techno-stress in Internet access.

Many public schools fail to adapt to technology change because the upgrading equipment is expensive and schools cannot afford to do this. Teachthought (2020) highlighted that challenges to classroom technology adoption as pace of change; different social dynamics; limited perceived effectiveness of technology; lack of alignment between technology, curriculum, and instruction; and lack of clarity about the purpose of a school.

2.3.4 Curriculum delivery

Curriculum is the central guide for all teachers for what is important for teaching and learning, so that every learner has access to teaching and learning. Based on the principles of the constructivist learning model, the use of educational technology is defined as a mind tool to support problem solving activities. The introduction of iPads and tablets provide learners with greater power and autonomy over what they are teaching (Gutnic et al., 2011). Hurst (2013) stated that learners have changed their way of learning as their knowledge of learning has improved and they can collaborate with each other. Learners interact with learners in other schools using technology. Franco (2018) indicated that an imperative feature of technology education is the educator's actioning (implementation) of the curriculum which includes an inclusive teaching strategy, planning, making resources available to teach with, and the assessment (evaluation) of the intended curriculum. Technology in the classroom has become dominant in the 21st century. Remon, Sebastian, Romero & Arauzo (2017) highlighted that computers and tablets are replacing text books and the chalkboard and learners can research anything they required when using smart phones and tablets.

The implementation of digital classroom technology is supported by (Ozuturk, 2011), who stated that the primary goal of a teaching curriculum is to introduce new methods of teaching by concentrating on the interest, needs and demands of students. Technology has improved

teaching with the availability countless online resources. Teachers can use different applications and online resources to enhance teaching in order to keep students more engaged. Gutnick et al. (2011) argued in support of digital classroom technology implementation since the learners of today use technology equipment from the early age, which makes their adoption of new educational technologies at school easier. Lowther et al. (2012) argued that education technology has not yet dominated teaching and learning. Webaywhwere (2018) supported the implementation of digital classroom technology that provides different opportunities to make learning more enjoyable and fun, because it allows for the same things to be taught in new ways.

2.3.5 Migration of teachers to technology

Many teachers across the globe have already migrated to digital classroom technologies because these technologies make teaching and learning processes easy and learning takes place anytime and anywhere (Eady & Lockyer, 2013). Digital classroom technologies make “the work of the teacher more interesting and relevant in this digital age. Teachers’ migration to technology makes teacher collaboration with other teachers at other schools possible.” This is also applicable to learners.

Armstrong (2014) highlighted the fact that “technology is credited as the principal factor changing the role of the teacher into that of a facilitator who guides and encourages learners.” The migration of 21st century teachers to digital classroom technology allows learners to become social constructivists. In digital classrooms, interactive pedagogical practices promote learning (Yang & Wilson, 2006). The following segment discusses theories that guide this study.

Technology use has escalated and its use in education cannot be taken for granted (Gutnick, et al., 2011). Technology makes the work of the teacher in a digital scenario interesting and relevant. If used appropriately, technology improves classroom practice and learning process. Teachers have experienced the importance of technology in teaching and learning. Teachers

teaching and learning and when making lesson plans as well as setting test through has improved through technology. Teachers who have migrated to technology differ from other teachers in a number of ways, and in their behaviour since they transfer knowledge through active inquiry. Technology is credited as the principal factor in the changed the role of teachers to facilitators, who guide learners to take control of their learning (Armstrong, 2014).

Teachers who have migrated to technology are technologically competent in their work. The South African e-Education promotes the use of classroom technology with the purpose of improving teaching and learning in all schools. Maor & Taylor (1995) indicated that the use educational software in their classroom by teachers varies according to their epistemological orientation. Teachers use technology to promote teamwork and collaboration, and to link learners to digital technology. Teachers have adopted a learner-centred approach and they are active in order to maintain attention and motivation to learners (Yang & Wilson, 2006). Technology provides immediate feedback for both learners and teachers.

2.4 EDUCATIONAL TECHNOLOGY TRENDS

In order to understand the evolution of digital educational technology, a discussion of trends is deemed crucial. A detailed discussion of the following trends is offered, namely, digital educational technology; mobile learning technology trend; flipped classroom; virtual learning; e-resources; and open educational resources.

2.4.1 Digital classroom technology

Digital classroom technology (DCT) has the capacity to “transform classrooms if accompanied by increased time-on-task, computerized learning resources, effective assessment and reporting, guaranteed individualized instruction, and facilitative teachers” (Van Dusen, & Worthen, 1995). Technology supports an approach to education that is known to be “a historical

process of cultural development that creates a more humanized world, improving humanity in people as it asserts the culture appropriation as an education process” (Haddad, Ferreira & Faria, 2014). This study by Haddad and colleagues is related to the current study because it aims to analyse the specific use of educational technology in and enables the appropriation of teaching and learning. The study by Haddad and colleagues further revealed crucial requirements for effective use of educational technology, namely, sound and easy to follow implementation guides or manual; adequate training of teachers; the and availability and accessibility of equipment. Research shows the contribution made by technology to education by enabling the acculturation and appropriation of teaching and learning processes (Haddad et al., 2014) that education strives to achieve. Hadad et al. (2014) highlighted the fact that the teacher has a pedagogical function, which is to comprehend and to intervene in, the learning process of students, showing them the paths to follow by using adequate technological resources. The teacher needs to make use of technologies and to recognise their use as an educational resource. According to (Hadad et al. 2014), the use of the internet is seen as a research tool used to access information and data. The internet can be used as a means of communication, enabling students to participate in projects, forums and debates, where they can discuss, interact and exchange experiences.

The penetration of technology has provided for the advent of flipped classrooms and virtual learning by combining educational resources with technology tools, where the teacher interacts with learners using digital classroom technology in support of education. This penetration has resulted in learners’ integration in learning and collaborating with each other on line. Learners communicate with teachers online using the internet when doing projects and assignments. In this way, virtual learning is promoted. Virtual learning requires the use of advance technology, such as Web 2.0 and 3.0. “Web 2.0 and now Web 3.0 have created new tools and technologies for facilitating web-based education and learning” (Lal, 2011), Ohei and Brink (2019) put it clearly by saying:

There is an understanding that the traditional approach is not adequate to effectively address and improve all student-learning demand or outcomes. The successive incorporation of Web and Web 3.0 tools and applications in universities may serve as additional tools to support educational goals, offering students the affordability and assortments to educational choices and learning platforms.

The new features of technological advancement has come in handy during the era of Covid-19 pandemic, where learners are using digital classroom technology to further their studies and to communicate with teachers and with each other (Mahaye, 2020). Salavati (2016) highlighted the fact that the availability of technology in schools enables quick and easy feedback for teachers and faster communication between teachers and learners.

Prensky (2001) stated that today's students have changed to the use of technology and they are no longer the people our educational system was designed to teach. These 21st century learners use smart OER phones and tablets for studying, playing games, seeking information and for communicating (Punamaki et al., 2007). Learners use technology to collaborate with each other when doing school activities. Smart phones and tablets are less expensive and are easier to carry throughout the day than desktop and personal computers are, and learners can do their school work anytime anywhere. Furthermore, digital classroom technology supports education by easing teaching and learning gaps related to knowledge gap created because of a lack of educational resources, this enabling learning space for active and interactive learning (Raja & Nagasubramani, 2018). The use of technology in education makes learning influential. Digital classroom technology supports learners in the development deep subject knowledge and understanding (Education Foundation, 2014). Tripathi (2018) stated that the increasing access to smart phones, the development of technology based learning applications, developments in artificial intelligence (AI) application and the continuously evolving virtual, mixed and augmented reality technologies are some of the factors which control and guide the adoption of technology in education.

2.4.2 The use of digital technologies in South African universities and schools

The level of classroom technology use in South Africa is very high because of the Covid-19 pandemic. Teachers and learners have migrated to digital classroom technology in order to redirect their focus on delivering alternative learning methods. Teachers teach their students while they are at home, using virtual classroom services at scale in the context of the corona crisis (OECD, 2020). The South African President, Cyril Ramaphosa, announced lockdown at the end of March 2020 and all schools and universities were closed and classes went digital, requiring learners and teachers to collaborate online using digital classroom technology. Since lockdown, teachers are using an online teaching and learning strategy to communicate with learners to ensure that learning continues. The Africa Report (2020) highlighted that, through online teaching, teachers have connection with learners and are able to support their learners in order to increase the skills level of their learners.

Mhlanga & Ndlovu (2020) highlighted the notion that, “in reality, we are of the view that COVID-19 has changed the method of teaching and learning in the education systems during the lockdown.” Tertiary institutions and schools have migrated to technology where they use online learning, using YouTube, Microsoft Teams, Zoom, Skype, WhatsApp, and Digital Satellite television (DStv) and the level of DCT is very high (Tung, 2020). Universities interact with learners using Facebook, WhatsApp and Skype. In Microsoft’s case, integrations of DCT are typically done to bring application data onto its own platform. On the flip side, Zoom is often added as integration into other platforms.

Mahaye (2020) stressed the importance of installing South African public schools with educational technology in order to ensure the accessibility of online learning to all learners in South Africa. In support, (Tatnall, 2020) stated that, in the South African education system, the level of classroom technology has improved, students use formal e-learning platforms, Moodle

and WhatsApp, to improve e-learning. However, there are studies by (Nkadimeng & Thaba-Nkadimene, 2019) and (Thaba-Nkadimene & Mogatli, 2020) that show the scourge of lack of digital classroom technology implementation faced by rural public schools in South Africa.

2.4.3 The emergence of artificial intelligence and its use in Educational Technology?

Artificial intelligence (AI) refers to the rapid growth in a technological domain capable of monitoring every aspect of our social interactions (UNESCO, 2019). AI in education facilitates automation of administrative tasks, namely, smart content in the curriculum, grading of students and personalisation of the teaching process. The aim of using AI is to provide faster, more relevant data to end-users. Russell, Stuart, Norvig, & Davis (2010) highlighted “Artificial intelligence (AI) means the simulation of human intelligence in machines that are programmed to think like humans and mimic their actions which may also be applied to any machine that exhibits traits associated with a human mind such as learning and problem-solving.”

Winn (2020) highlighted the notion that, as we move to a world that is more connected, AI is one of the major trends in educational technology which is predicted to grow by 45% through 2021. AI in education facilitates automation of tasks, namely, smart content in the (marking of students tests online) curriculum, grading of students and personalisation of the teaching process (UNESCO, 2019). The following discussion focuses of Web 1.0, Web 2.0 and Web 3.0.

2.4.3.1 The emergence of Web 1.0

Strickland (2007) defined Web 1.0 as a techno-social system of cognition that allows humans to publish their ideas and to engage with the ideas of others. The emergence of Web 1.0 made it possible to retrieve and display information stored on the internet in a systematic way, in the shortest possible time, at minimal possible cost (Mata & Quesada, 2014). According to Pegrum

(2019), Web 1.0 offered students the freedom to the use authentic materials and scenarios, exposure to multi-literacies and a limited level of interactivity. Naik, & Shivalingaiah (2008) highlighted the fact that Web 1.0 provided people with the ability to get information by going directly to the source.

Web 2.0 refers to the social use of the Web, which learners use to integrate with each other and collaborate, actively involved in creating content to generate knowledge and to share information with each other online (Grosseck, 2009). Turban, King, Lee, & Viehland (2004:808) described Web 2.0 as “a liked term for advanced Internet technology and applications including blogs, wikis, RSS and social references.” Constantinides & Fountain (2008) described Web 2.0 as “a collection of open-source, interactive and user controlled online applications expanding the experiences, knowledge and market power of the users and participants in business and social processes.”

2.4.3.2 The advent of Web 2.0

Grosseck (2009) stated that “Learners collaborate actively when using Web 2.0 technologies which allow them to get involved in creating content, and to share and exchange online information.” With Web 2.0, learners have the ability to solve problems, work collaboratively with each other, explore creativity, work cooperatively and constructively (Grosseck, 2009). Web 2.0 technologies allow learners to share online information. Teacher’s give learner’s pre-emptive teaching by adopting an activity-based form of group and individual work to face knowledge experiences.

Hargadon (2008) indicated that “Web 2.0 is the future of education once learners engaged in using technologies they will discover it is worth the effort and they will enjoy its profits.” Constantinides (Fountain, 2008) stressed that Web 2.0 applications support the creation of informal user networks, facilitating the flow of ideas and knowledge by allowing the efficient generation, dissemination, sharing and editing/refining of informational content. According to

(Palaigeorgiou & Grammatikopoulou, 2015), Web 2.0 learning promotes a learner centred strategy and assists learners to learn, cooperate and create digital content reflecting on their thoughts.

2.4.3.3 The launching of Web 3.0

According to (Bruwer & Riaan, 2015), Web 3.0 is said to be the new paradigm in web interaction and will change how developers create websites; more importantly, Web 3.0 will influence how people interact with each other using those websites. Techopedia (2019) further says that computer scientists and internet experts believe that this new web will further make people interact with each other online. Web 3.0 is able to understand words put into search queries in the same way that a human would, enable it to generate and share better content. Ohei & Brink (2018) highlighted the understanding that Web 3.0 will enhance and improve the processes of education. The mode of delivery is very important to take into consideration when designing learning activities that will support learners in their quest to develop the knowledge and skills required achieving the intended learning outcomes. Ansari & Khan (2020) stated that Web 3.0, used for collaborative learning, has a significant impact on interactivity with peers, teachers and online knowledge-sharing behaviour. According to (Dogan, Soylemez, Ozcan & İşleyen 2018), Web 3.0 makes the internet much faster, as well as making it easier to search for information.

2.4.3.4 Gamification and the use of video games design

Gamification is an approach to enhancing people's experience of a service or system by incorporating game-like experiences into the service or practice (Leaning, 2015).

Gamification has turned the learning process into a more fun, engaging learners in all learning activities. Gamification was found to positively influence engagement in learning variables, such as "computer self-efficacy, meaningfulness, mastery goal, performance-approach goal, and performance-avoidance goal" (Poondej & Lerdpornkulrat, 2016). Video game designs and

gamification are two different things. The difference is that video games offer enjoyment and rewarding digital interactions to learners, while gamification integrates game mechanics with training content to turn learning outcomes into practice (Garbade, 2019). According to (Papadakis, 2018), using video games in the classroom kept learners actively involved in the lesson. This education technology trend has improved the concentration levels of learners. Adding games to the lesson accommodates all learners, including those who learn slowly. The use of video games in the classroom enhances learning since all learners would improve their learning. All learners participate actively and are involved in discussions after the lesson (Costley, 2014).

Online games offer increased social interaction and engagement between the children and youth (Sholikhah, 2011). In this study, it was further revealed that educational games attract the interest and attention of learners (Sholikhah, 2011). Teachers brought video games into the classroom and this made learning more interesting, particularly for learners who are slow to learn, increasing participation in the class. Sholikhah (2011) found that gamification turned the lessons in the classroom into more interesting and more fun activities. Videos give learners the opportunity to understand the lesson and they were able to give feedback on what they have watched on the video. Learners become more active and were able to discuss and debate, and come up with the solution to the activity. The teachers guided learners in solving problems and encourage them.

2.4.3.5 Mobile learning technology trend

“Although smartphones have only been invented for a few decades, mobile phones have become an indispensable tool in our lives” (Ku, Chen, Zhu, & Huang, 2018) Mobile learning is no longer used like library books; however, it allows communicative pedagogy and has created digital interactive spaces for 21st century learners and teachers.

P21 Partnership for 21st Century (Leaning, 2015) further highlights that “in learner centred, technologically-enabled postsecondary classrooms, twenty-first century digital and mobile technologies provide avenues for flexible, personal learning for different groups in the same classroom and enable individual discovery.” Lan & Sie (2010) defined mobile learning as a learning model which provides learners with access to educational materials, anywhere and anytime, through the use of the internet and mobile technologies.

Mobile learning enhances the education experience by allowing students to access high quality content wherever they are and to improve the learning experiences of students with physical challenges (Lan & Sie, 2010). Mobile learning applications have the ability to share knowledge without any limits placed on space and time; it facilitates the development of critical thinking, participatory learning and problem solving; and the development of lifelong communication skills (Abidin & Tho, 2018). Liaw, Hatala & Huang (2010) stated that mobile learning increases the value of existing learning styles but can never replace traditional teaching strategies. On the other hand, “WhatsApp was found to be the most preferred collaborative learning platform and valuable tool for communication of pedagogical information because of its Web 2.0 with MIM technology features” (Thaba-Nkadimene, 2020).

2.4.5.1 Smart phones

Rouse (2020) defined the smart phone as a cellular telephone with an integrated computer and other feature not originally associated with telephones, such as an operating system, web browsing and the ability to run software applications. Smartphones, which were released in 2016, have a screen size of 5 in (130 mm), with larger versions, such as iPhone 7 Plus, Pixel X, and Samsung Galaxy S7 Edge which uses 5.5 in (140 mm) displays. Earlier smartphone screens had ratios of 16:9, while now screens of 18:9, 18.5:9 and even 20:9 and are more convenient to use. Now as the displays have become longer and narrower where 6+ inch screens are more convenient than phones of earlier generations.

2.4.5.2 Tablets or iPad

Learners with access to a smart phone or similar device such as an iPad or a tablet,” they are exposed to a “valuable sources of knowledge, helpful teaching tools and motivators of learning” that are brought about by access to such devices (Mare, 2019). “Studies proving the benefits of using iPads in the classroom range from Pre-schoolers using devices getting better results for literacy than their peers not using devices, to iPad-equipped medical students scoring 23% higher in their final exams than previous classes who were unequipped” (Mare, 2019). A study by (Lazarus, Sookrajh & Satyapal, 2017) found that, when tablets were used as mobile devices, engagement was focused on accessing lecture notes, whereas constraints, such as poor Wi-Fi connectivity, were identified as challenges to teaching and learning.

2.4.6 Cloud technology trend

Weinhardt, Anandasivam, Blau, Borissov, Meinel, Michalk, & Stober (2009) highlighted that cloud Computing (typically referred to as simply "Cloud") is the on demand availability of computer system resources, especially data storage and computing power, without direct active management by the user. The term is generally used to describe data centres available to many users over the Internet. Large clouds, predominant today, often have functions distributed over multiple locations from central servers.

Wang, Liang, Jia, Ge, Xue, & Wang, (2016) stated that cloud computing refers to the provision of computing capability as a product, rather than a service, for example, shared resources, software and information are provided to computers and other devices as a benefit over the internet. According to (Attaran, 2017), academics, students, businesses and government would no longer face the problem of losing valuable information and documents, transposing heavy books and using USBs with cloud technologies. Teaching documents would be shared in a joint network in order to facilitate learners learning and teachers' tasks.

Cloud technology has vast benefits to the education fraternity. According to (Vu, Hartley & Kankanli, 2020), learners and teachers interact with each other, get connected and manage information faster, and in a more dynamic way, using cloud technology.

Cloud-hosted contributions are shared between different schools and universities, while applications and services, such as tools for collaboration between students and different institutions, allow social communities to be implemented (Hirsch & Ng, 2020). Teachers and students upload documents, textbooks and other materials to the cloud (Appiahene, Kesse & Ninfaakang, 2016) whenever they need them. By using the cloud-based technology, the education system could build an endless storage of learning information, with unlimited potential of use. Teachers and learners could access data stored in a cloud-based system from any device with an internet connection.

The use of educational technology is absolutely necessary for personalised learning (Cha, 2020). Personalised learning using ICT focuses on the learning of tomorrow, namely, lifelong, personalised learning in a social environment, supported by technology. Personalised learning requires the development of new ICT-rich learning arrangements and professional teachers who are technology competent. The ability to use educational technology is, essential, a skill which teachers should train learners. ICTs contribute learning to education that does justice to the differences between the learning potential and the development needs of the present generation of learners, and to the rapidly changing demands of knowledge society. Aydin (2007) stated that the 21st century learners do not just develop ICT skills; they are trained to have these skills. ICT teachers in schools have trained learners in computer literacy using computers. Learners collaborate with teachers, experts and other students, for the benefit of professional practice (Davis, 2020). ICT provides students with skills required for improving education by communicating with each other, using smart phones, tablets, Skype, email and texting. They collaborate with each other online when doing projects by sharing information.

2.4.7 Flipped learning trends

The flipped classroom concept promotes collaborative pedagogy, learner engagement and active learning (Keengwe, Onchwari & Oigara, 2014). Collaborative learning in education is empowered by a wide range of social media technologies, such as email, texting, videos, Skype, Google and teleconferencing (Lee, Abdullah & Kiu, 2016). According to Le, Janssen & Wubbels (2018), true collaboration requires a trained teacher who is technology competent. Learner engagement in flipped classrooms is their desire to actively participate in class activities, such as submitting homework, working on what the teacher has asked them to do, listening to the topic and attending the class (Yang & Cheng, 2014). In support, (Kim, 2014) stated that learners engage actively in flipped classrooms and are able to prepare for class activities by accessing and exploring online learning materials before coming to class. Kim (2014) further stated that the success of flipped classrooms relies on learners undertaking out-of class activities and being motivated to work independently.

Heick (2018) highlighted the fact that learners feel confident when learning because they have already prepared themselves before coming to class and they are able to participate in debates and discussions, as well as solve problems and exchange ideas with peers. The use of flipped classrooms promotes critical thinking in learners and promotes development, engagement, and learner empowerment (Keengwe et al., 2014). Learners interact with each other in a flipped environment in the classroom and in distance learning. They interact communicate with all elements of the learning environment, including the teacher, other learners and the content (Woo & Reeves, 2007). This proves that learners in a technology environment are more effective in learning than in traditional classroom (Johnson, Jacovina, Russell, & Soto, 2016). Darling-Hammond, Flook, Cook- Harvey, Barron & Osher (2019) stated that technology helps learners to interact easily with all communities, both inside and outside the classroom. Learners are able to interact with teachers online when doing homework.

The goal of the flipped classroom in education is to enhance the learning and achievement of learners by focusing on class activities and on learner understanding, rather than on teaching. Technology in the flipped classroom is utilised to promote learner achievement. A flipped classroom is more effective compared to the traditional classroom in terms of learner achievement (Tomas, Evans, Doyle & Skamp, 2019). In the flipped classroom teachers evaluate learner improvement in their learning activities through formative assessment. Learners who do not perform well, can watch the videos again in order to improve in the next formative assessment (Kim, 2014)

2.4.8 Virtual learning trends

Virtual learning environments offered by Blackboard, Canvas & Renweb extend the classroom and the administration offices (Watson & Watson, 2007). Virtual learning requires student to master lesson content or a skill before moving forward and learners are required to demonstrate mastery in the lesson or topic by answering all questions correctly (Dougherty, 2020). This mastery is very difficult but it makes sense; for example, we would not settle for a cardiologist who is 70% competent to perform a heart operation. Mastery is highly needed in cases like this; therefore, 100% competency is required. Intensive use of online study tutorials and teacher assistance are required. Kokotsaki, Menzies & Wiggins (2016) highlighted the fact that many convectional classrooms operating in project-based learning manner. Students work on subject-specific educational projects, instead of reading chapters, writing tests and answering questions. Projects are done in a group. Project-based learning programmes cover all learning outcomes and train students to work in groups, solve problems and break down projects in parts. Online students remain connected online; learn how to communicate and cooperate; and how to be committed group member.

According to (Hybrid Hall & Villareal, 2015) a hybrid model combines online and in- person classes, where students balance the accessibility of online attendance with access to campus resources, such as fellow classmates, lectures and the library. Some schools demanded a

hybrid option because of school restrictions on online classes. According to Illaria (2016), many students find the hybrid model the most attractive for their learning. In some colleges, most online programs required learners to attend a bricks-and-mortar classroom. Tam, El-Azar & Project (2020) stated that the most surprising areas for innovation in online education are found in the home schooling movement. According to (Gross, 2001), enrolment classes, dual-credit classes and the administration of college level courseware for high school students has been conducive to advance the cause of the online learning. He further highlighted the notion that unschooling learning nurtures and encourages curiosity by allowing students to choose what to learn and how to learn. This movement promotes a borderless world of exploration. Students use unschooling to watch videos, peruse free courseware or read lecture notes. Education is not the same as going to school (Tam, El-Azar & Project, 2020). Online education enhances and diversifies opportunities to drive students own learning.

Passig (2009) stated that the adoption of virtual reality (VR) in education occurs because of the increase in demand for experimental learning. The adoption of VR has facilitated fast-growing trends towards independent and collaborative learning by taking learning beyond the classroom. Learners watch virtual videos outside the classroom and use class time to discuss what they have learned, assimilate knowledge and debate what they have done at home Mazur (2009). Having sound knowledge of the activity gives learners confidence when going to the class. Learners give feedback to the class, as well as debate, discuss and solve the problem. Polly, Allman, Casto & Norwood (2017) stated that the teacher motivates and guides learners to finalise the activity, learners collaborate with each other. DCT prepares learners for the future. Cebrián (2020) highlighted that a smart learning environment is one of the major trends in education. These trends encourage a personalised education system, better engagement and improved skills enhancement. The contemporary learning process becomes integrated into teaching and learning and complicated, therefore smart learning environments have been adapted to change and transform the way learners learn.

2.4.9 E-Resource trends

Injac-Malbaša (2014) highlighted that electronic resources are accessible in libraries as licensed with paid services and open free e-resources. We can say that other name for open e-resources is open access resources. Jamridafrizal, Pratiwi - Maktabatuna, (2019) stated that e- resource is distinguish through OA resources (articles, journals, books, thesis, databases etc.) and open digital heritage (journals, books, non-book material, audio and video material, etc.), mainly intended for general public. Companies such as Amazon and Google have developed user-data-driven processes to provide personalised services to their clients (Chaffey & Ellis-Chadwick, 2013). Therefore, ARLS have developed practices and technologies designs to improve patron interactions with library computer systems, as well as the use of space, signage and any other aspects of patron touch points with staff and library resources (Liu & Ma, 2018).

2.4.10 Open Education Resources (OER)

Open educational resources support all forms of learning, from elementary through higher education (UNESCO, 2015). Internationally, OERs include digital and print books for students who do not have sufficient reading resources. It enables the low cost translation and modification of learning material for cultural appropriateness so as to increase access to this material by speakers of underserved languages, which engages and empowers learners in learning (Huttner, Green & Cowher, 2018). Textbooks are very expensive and some students cannot afford to buy them (Valle, 2019). The amount of money students spend on course materials has rapidly increased because of a lack of competition in the higher education publishing industry. Digital textbooks, especially those that come with access codes, have also contributed to rising costs. When students buy a textbook, they are not just paying for the binding and the pages; they are paying for the research, editing, production and distribution of the book.

Senack (2014) highlighted the following: “Through virtual learning students are forced to be creative and save money, borrow, share and rent textbooks while Open educational resources had finally offered solution that helped students and colleges to eliminate textbook costs.” Ikahihifo (2017) highlighted that students prefer OER over traditional resources because of cost saving. OERs make it possible for every student to have their own copy of the required course text. Colvard, Watson & Park (2018) stated that faculties that use OER are not just saving the students money, they are directly impacting student’s ability to enrol in, persist through and complete the course successfully.

Darling-Hammond, Flook, Cook-Harvey, Barron & Osher (2019) highlighted that OER gives teachers the choice to adapt full lesson plans that align with individual student learning styles, which help them to meet all needs of all students). Teachers find ready to-use materials that are best for their students, and they can create their own resources and share them on a website. Hodgkinson-Williams, Arinto, Cartmill & King (2017) stated that students and teachers are able to print and modify OERs without being limited by copyright restrictions. Teachers can update OERs, making sure that students receive the most current accurate available information, without waiting for updates to the textbook. Students and teachers can keep their materials forever, not just for a short period of time with OER. As teachers around the world increasingly use OER, they are creating a growing movement in support of freely high-quality resources which meet the needs of learners. OERs give teachers the power to create what is best to their students in order for them to embark on their own adventure towards future success.

Academic staff is encouraged to use student feedback on OERs to improve their own material and to publish and contribute to OER (UNESCO, 2015). Students are supported and encouraged to use OERs for the purpose of self-directed study of developing the curriculum. The use of OERs gives learners and teachers freedom to decide when to access content and

whether they want to alter the content because of the potentially non-destructive and recorded nature of the original material and all versions they make of it. OERs are learner-centred because they contain quality frameworks for formal educational materials to be used in formal and informal settings (National Academies Press, 2000).

New technologies are explored collectively to open up the recognition of achievements gained through individual learners and group-based participatory learners to create cost-effective and credible systems and processes. Navarrete, Sergio, Luján-Mora & Peñafiel (2016) highlighted the fact that the availability of OERs has become a valuable opportunity to foster access to high quality educational content released by academic institutions and universities around the world, under open licenses that allow adaptation, free use and reuse. Furthermore, OERs have different formats, such as web pages, video streaming, presentations, documents, images and podcasts. The participation of higher education in the OER movement has encouraged a greater diversity of learners and teachers to harness these materials. Teachers can customise OERs to fit their needs in different educational contexts in order to support the learning outcomes of their students. The most representative stream of OER is open courseware (OCW). OCW is published in the public domain and enables all materials in a course to be adapted, redistributed and used according to open license conditions.

2.5 THE ROLE OF THEORY IN THE STUDY

The role of the theory in this study is captured by (Kelly, 2010), who identified three important areas of influence in educational research, namely: that “theory influences research design and development of research questions; theory underpins methodology; and theory used to help develop other theories.” The world of education develops new movements, frameworks and theories to explain how learning occurs and how learning environments must be conducted. Armstrong (2014) highlighted that learning has changed teachers from teacher-centred to

learner-centred. Researchers are guided by theories in order to frame their research studies. In this study, the technology acceptance theory, change theory and social constructivism were adopted as the theoretical frameworks which guided the researcher.

The technology acceptance model (TAM) was chosen in order to understand the following: teacher perceptions of the ease of use and the usefulness of digital classroom technologies, and how these technologies help in promoting inclusivity and collectivity in the learning process; how learners process information; the choice of educational strategies and the promotion of collaborative learning. The technology acceptance theory by (Vankatesh & Davis, 2000) explains the factors that influence the adoption of education technologies and the use of such technologies, in this case,

DCTs. This theory is premised on two fundamental principles, namely, “perceived usefulness and perceived ease of use” (Vankatesh & Davies, 2000). The principle of perceived usefulness is used in this theory to guide the framing of, and reporting on, the research questions.

2.5.1 Technology acceptance model

The TAM is selected to understand teachers’ perceptions of ease and usefulness of digital classroom technologies and how these technologies could help in promoting inclusivity and collectivity in the learning process; how learners process information; the choice of educational strategies and the promotion of collaborative learning. This theory is premised on two fundamental principles, namely, “perceived usefulness and perceived ease of use” (Vankatesh & Davies, 2000). The principle of perceived usefulness was used in this study to guide the framing of, and reporting on, the research questions.

Furthermore, TAM was adopted in this study (Davis et al., 1989) found TAM to be a better predictor of intentions to use DCTs than TRA. TAM predicts that user acceptance is determined by three factors, namely: perceived usefulness, perceived ease of use and behavioural

intentions. TAM was used to investigate the acceptance of technology, such as the World Wide Web and software utilisation, by teachers and learners (Dishaw & Strong 1999). Furthermore, the TAM has been used to investigate student acceptance of online courses, course websites, online communication for a class projects and the perception of computer technology in relationship to their intension to use computers (Yuen & Ma, 2002).

A theory of TAM that was developed by (Davis, 1986) and its improved version by (Vankatesh & Davis, 2000) was used to understand the use of classroom technology in four Limpopo CoLab schools and how classroom technologies influenced teaching and learning. The theory of (Vankatesh & Davis, 2000) is premised on two principles, namely, perceived usefulness and perceived ease of use. The adoption of technology by a department or school does not guarantee automatic acceptance by teachers; however, an individual teacher can choose to accept and use classroom technology to improve learning environment (Un Jan & Contreras, 2011).

The research findings from this study show that principals, heads of department and teachers have accepted digital classroom technology but all schools do not have sufficient technologies to use for teaching and learning. TAM has succeeded for social influence in the acceptance, adoption and utilisation of new classroom technology and has created a platform for information technology researchers to understand classroom technology use behaviours (Un Jan & Contreras, 2011), through the principles of perceived usefulness and perceived ease of use. The principle of perceived usefulness is premised on the belief that the work performance of individuals can be improved when a technology is used (Vankatesh & Davis, 2000). The second principle, perceived ease of use technology, is premised on the belief that there is no need to try hard to learn a new technology (Vankatesh & Davis, 2000). The research questions were informed by TAM (Davis 1986, Vankatesh & Davis, 2000).

The research questions posed are as follows:

1. How do teachers perceive the usefulness of classroom technology?
2. How do teachers perceive the ease of use of classroom technology?
3. What is the level of classroom technology usage by teachers and learners?

2.5.2 Change theory

Change theory is relevant to this study because it focuses on how people and systems change. The theory of change explains how an intervention is expected to produce results. Boyatzis (2006) highlighted the idea that student's processes information and how teachers can use educational strategies to promote student understanding of materials. Change theory inspires teachers and learners to facilitate learning to become creative in global society. Teachers use a full range of digital classroom tools to improve learner engagement and achievement. Pitler et al. (2007) described how students can better understand new material when incorporating technology into learning. They further indicated that students use word processing software, such as Microsoft Word, to track changes made to a particular written passage in order to summarise the passage. Change theory provides people with an understanding of technology and how technology changes people's way of life. Gibbs (2017) highlighted that computers are changing the way people work and relate to each other. Technology changed the environment and processed new information using creative, critical and problem-solving skills. The theory facilitates an understanding of learners from the principle of inclusivity, individuality and collectiveness. Adam-Turner (2017) highlighted that digital classrooms are inclusive because they accommodate learners with varied digital literacies or mental capacities. The principle of individuality requires teachers to understand that students are unique and that they learn in different ways. Meyers (2018) stated that the principle of collectivity helped the researcher to understand the value of collaborative learning in digital or flipped classrooms.

2.5.3 Social constructivism as a theory

Social constructivism was adopted in this study because of its focus on the notion that human development is socially situated and knowledge is constructed through interaction with others. Constructivism is a departure in thought about the nature of knowing of teaching and learning. Tam (2000) stated that the constructivist perspective describes learning as a change in meaning constructed from experience. Bruner (1996) stated that learners construct new ideas based on their current or past knowledge. He also believed that constructivist learners transform information, construct hypothesis and made decisions relying on cognitive structures.

Vygotsky (1978) stated that social interactions play a key role in the development of cognitive function, and that higher order thinking results from relationships between individuals. In social constructivism, learners are incorporated into a knowledge community based on language and culture. Technology has influenced the pedagogies of social constructivism significantly. According to (Desai, Monteiro & Narayan, 1998), instructional design is a critical factor in the creation of effective online instruction. They further stated that one of the most important steps in creating a successful e-learning environment is the development of flexible technology-based on course content. Shah (2013) indicated that as a result of technology students and teachers learning and teaching have changed and students do not depend on teachers as the main source of information any longer. "Web-based environments are important forums for joint problem solving, sphere of ideas and knowledge building" (Nevgi et al., 2006). Students learn in a social setting by communicating with more people who are knowledgeable; therefore, educators need to be active in order to maintain the attention and motivation of the learners. Students interact with each other online and participate in virtual group work, which includes email, texting and instant messaging. Robler (2006) highlighted the fact that constructivist learning theory includes inquiry-based integration strategies.

Thomas (2010) stated that constructivist teaching strategies are affective in achieving the desired educational goals of constructing knowledge through active and creative inquiry. To

succeed as a 21st century teacher, one has to become a social constructivist. The social constructivist teachers adopt learner-centred strategies that support interaction and collaboration between learners. Digital classrooms allow learners to be actively involved in their own process of learning through active inquiry and discovery (Naude, 2014). The principles of this theory that the researcher focused on are: knowledge is constructed through interaction with others; and learning is viewed as an experienced-based process of inquiry.

2.5.4 Integration of the three theories

Integration of the technology acceptance model, the change theory and the social constructivism theory were necessary in order to understand the possibilities and challenges in the process of moving towards DCT adoption in secondary schools in the Capricorn District. The three theories integrate because learners collaborate, engage and build their own knowledge by working in groups online, effectively. Digital classroom technology is inclusive because it accommodates all learners, including physically challenged learners, Active inquiry and discovery. Digital classroom technology allows learners to be actively involved in their own process of learning through active inquiry and discovery. For example, learners are able to use the internet on their own to find information. Digital classroom technology allows learners to be actively involved in their own process of learning through active inquiry and discovery. For example, learners are able to use the internet on their own to find information International and local education systems have changed from teacher-centred learning to that of learner-centred learning. The principle of collaboration in social constructivism promotes integration of technology into learning and teaching. Learners engage in online collaboration and build their group knowledge.

2.6 CHAPTER SUMMARY

In this chapter, the researcher presented a review of the literature pertaining the levels of DCT availability and the use of technology by teachers in selected schools in the Limpopo Province. This chapter started with introduction, definition of concepts, namely, the digital classroom, ICT, pedagogy, the flipped classroom concept, virtual learning and e- resources and open educational resources were defined. A discussion was further advanced to clarify the focus areas of the study namely: what is digital classroom technology; benefits of digital classroom technology, challenges of digital classroom technology, and benefits of digital classroom and migration of teachers to technology were outlined. Educational technology trends, comprising the following, DCT trends, the use of digital classroom technology in South African Universities and schools, the emergence of artificial intelligence and its use in educational technology, the emergence of Web 1.0, advent of Web 2.0 and the launching Web 3.0 were discussed. Mobile learning trend, smart phones, tablets or iPad was elaborated; cloud technology trends, flipped classroom trends, virtual learning trends, e-resource trends and OER trends were discussed. Lastly a discussion of the theories framing the study, namely, the technology acceptance model the change theory and social constructivism were discussed.

CHAPTER 3: RESEARCH DESIGN AND METHODOLOGY

3.1 INTRODUCTION

This chapter focuses on the research design and methodology. In this chapter, the researcher discusses the interpretivist research paradigm; the qualitative research approach; case study research design; population and sampling; sampling techniques; data collection methods; data analysis methods; quality issues and ethical considerations.

3.2 RESEARCH PARADIGM

This study adopted interpretivist research paradigm, which informed the nature of the research questions. Paradigm is a concept introduced by (Kuhn, 1962) in his book “The Structure of Scientific Revolutions” which refers to a philosophical way of thinking.

Kivunja & Kuyini (2017) stressed that paradigms offer a “worldview is the perspective, or thinking, or school of thought, or set of shared beliefs, that informs the meaning or interpretation of research data.” The interpretivist paradigm offers philosophical tools that allow researchers to gain a deep understanding of a phenomenon and the complexity of that phenomenon within the context that the phenomenon exists (Creswell, 2007). This study tapped on benefits of the interpretivist approach outline by (Kivunja & Kuyini 2017), as follows:

Every effort is made to try to understand the viewpoint of the subject being observed, rather than the viewpoint of the observer. Emphasis is placed on understanding the individual and their interpretation of the world around them.

3.2.1 Epistemology and ontology

Epistemology and Ontology helped the researcher to recognize how certain she can be about the truth and existence of DCT in selected schools. Charmaz (2006) stated that research design is consistent with epistemology and ontology by “placing priority on the phenomena of study and seeing both data and analysis as created from shared experiences and relationships with participants and other sources”. Epistemology and Ontology ensured this study in providing reliability (consistency of results obtained) and external validity (applicability of the results to other contexts) and they relate to the idea that reality can be expressed in a range of symbol and language systems and stretched and shaped to fit the purposes of individuals such that people impose meaning on the world and interpret it in a way that makes sense to them (Moon & Blackman, 2014).

3.3 RESEARCH APPROACH

The interconnection between the interpretivist paradigm and the qualitative research approach is reflected in (Thahn & Thahn, 2015), which resulted with the adoption of a qualitative research approach in this study.

This approach offers an “opportunity for an in-depth description and understanding” (Creswell, 2004) of teacher perceptions of the use of DCTs during curriculum implementation. In support, (Niewenhuis, 2007) highlighted the fact that qualitative research focuses on describing and understanding a phenomenon in its natural context. This qualitative research method is applicable in this study because it affords the researcher a platform from which to conduct face-to-face interviews and interact with research participants in their natural settings (MacMillan & Schumacher, 2010)

According to (Simons, 2009), multiple case studies have the potential to engage participants in the research process. The researcher used a descriptive research design to collect data that

described events and then organises, tabulated, and measured the data to establish trends and patterns relating to the availability of school resources and how these resources influence the quality of teaching and learning.

3.4 RESEARCH DESIGN

This study adopted a descriptive multiple case study research design to explore, understand and examine the level and usage of DCT, in selected secondary schools in the Capricorn District. The study further explored teachers' use of, and their perceived ease of use of DCT. This research design afforded the researcher an opportunity to document multiple perspectives, identify contested viewpoints and demonstrate the influence of key actors and the interactions between them (Baxter & Jack, 2010). According to (Simons, 2009), multiple case studies have the potential to engage participants in the research process. The researcher used a descriptive research design to collect data that described events and then organises, tabulated, and measured the data to establish trends and patterns relating to the availability of school resources and how these resources influence the quality of teaching and learning.

3.5 SAMPLING

Sampling refers to the process of collecting selected groups of individuals from a population that displays the characteristics that are the focus of the study. Drabble and O' Cathain (2015) refer to sampling as the targeting of a population that participates in a research inquiry.

From the population of ten Limpopo CoLab secondary schools, four schools were selected. Four schools were chosen purposively based on the criteria of size and performance according to academic results. The sample comprises two relatively small schools, and two relatively large schools. Of these schools selected, two are classified as high performing schools and two are classified as low performing schools. In each of the case schools, one principal, one head of

department and one teacher was sampled to make the total of 4 school principals, 4 heads of departments and 4 teachers sampled in this study. Purposive sampling was used in this study to select 12 participants because of their ability to contribute to rich information that addressed the research questions (Creswell & Creswell, 2018). As a researcher I used purposive sampling to select participants who are knowledgeable experts with the use of Digital Classroom Technology.

3.6 DATA COLLECTION

The collection of data was aimed at answering the research questions and addressing the research problem. Burns & Grove, (2010) stated that “data collection is a process that involves systematic gathering of information relevant to the research question and problems.” In this study, data was collected using interviews and document analysis. Data collected is important in this study since they informed the findings. Data was conducted at the school premises of four selected schools.

3.6.1 Interviews

The first data collection method to be used in this study involved interviews. According to (Babbie, 2010), interviews afford the interviewer a chance to observe respondents in their surroundings and to develop an in-depth understanding of the participants. In support, (Turner, 2010) highlighted the notion that “interviews provide in-depth information pertaining to participants' experiences and viewpoints of a particular topic.”

Furthermore, (Englander, 2012) stated that face-to-face interviews are “richer in terms of nuances and depth.” Interviews with open-ended questions offer a platform for follow-up and clarity-seeking questions. Semi-structured and face-to-face interviews were conducted at the schools premises to enable the researcher to obtain in-depth data.

The aim of using interviews was to document in-depth and detailed information received from the research participants in terms of their lived experiences of, perceptions of, and reflections on the availability or non-availability of school resources and the influence of these resources on the quality of teaching and learning. A Pilot study was conducted in 2018 for two weeks in selected schools and interviews were conducted in 2020 before the covid19 pandemic in one week.

3.6.2 Document study

Document analysis was used as a data collection method in this study. Document analysis was used to gather data from the four schools. The document study involved a review and analysis of data from school documents, such as the SGB minute book, the staff minute book, purchase books and computer room rosters, as well as assets and maintenance files, ICT policy, lesson plans and teaching materials. The data obtained from the document study was used to provide voice and meaning to the research problem and the research questions (Bowen, 2009). Data from these documents reflected on how DCT and issues related to technology in the selected schools, were deployed, adapted and directed in order to foster meaningful classroom encounters.

3.7 DATA ANALYSIS

The data collected was presented using tables, pie graphs and discussions. Biographic data was presented using tables and charts. Qualitative data from interviews and document study was packaged, processed and categorised into patterns in order to identify emerging themes for analysis. Such data was analysed using thematic analysis and narratives. According to (Hsieh & Shannon, 2005) thematic analysis refers to a “research method that is used for subjective interpretation of content text data that is categorised into themes that results from systematic classification process of coding and identifying themes or patterns.” Emerging

themes were presented and discussed. The discussion of the findings was supplemented by the narratives of the participants and the literature. Thematic and narratives analysis were used in qualitative research and focused on examining themes and patterns of meaning within data.

3.8 QUALITY CRITERIA

Every study needs to adhere to certain standards in order for it to be valid. This is important because it gives the study credibility and ensures that all the work done is shielded from elements that could compromise and jeopardise its credibility and value. The researcher adhered to the following quality issues, namely, trustworthiness, credibility and dependability.

3.8.1 Trustworthiness

Trustworthiness is mostly dealt with in qualitative research as an important data validation quality issue. “Every qualitative researcher is obliged to ensure that research findings are credible and trustworthy so that they can be interpreted, applied in the field and benefit researchers and other interested parties” (Gay, Mills & Airasian, 2011). For the purposes of this study, an element of trust was established between the participants and the researcher. Trust is crucial because, in order for individuals to take part in the study, they need to trust the researcher. In this study, the researcher achieved these goals by employing member checking of data collection tools. Participants and respondents were furnished with interpreted results in order to verify the correctness of the interpretations. The researcher reported the findings of the study in a complete and honest manner, without misrepresenting what respondents said.

3.8.2 Credibility

In order for any study to be credible, the researcher must consider the truth and confidence that can be placed in a study. In this study, the researcher ensured that information obtained from

the participants, as well as the original data, were correctly interpreted and was reflective of the participants' original views, as presented to the researcher (Graneheim & Lundman, 2004).

3.8.3 Dependability

Dependability aims to ensure the reliability and repeatability of research is consistent (Cohen & Crabtree, 2008). This study provides detailed research collection and analysis methods and procedures, and how they were used, in order to assist in the replication or repeatability of the study.

3.8.4 Triangulation

Triangulation refers to a “qualitative research strategy to test validity through the convergence of information from different sources” (Carter, 2014). In support, (Patton, 1999) defined triangulation as the use of multiple methods or/and data sources in qualitative research to develop comprehensive understanding of phenomenon under study. In this study, triangulation was used as qualitative validation strategy, where data from interviews and the document study were used to understand the levels and usage of DCT and teacher usage of technology in selected schools in Limpopo Province. This study achieved three of the four triangulation methods identified by Patton (1999), namely, method, theory and data triangulation.

3.9 ETHICAL CONSIDERATIONS

In conducting a study, “it is important for the researcher to bear certain ethical considerations in mind” (Flick, 2011). In support, (Creswell, 2007) argued that, in order to gain the right of entry into any field of research, such entry should be authorised by the management office. This entailed applying for ethical clearance from the University of Limpopo before conducting the research. “Social research and other forms of research which study people and their

relationships to each other and to the world, need to be particularly sensitive about ethics” (Walliman, 2005). The following areas received the researcher’s attention before embarking on this study: seeking permission from the University of Limpopo to undertake the study and applying for ethical clearance to do the study; obtaining permission to undertake the study from the Limpopo Department of Education, the Capricorn District, and the four schools; and, obtaining informed consent from the research participants. Moreover, the research participants signed an informed consent form. Other areas addressed included voluntary participation in the research, research integrity and protection from harm. The identified ethical measures were taken into consideration during the entire process of the study.

3.9.1 Permission

Permission to conduct the study was requested from the Research Ethics Committee of the University of Limpopo. Permission was also being requested from the Limpopo Department of Education and the circuit office to conduct the study in secondary schools in Capricorn District of the Limpopo Province.

3.9.2 Informed consent

A respondent voluntarily agrees to participate in a research study when he or she has full understanding of the study before the study begins (Brink, Van der Walt & Van Rensburg, 2011). The researcher ensured informed consent by explaining to the respondents what is going to be investigated, the expected duration of the respondent’s involvement, the procedures that were to be followed during the investigation, the possible advantages, disadvantages and dangers to which respondents may be exposed (Brink et al., 2011; De Vos et al., 2011). The researcher informed the respondents that the information shared between them and the researcher would not be shared with anyone who was not involved in the study. The

respondents were informed that they had the liberty to withdraw from the study at any time, without being penalised (De Vos, 2011).

The respondents signed a consent form as evidence of granting the researcher permission to include them in the study. The researcher ensured that the signed consent forms were treated with utmost discretion and stored away in a correct manner, so that a particular form could easily be found, if the need arose (De Vos, 2011). The researcher explained to the participants what data collection methods would be used, namely, interviews and document study (Brink et al., 2011).

3.9.3 Voluntary participation

Trochim (2000) stated that the principle of voluntary participation requires that people should not be coerced into participating in research. Participants should be informed that their participation is highly valued in the study and is on voluntary basis. There should be no stipend for their participation and that they have the right to participate up to the extent they wish to participate, without any form of penalty or offence. Participants were informed that they had the right to withdraw from the study at any time and that they would not be penalised in any way for withdrawing from participation in the study.

3.9.4 Research Integrity, Confidentiality and Anonymity

Integrity: The researcher strived to maintain integrity when carrying out the research project. The researcher explained to the participants that the information gathered would remain confidential between the researcher and the individuals who formed part of the study. The researcher assured the participants that their names would not appear anywhere in the study. Roberts, Hammond, Warner & Lewis (2005) highlighted the notion that research ethics and

integrity practices ensure that research is conducted according to the highest standards of practice, with the minimal risk of harmful outcomes or consequences.

Confidentiality: Brink, Van der Walt & Van Rensburg (2011) defined confidentiality information about the respondents, from being made available to anyone who is not part of the study, by keeping the completed consent forms under lock and key. The researcher instructed the respondents not to write their surnames on the consent form, but to write only their first names on the form. The researcher ensured that the names of the respondents were not used on the interview question papers, instead codes were used to trace respondents in the case of an entry error. The respondents were informed that they had the right to withdraw from the research investigation at any point if they wished to do so. Brink et al., (2010) highlighted the notion that the respondents have the right to refuse to answer any question asked of them, and to have the confidentiality of their data protected.

Anonymity was ensured by keeping the respondents' identity unknown. The respondents were informed not to write their names on the interview questionnaires. The respondents were assured that neither their names nor their school's name would appear on the research report, in order to avoid revealing the identity of any of the participants. The researcher informed the respondents that the collected data would be entered into a computer using codes. Codes were used during data analysis.

3.10 CHAPTER SUMMARY

In this chapter, research design and methodology, the research paradigm, research approach, research design and the research methodology were presented by the researcher. The research design aspect, namely the interpretivist paradigm, the qualitative research approach and case study research design were discussed by the researcher. The research methodology aspects, namely, population and sampling, sampling techniques, interviews and document study data collection methods; content and narratives data analysis methods were discussed

by the researcher. Lastly, the most important aspects of research, namely, quality issues and ethical considerations were discussed.

CHAPTER 4: SCHOOL PROFILING DATA

4.1. INTRODUCTION

In the previous chapter, the researcher outlined the research design and methodology employed in this study. This chapter focuses on the presentation and discussion of data gathered through interviews and the document study, where twelve respondents were

interviewed and documents were reviewed from four purposively sampled secondary schools. Data from the interviews were analysed along with data generated from the study of documents about DCT in four selected secondary schools in Capricorn District, Limpopo Province. To present and discuss data generated for the study in a clear, logical and meaningful pattern, the researcher commences the process of data presentation by first sharing information about the profiling of the schools and the teachers from the four sampled secondary schools, and the nature of the research respondents from those schools. Demographic information about the sampled secondary schools and research respondents will be discussed. The school profiles include the following: teacher profiles, job description of participants and qualifications of participant's school's teachers, job description of participants and highest qualifications of participants were elaborated.

4.2. SCHOOL PROFILING

Profiling is more of a trend in qualitative research than in quantitative research (Creswell & Plano Clark, 2010). The Common Application is an electronic college application system that collects information: personal data, educational data, standardized test scores, family information, academic honours, extracurricular activities, work experience, a personal essay, and criminal history. According to *The Common Application* school profile is a summary of information about the school that includes the school's student body, curricular offerings and grading system. The school profile is an important tool for the principal and school management team (SMT) to reflect on the school's background, achievements, challenges and realities. The use of school profiling in this study helped the researcher to gather the required information about DCT in four selected secondary schools.

School The required research information about DCTs in the four selected secondary schools in Limpopo Province. The rationale to include school profile was to provide information about the schools, including number of teachers, the number of learners, allocation fees, classrooms and the school resources at the time the study was undertaken. In this study, the school profile provided information on the four schools with regard to type, location, quintile, funding, learner enrolment and total number educators employed.

Table: 4.1 Summary of School Profile

School	A	B	C	D
No of teachers	22	10	31	18
No of principals	1	1	1	1
No of deputy principals	1	0	2	1
No of HODs	1	2	3	2
No of learners	849	380	951	559
No of classrooms	19	12	24	11
No of administration offices	1	0	1	0
No of pit toilets	18	9	28	4

No of laboratories	3	0	0	0	
No of computers	42	5	14	6	
Allocation fee	R647 010.00	R339 001. 60	R770 123. 20	R490 000.00	

At the time of this study, school A qualified for the posts of deputy principal and 2 HoDs, while 1 post of HoD posts was not filled, with nobody acting in that position. According to the Personnel Administration and Management (PAM) (Department of Basic Education, 2016), HoDs have to display instructional leadership competencies and “maintain a good teaching standard and progress among the learners and to foster administrative efficiency within the department and the school; and to collaborate with educators of other schools in developing the department and conducting extra-curricular activities”. If such a post is not filled, then the school is denied the services offered by such an incumbent. The hiring of a second HoD in this school would have eased the workload of the principal and deputy principal. Cape (2016) stated that the practice of waiting for the staff provisioning cycle, despite changes in learner enrolment, is the main cause of staffing challenges in public schooling. Furthermore, data reflects 1:38 teacher-learner ratio at this school, which that does tally with the country’s teacher-learner ratio of 1:30.4, announced in 2012 by the Minister of Basic Education (Politics Web, 2012).

At the time that this study was undertaken:

School B had 10 teachers, consisting of 1 principal, 2 HoDs and 7 teachers. The school had 380 learners.

School C had 27 teachers, consisting of 1 principal, 3 HoDs and 23 teachers. The school had 951 learners.

School D had 14 teachers, 1 principal, 1 deputy principal, 2 HoDs and 14 teachers.

The school had 559 learners.

4.2.1 School infrastructure

School A had 19 classrooms for teaching and learning; an administration office; and two blocks of toilets, which contained 18 pit toilets each. The school had water, electricity and a razor plate wire fence. All these facilities were provided by the Department of Basic Education, as the school is a public school.

The school was advanced, boasting 3 laboratories, namely, 1 computer laboratory, 1 science laboratory and 1 biology laboratory, as well as a library and 42 computers. Teachers have opportunities to learn and use computers and laptops, and this allows them opportunities to enhance their computer and digital literacies. As this school was a no-fee school, it was allocated R647, 010.00 for academic year, 2018.

According to the SMT, this allocation enabled the school to run effectively and they were able to purchase all the school's needs during the course of the year. The school profile was the best of the four schools since SMT managed and leads the curriculum using DCTs effectively. The school had security guards to protect the school property, the teachers and the learners.

School B had 12 classrooms, no administration office; they have converted one classroom into an administration block with four offices. The school had a fence but it is old. Water and electricity were available. The school had 9 pit toilets. There was no library and no laboratory. Only one desktop computer and four laptops were available at this school. Most teachers in this school are computer illiterate. The principal indicated that the Limpopo Department of Education had been promising to provide the school with forty computers for learning and teaching for the past two years but, at the time that the study took place; this had not been done. The principal further lamented that the Limpopo Department of Education had failed to fulfil its promise by saying that “the department does not take care of us, look we do not have administration office and computers at this school. We had to waste money renovating and equipping the classrooms without the help of the Department.” The school is allocated R339 001.60.

School C had running water, electricity and a fence. There were 24 classrooms and no administration office, but the school had converted one block into an administration office block with ten offices. There were three blocks of pit toilet facilities with 28 single toilets. The SMT was creative and had converted one classroom into a library to house books for learners to read and find information from. There was no laboratory. Vodacom had supplied the school with seven laptops and the school bought seven desktops themselves. The school was allocated R770 123.20 for administration and maintenance purposes.

This allocation enabled the school to run smoothly, and they are able to purchase much of their requirements during the course of the year. The school profile was good enough for the SMT to manage and lead school effectively.

School D had water, electricity and a fence. It had 11 classrooms and no administration office but had converted a classroom into an administration office. The school had no library and no laboratory. The school had only 4 pit toilets. Only six computers were available in this school. Since the school was a no-fee school, it was allocated R490 000 for the year for administration and maintenance. According to the principal, this allocation enabled the school to run effectively since they managed to purchase all their needs during the course

of the year. The school profile was good enough for the SMT to manage the school effectively.

4.2.2 School type and location

All four case schools were public and situated in a rural community. The rurality of the school qualifies it as quintile 1, or no fee school. The four selected school were not allowed to demand school fees and were referred to as no-fee schools. The schools were funded by the Limpopo Department of Education. The South African Schools Act No. 84 of 1996 (SASA) established the quintile system, based on the socioeconomic conditions of the community surrounding the school.

Table 4.2 School type, location and quintile

School	A	B	C	D
Type	Public	Public	Public	Public
Location	Rural	Rural	Rural	Rural
Quintile	1	1	1	1

Table 4.2 above shows school type and location. This table reflects that four schools that participated in this study were classified as public and rural, falling in quintile 1.

4.2.2.1 Public school

According to South African School Act (SASA Act 84 of 1996), the Department of Basic Education launched a national schooling system that classified schools into public schools and independent schools. Public schools are also referred to as government schools, and they dependent on the government for funding, materials, operational costs and teachers' salaries (Guide School, 2020). Most of the public schools are no fee and are subsidised by the government (Justlanded, 2020). Justlanded further highlighted the fact that public

schools are found in the poorest areas and that such schools receive support from the National Schools Nutrition Programme (NSNP), which feeds over 1.6 million children every day.

4.2.2.2 Rural schools

Rural schools refer to schools in rural areas; they are referred to as community schools. Rural schools are characterised by geographic isolation and small surrounding population. Msila (2010) stated that rural schools in South Africa are faced challenges of poverty that unable them change.

4.2.2.3 Quintile 1 schools

Quintile 1 schools are schools which are declared non-fee schools. Quintile 1 schools, commonly known as no fee schools Fee, meaning that learners at these schools are exempted from paying school fees, Quintile 1 and 2 schools, that are also no fee schools and are mostly found in rural and farming communities that are mostly poverty stricken with poor infrastructural houses and buildings (Daas & Rinqest, 2017). No Fee schools are also found in peri-urban and poor township in South Africa, that many of neighbourhood members live in extreme poverty, with majority of the households that are poverty stricken. According to (Vally, 2019) highlights No fee school factors that threatens quality education to majority of the South African black children, when she states that “public schools in peri-urban and rural areas make up 75% of the schooling system in South Africa – populated by poor black children mostly – and continue to be overcrowded, under-resourced and downright dysfunctional”. Quintile 1 and 2 schools receive a full government subsidy (Daas & Rinqest, 2017). Van Wyk (2015) stated that quintile 1 schools are the poorest schools, while quintile 5 schools are the least poor schools.

4.2.3 Learners, teachers and school amenities

Learners, teachers and school amenities are the resources available in schools to promote effective learning and teaching. The importance of including them in this study is that they have a profound impact on the teacher and learner outcomes. With respect to teachers, school amenities affect teacher recruitment, commitment and effort. With respect to learners, school amenities affect health, engagement, behaviour, achievement and learning. The findings further revealed that there is lack of computers in these schools and teachers are not using classroom technology in teaching. According to (Lawson & Gede, 2011) the availability of school amenities contributes to the successful and effective implementation of the school programme.

Emakuma (2013) argued that school amenities are imperative because they help to improve teaching and learning effectiveness. Blake (2009) stated that teachers are not using technology for teaching and learning.

Table 4.3: Learners, teachers and school amenities

School	A	B	C	D
Learner enrolment	849	380	951	559
Number of teachers	13	22	31	18
Number of classrooms	12	19	24	11
Number of computers and laptops	5	42	14	6
Number of pit toilets	9	18	28	4
Number of flushing toilets	0	0	0	0

Table 4.2 above shows the learners, teachers and school amenities at each of the four schools, which include the following, learner enrolment, number of teachers, number of

classrooms, number of computers and laptops, number of toilets and number of flushing toilets.

4.2.4 Schools' resources and infrastructure

School resources and infrastructure are the equipment's and materials the school had to use in order to progress with teaching and learning. The school resources and infrastructure in this study comprise of clean water, electricity, library, laboratory and computer centres. The importance of including the school resources and infrastructure in this study is to reveal the availability of resources and infrastructure in the four selected secondary schools. The general findings revealed that all schools had clean water and electricity. Only one school had all the resources and infrastructures. School C has converted two classes into a library and laboratory and does not have a computer centre.

The lack educational essentials in rural schools are the results of Apartheid rule that enacted and authorized educational policies that promoted high levels of inequality and poverty (van der Berg, 2007). Scheneider (2002) highlights that environmental conditions play part in learners' success and lack of resources and infrastructure can positively and negatively impact teaching and learning. In support of inadequacies of educational resources and infrastructural provisioning, (Bullock, 2000) argues that the overall building conditions, the age of the buildings have a positive and negative impact to learner's achievements in learning. In contrary, (Best, 2005) argued that every learner had access to quality education in school facilities that provide educational settings suited for teaching and learning.

When debates on whether schools have adequate infrastructure or resources, and on the other side the debate is on that focuses on the failure of public schools to transform large sums of quintile 1 and 2 allocations into improved learners' outcomes. Education policies are failing to change the previously disadvantaged circumstances of the poor African people for better.

The schools without laboratory, library and computer centres which compromise quality teaching and learning, and makes the possibilities of encroaching into the 4th Industrial Revolution a far-fetched dream for African children. When children from affluent families are thinking of becoming relevant global citizens through attainment of 21st Century competencies, and moving into 21st Century spaces, it is a reality that almost 80% of public schools are poor (Spaull, 2013) and servicing 51% of children living in poverty (von Fintel, Zoch & van der Berg, 2017). This situation is depicted by 70% of public school that are classified at quintile 1 and 2 category by (Taylor, Wills & Hoadley, 2019) that is known to be poor schools in impoverished farms, villages and locations. When the government of the day is striving towards attainment of equity and equality through promulgation of statutes and policies, the equity and equality gap is widening. This is reflected in education sector, both basic and higher educational institutions that African children from poor households are educationally excluded from quality education that others enjoy in South Africa.

Table 4.4: Schools’ resources and infrastructure

School	A	B	C	D
Clean water	Yes	Yes	Yes	Yes
Electricity	Yes	Yes	Yes	Yes
Library	No	Yes	Yes	No
Laboratory	No	Yes	Yes	No
Computers centre	No	Yes	No	No

Table 4.3 above displays school resources and infrastructure in four selected secondary schools the following are included in this study: clean water, electricity, library, laboratory and laboratory.

4.2.4.1. Clean water

The above table depicts that in all the four schools there is water. All schools had boreholes. Learners and teachers use the water to drink and to wash their hands. Water will help learners not to be infected by COVID 19. The school feeding schemes in all four schools use water to cook food for learners. Clean water is important for public health. Khalifa & Bidaisee (2018) highlighted that clean water is used for drinking, domestic use and food production purposes.

4.2.4.2. Electricity

In all selected four schools there is electricity. Teachers and learners use electricity in these schools through photocopy machines to photocopy their work, use internet and use computers. Electricity access play significance role in improving learning outcomes at schools (Kanagawa & Toshihiko, 2014). It extends studying hours, facilitation of ICT, assist teacher training, enhance staff retention and improve learners' performance through online learning.

4.2.4.3. Library

In school A, there is a library where learners go and read books and find information when writing assignments, homework and tests. In school B there is no library. The school had shortage of classrooms. School C has creative school management and teaching personnel who changed one of the classrooms into a library. They had put books in this classroom and learners use the classroom as a library. School D has no library. The value of a library in schools that it is a source of knowledge to young minds where learners find new information. School library enhances learners' achievements. According to (Rashidah, 2017) the school libraries plays important role in the life of learners by serving as a store house of knowledge and equip them with skills necessary to succeed in a constantly changing technological, and social and economic environment.

4.2.4.4 Laboratory

In four selected schools, only one school, which is school A, had 3 laboratories where learners made experiments inside. Science teachers use these laboratories when teaching learners science subjects. The three schools B, C and D do not have laboratories. They had all indicated that they do not have enough classrooms. The value of laboratory in schools is assist learners to learn science through the acquisition of conceptual and theoretical knowledge, helping them to learn and about science by developing an understanding of nature and methods of science (Ottander & Gunnel, 2006). She further elaborates that laboratory stimulates the development of analytic critical skills and create learners interest in science.

4.2.4.5. Computer centre

School A is the only school that had a computer centre. All learners and teachers use the computer centre to find information. Learners use the computer centre regularly for completing their homework's, classwork, assignments and when preparing for tests. The other three schools, which are, school B, C and D do not have computer centres. They had all indicated that they do not have enough computers and enough classrooms at their schools that is the reason they don't have computer centres. The value of computer centre is to access information and communication (ICT) for teaching and learning (Czerniewicz & Brown, 2005). Teachers and learners get access to information when doing research, projects, assignments, homework and writing tests.

4.3 TEACHERS PROFILING

Having discussed the nature of secondary schools sampled in this study, it was appropriate that teacher's profiles be unveiled. This means the gathering of teachers' profiles. Creswell & Plano Clerk (2010) highlighted that profiling is more of a trend in qualitative research than in quantitative ones.

A teacher's profile is a profile that provides details of the teacher to promote teaching and knowledge in a particular field. In this study, the teachers' profiles provided the researcher with information regarding gender, age, job description and qualifications. The profiles of the four sampled secondary schools helped in providing demographic information that afforded understanding of circumstances surrounding the case schools and the teachers better. The following are included in my discussions: Gender, age band of participants in four schools, job description of participants and the highest qualification of participants.

4.3.1 Gender

UNESCO (2003) defined gender as the roles and responsibilities of women and men created in our families, our cultures and our societies. Gender is important in this study as both female teachers and male teachers should receive fair treatment according to their respective needs. What is included in my discussions are the frequency and percentage of female and male participants. The findings revealed that in four participating secondary school's female teachers and male teachers received equal treatment and enjoyed the same rights, resources, opportunities and protection in their schools. Both teachers are treated equally and participate as equals through legislative forms. Pilcher & Whelehan (2004) stated that gender perspective gave women the opportunity to have the rights and privileges that men have through legal reforms. Lorber (2012) argued that gender equity has provided women to occupations and professions dominated by men and promoted them to positions of authority.

Gender of participants is shown below:

Table 4.5: Gender

Gender	Frequency	Percent
Male	26	49.1
Female	27	50.9
Total	53	100

Table 4.4 depicts the gender of research participants who completed questionnaires. The distribution of gender revealed that female participants who participated in the research were 27 with 50.9% and male participants were 26 with 49.1%. The above table indicated that female participants were more than male participants in four secondary schools.

4.3.2 Age band of participants in four schools

The following shows age band of participants who participated in the research questionnaires. This is important in this study because it shows the age of teachers who participated in this study. Years of participants included in this study are from 21- 30 years, 31- 40 years, 41- 50 years and 51- 60 years. The findings revealed that in terms of age majority (37, 7%) respondents were between 51- 60 years old, those between 41-50 years constituted 34% while those in the age of 31-40 constituted 15, 1%. The youngest participants were between 21- 30 years old and constituted 13, 2 %. The findings had revealed that majority of teachers are above 50 years. Age could affect negatively the ability to use technology. Naseri & Elliot (2011) stated that young people use Internet more than older people. The study revealed that many teachers between the age of 51- 60 would leave the Department of Education and young teachers will enter the teaching profession and the low rate of technology in this district would change. Mpinganjira & Mbango (2013) argued that young people of today are growing up in a technological environment and they need teachers with CT knowledge. Punamaki et al. (2007) stated that young people of today use technology such as tablets, smartphones for studying, playing games communication and seeking information. Information on age band of participants follows:

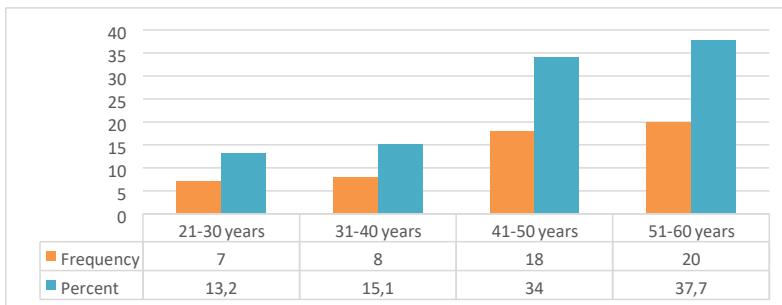


Figure 4.1: Age band of participants

Table 4.1 reflects the age band of teachers in four selected schools. The table revealed that most teachers are between the ages of 51- 60 years. Most teachers in this age are old and do not use technology in their daily lives. Dikba, Ilgaza & Usluel (2006) stated that older teachers without computer skills might have more difficulties in using digital classroom technology than younger colleagues in schools. The other majority of teachers are between the age of 41- 50 years meaning that in these four schools there are many teachers who are about to leave the education system due to retirement. Minority of teachers are between the age of 31- 40 and 21-30. This generation uses technology in their everyday activities. Apay & Ozbasi (2008) argued that computer usage is low with older teachers, and an increase of new generation of teachers with higher computer competency skills enters into the education system.

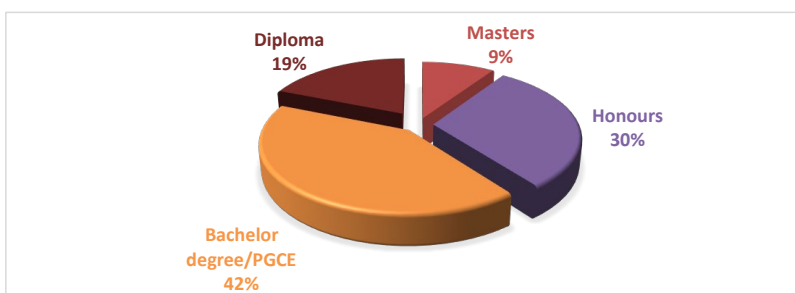


Figure 4.2: Highest qualification of participants

Figure 4.3 reflects on the highest qualification of participants. In summary 61% of participants possess junior degrees and diplomas, whereas those with post-graduate qualification were 39%.

4.3.3 Job description of participants

The table below describes job description of teachers in four selected schools. Job description describes the type of job the teacher is doing in the school. In this study, the following job description is included: principal, deputy principal, HOD, senior teacher and teacher. Data on job description of participants is exhibited below:

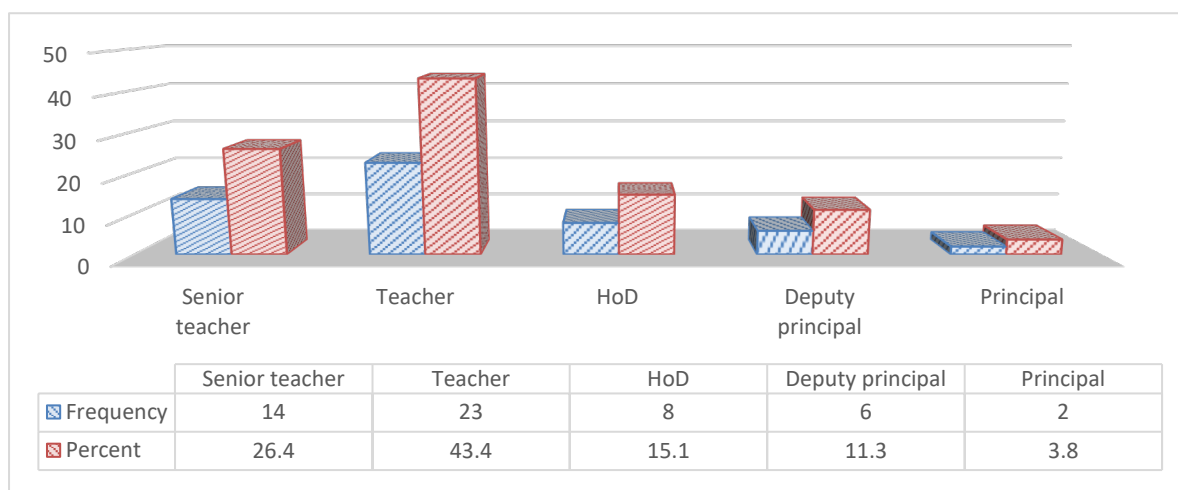


Figure 4.3: Job description of participants

Figure 4.2 reflects on job participation of the participants. In summary, data reflects that 69.8% of the research participants were teachers, whereas, 20.2% of participants were members of the SMTs.

4.3.4 Highest qualification of participants

The term highest qualification is important in this study because it shows the qualifications of the respondents and the highest qualifications of teachers in four selected secondary schools in the Capricorn district. In my discussion the following is included: Diploma with 19%, Bachelor degree\PGEC with 42%, and honour's degree with 30% and Master's degree with 9%. As far as qualifications of the respondents were concerned at least 19% of the respondents had acquired a post- matriculation qualification with three year diplomas in teaching and 42% of the respondents had obtained a Bachelor's degree\ PGCE. Teachers with Bachelor's degrees had this degree on top of their teacher's qualifications. The qualifications obtained included exposure to educational technology because all teachers were furthering their studies online through different universities. Teachers in the four selected schools had improved their teaching using online education.

4.4 CHAPTER SUMMARY

This chapter discussed the school profiling consisting of the staff provisioning, school infrastructure consisting of clean water, electricity, library, laboratory and computer centre were outlined; school type and location comprising of the following were discussed: public schools, rural schools and quintile 1 schools; learners, teachers and school amenities were discussed, the discussion of teachers profiling which consist of: gender, age band of participants in four schools, job description of participants and highest qualifications of participants were discussed and lastly the chapter summary was outlined.

CHAPTER 5: ANALYSIS AND PRESENTATION OF DATA FROM INTERVIEWS

5.1 INTRODUCTION

This chapter focuses on a qualitative presentation of the data derived from interviews with the participants and the document study including the discussion of themes that emerged from principals' and head of departments' interview data. Whereas 8 themes emerged from the HoDs and another 8 from teachers' interview data. Interview data was derived from the main research questions, namely, what is the usage level of classroom digital technologies

in schools? What is the teachers' level of use of using digital classroom technology? What is the teachers' perceived ease of use of new digital classroom technology?

5.2 QUALITATIVE FINDINGS FROM SCHOOLS' PRINCIPALS

In this section, the researcher presents the findings derived from the data collected during the interviews with the school principals of the case schools. The main aim of these interviews was to investigate levels of DCT and teacher's usage of technology in selected schools in Limpopo Province. It is duty and responsibility of the school principal, within their role as leader and manager of a school, to ensure the successful implementation of DBE policies and other prescripts, including the White Paper on e-Education and the Digital Framework for Professional Development, in particular. A study conducted by (De Freitas & Oliver, 2005) revealed that the "relationship between e-education e-learning policy and organisational change and development and that e-education or e-learning strategy can be used as one of change management strategy in the school." The principalship duty is to ensure school development and innovation through well thought school strategies, inter alia, e-education policies.

Olson (2000) argued that there should be a dialogue between school principals and teachers on how to integrate classroom technology into learning and teaching. Apart from school development and innovation, (Menstry, 2004) highlighted three other responsibilities of the school principal, namely, professional management of the staff, seeing to the day-to-day administration of the school, performing departmental responsibilities prescribed by law and organising all activities which support teaching and learning and support of principal's duty towards staff development. Dawson & Rakes (2003) argued that school principals are expected to act as institutional leaders to make sure that teachers are equipped with the necessary preparation for the intervention of classroom technology. A principal can either promote or inhibit a school's provision of effective digital DCTs and the adoption of the effective digital classroom pedagogies.

There were eight (8) themes that emerged from data generated from interviews, as captured in Table 5.1 below.

Table 5.1: Themes and sub-themes emanating from principals' interviews

	Research question	Theme	Subthemes
1	"What digital classroom technologies are available for use by teachers at your school?"	Digital classroom technologies available in schools.	Principals believe that schools had insufficient digital classroom technologies
2	What is the level of use of classroom technology for teaching and learning by teachers?	The level of use of digital classroom technology for teaching and learning by teachers.	Principals believe that the level of use of digital classroom technology for teaching and learning by teachers is low because not all teachers use DCT for learning and teaching.
3	Have teachers changed from traditional teaching strategies to digital teaching strategies?	Teachers changed from traditional teaching strategies to digital teaching strategies.	Principals believe that teachers did not change from traditional teaching strategies to digital teaching strategies due lack of technologies in schools
4	What is teachers' perceived level of usefulness of using digital classroom technology?	Teachers' perceived level of usefulness of using digital classroom technology	Principals believe that teachers perceived level of using digital classroom technology is low.
5	How digital classroom technology does influences teaching and learning?	Digital classroom technology influences teaching and learning	Principals believe that DCT influences teaching and learning

6	Does the integration of DCT in school curriculum facilitate change from teacher-centred pedagogy to student-centred pedagogy?	Transiting from teacher centred pedagogy to learner centred pedagogy through the use of DCT	Principals believe that teachers resist to change from teachers-centred pedagogy to learner-centred pedagogy; Principals believe that DCT integration can facilitate change from teacher centred pedagogy to learner-centred pedagogy.
7	Does digital classroom technology promote learner- centred pedagogy and collaborative learning?	Learner- centred pedagogy and collaborative learning were promoted through DCT.	Principals believe that DCT promotes learner-centred pedagogy and collaborative learning
8	Do teachers receive adequate training and support on digital classroom technology?	Teachers receive adequate training and support on digital classroom technology	Principals believe that teachers did not receive adequate training and support on digital classroom technology

Table 5.1 displays themes and sub-themes that emanates from principals' interviews. This summary of results for school principal namely: classroom technologies available in schools; the level of use of classroom technology for teaching and learning by teachers; teachers changed from traditional teaching strategies to digital teaching strategies; teachers' perceived level of usefulness of using digital classroom technology; classroom technology influences teaching and learning; transiting from teacher-centred pedagogy to learner-centred pedagogy through the use of DCT; principals stated that DCT promote learner-centred pedagogy and collaborative learning, and that schools provide in-service training of digital technology to teachers.

5.2.1 Classroom technologies available in schools

This theme emanates from the question, “What classroom technologies are available for use by teachers at your school?” All principals in the four selected schools indicated that they did not have access to DCTs because of an inadequacy in the supply of such technologies. Teachers have to queue to use computers when preparing for teaching and assessment.

School A had 35 computers and 7 laptops, and did not manage to use their technology because all 35 of the computers were used for the school subject, Computer Application Technology (CAT). Five of the laptops were used by teachers, whereas 2 laptops were used for administrative duties. The principal in School A noted that: *The majority of teachers in our school had their own laptops but we need enough computers for everybody to learn using classroom technology. We don't have projectors but we have 3 whiteboards and 1 photocopy machine.*

In the same vein, the principal of School B revealed that:

Their school has one computer, 4 laptops and 1 printer and it very hard for teachers to prepare their work using them. They are primarily used for administrative purposes and for preparation of assessment activities.

The principals of school C and D indicated that they had the same problem as the principals of schools A and B had regarding the availability of technologies in their schools. School C had 7 computers and 7 laptops whereas; school D has 6 computers and laptops.

This study is in line with the e-Education policy that shared its intentions when it highlights that “this policy sets out Government’s response to a new information and communication technology environment in education, we want to ensure that every school has access to a

wide choice of diverse, high-quality communication services which will benefit all learners and local communities” (Department of Education, 2006).

This is line with other education ministries across the globe that equipped teachers with computer and digital training; and is hugely invested in digital classroom technological infrastructure for schools. Since technology integration in the classroom is considered to be a significant national priority for the Greek educational system, a large investment from the European Union targeted teacher digital training and supply of school DCT infrastructure (Jimoyiannis & Komis, 2007).

The Limpopo Department of Education (LDE) contravenes the intentions of the White Paper on e-Education policy of 2004 by not providing adequate educational technologies to schools in support of digital teaching and learning. Whereas the White Paper on e-Education acknowledges that “many schools are exploiting the benefits of ICTs to enhance the quality of teaching and learning” (Department of Education, 2002). The Department of Basic Education has taken it upon itself to provide adequate infrastructure to roll-out the e-Education policy.

In support, the former Minister of Basic Education, Dr. Naledi Pandor highlighted the notion that digital classroom technologies have “opened up new learning opportunities and provided access to educational resources well beyond those traditionally available” (DoE, 2004). Digital classroom technology improves “the quality of teaching and learning and delivers lifelong learning” (DoE, 2004). The Limpopo Department of Education fails to implement the mandate of the Department of Basic Education that provides for adequate distribution of the required educational technology in public schools. This finding revealed that teachers, in the case public schools in Limpopo Province, do not have access to DCTs because of an inadequacy in the supply of such technologies. Teachers have to queue to use computers when preparing for teaching and assessment. In some developed countries, such as the United States of America (USA), the majority of schools have the necessary educational technology, which is not the case in South Africa.

In developed parts of the world, such as in the United States of America. Joseph South, formerly director of the Office of Educational Technology in the US Department of Education, declared that “We (USA) are encouraged by the fact that most classrooms in our country now have access to broadband, yet we know that many that do not are in communities where the potential impact is the greatest” (US Department of Education, 2017). If the USA and Greek public education systems are to be compared, South Africa is far from reaching a suitable level of DCT implementation.

This is a clear indication that learners in the South African public schooling are disadvantaged when venturing into digital world and opportunities to experience the 4th industrial revolution are slim or zero, in some cases.

In one study conducted in the Sekhukhune East District of the Limpopo Province in South Africa, the school management team members’ answer to the question on “how do you think schools can be made ready for the implementation of e-Learning?” was “the Department of Basic Education should provide schools with ICT resources, technology facilities, infrastructures, computers, TVs, etc., that will make it easier for the implementation of e-Learning” (Nkadimeng & Thaba-Nkadimene, 2019). In the same study, it was further stressed that the department should provide schools with “sufficient technological resources for the implementation of e-Learning, such as computers, laptops, multi-purpose centres, and ICT software and hardware” (Nkadimeng & Thaba-Nkadimene, 2019). In another study that was conducted in secondary schools in the Mopani District of Limpopo, it was revealed that “a lack of modern educational technology in schools” results in minimal usage levels (Thaba-Nkadimene & Mogatli, 2020). Furthermore, (Adesina, 2015) argued that teachers should have access to classroom technology because it contributes to an improvement in teaching and learning. Thinking of using DCTs for student learning in the four case schools, and for promotion of digital learning spaces, is simply not possible because of the lack of availability of these technologies in these schools. Teachers and learners are denied opportunities to experiment with digital teaching and digital learning spaces in order to reap from numerous benefits accruing from using such technology.

5.2.2 The level of use of digital classroom technology for teaching and learning by teachers

This theme originates from the question, “what is the level of use of classroom technology for teaching and learning by teachers?” All four principals from the selected Capricorn secondary schools indicated that not all teachers in their schools were using classroom technologies for teaching and learning. The principals revealed that almost all teachers in their schools had experience in the use of classroom technology, but decide not to make use of their experience.

The principal of School A highlighted that:

In our school not all teachers are using technology for teaching and learning. Some teachers still use traditional teaching method of using chalks, textbooks and chalkboard.

Schools B, C and D had the same challenge, with teachers not using technology in teaching and learning because of a lack of technologies in their schools. Principal C emphasised that:

The level of usage of technology by teachers is very low because they don't use technology in teaching and learning, because we have very few computers to cover all of them.

The findings of this study support the findings of a study conducted by (Johnson et al., 2016) that highlighted that “the access constraint is the primary external factor that influences the integration of technology in the classroom.” All principals maintained that, if a “school does not possess adequate computers and fast internet connection, the implementation of educational technology is not feasible” (Johnson et al., 2016). Instead, teachers resort to what they are used to, namely, using chalk and duster, and the use of a mixture of traditional and contemporary pedagogies to deliver the curriculum in their classrooms.

The choice of teachers not to use technology lies with inadequacies in the supply of technology, and teachers preferred not to fight for the opportunity to use the few targets available to them in the schools.

Some of teachers may have computer or digital skill challenges, but they hide behind the inadequacies of educational technology supply in schools. In case where non-use of education technology lies with a lack of teacher's skill, (Hyndman, 2018) recommended that "the right professional development to help teachers become proficient in digital technology." This observation is supported by (Burbules & Callister, 2000) who argued that access to technology is essential because exclusion means severely limiting life changes. Only one in the four schools surveyed had an adequate supply of computers which were obtained through school's allocated funding and from donations. This was done through school initiatives.

The principal of School A said that:

In our school we did not wait for the department of education to provide us with computers. I called a meeting and from that meeting resulted with a decision to buy our own computers and encourage every teacher to have their personal laptop. Apart from what the school can afford, we were provided with computers by the University of Limpopo CoLab School Project. The offer happened after the officials visited our school and found that all teachers in our school had an interest in using technology in teaching and learning and they provided us with thirty computers. Despite this supply, we still have some teachers who do not use available technology for teaching and learning because 35 computers are used for Computer and Application Technology (CAT) subject.

This was also confirmed by the principals of schools B, C and D. The principal of School C stated that "teachers in our schools do not use technology for teaching and learning." All four principals from the selected Capricorn secondary schools agreed that not all teachers in their schools were using classroom technologies for teaching and learning.

5.2.3 Teachers changed from traditional teaching strategies to digital teaching strategies

This theme emanated from the question, “have changed from traditional teaching strategies to digital teaching strategies?” Principals in four selected secondary schools indicated that teachers did not change from traditional teaching strategies to digital teaching strategies. Teachers were still using chalkboard and textbook methods of teaching at the time this study was undertaken. Principal of school A said that:

In our school we have inadequate technologies but not all teachers had changed from traditional teaching strategies to digital teaching strategies, some of them are still using the old strategy of chalkboard and textbooks.

Principals of schools B, C and D had the same challenge, where teachers did not migrate to digital classroom technology because of the lack of classroom technologies in their schools. The principal of school C revealed that:

Non-availability and non-access to digital devices hinder our school to implement digital classroom technology in learning and teaching.

The study is in line with the study conducted by Nkadimeng and Thaba-Nkadimene (2019) who indicated that “the failure to transit from traditional pedagogies to digital pedagogies is common in Limpopo schools.” In times when many teachers across the globe have already migrated to digital classroom technologies, it was not the case with these four participating schools.

The current findings of this study are in line with a study conducted by (Nkadimeng & Thaba-Nkadimene, 2019) who revealed that “teachers lack competencies on technology related teaching and learning strategies.” Many of South African public schools in rural areas are still faced access to digital classroom technological challenges, and teaching and learning are still done in the same traditional way. In this way, many African children are educationally excluded from 21st century education, and this contributes towards social injustice. The Limpopo Department of Education, under the leadership of Polly Boshielo, has to be blamed and held responsible and accountable.

5.2.4 Teachers perceived level of usefulness of using digital classroom technology

This theme emerged from the question, “what is teachers’ perceived level of usefulness of using digital classroom technology?” The research findings indicate that the school principals indicated that teachers show positive attitudes towards the use of classroom technology. The principal of School C highlights that:

I embraced change brought along by technology and education technology in particular. And I also think teachers share the same attitudes as I do. As such I think teachers do not view integration of technology for teaching and learning as a difficult thing. However, a lack of computer and internet infrastructure; and lack of teacher’s digital skills are most impeding factors.

The school principals noted their general observation of teachers’ attitude towards the ease use of technology as positive. What they reflected on is the fact that they think technology is not regarded as difficult by teachers, but considers access constraints and lack of digital skills as impeding factors towards successful implementation of digital classroom technology, as prescribed by the White Paper on e-Education. This finding is in line with the findings of (Rana, 2020) that indicate that “most of the teacher educators have positive attitudes towards the general role that information and communication technology can play in education and in the educational process.” Furthermore, the findings of (Habibu, Abdullah-Al-Mamun & Clement, 2012) tallies with this finding that “teachers had a strong desire to integrate ICT into teaching learning process even though with difficulties.”

The principal of School B indicated that:

Insufficient technologies in my school hinder teachers to use technology in teaching and learning. The Integration of classroom technology with curriculum is impossible in our situation where access is a primary constraint. Teachers are ready because there are positive on the aspect of perceived ease using classroom technology.

This finding indicates teacher's access to technology as an impeding constraining factor that influences low levels of teacher's use of digital classroom technology.

Whereas, the school principals highlighted that "the majority of teachers' view technology as easy and do not have difficulties of using it for teaching and learning." The blame was levelled at a lack of access to classroom technology as a major hindrance to optimal use of technology.

This finding is in line with the findings of a study conducted in Cape Town in South Africa by (George & Ogunniyi, 2016) who found that the "selected schools did have at least the basic ICT-resources in the science classrooms," and blames a lack of optimal usage of the little technologies they have on teaching and learning. George and Ogunniyi (2016) further identified the perceived usefulness of ICT-resources as "the most influential factor for the teachers' intention to integrate classroom technology in teaching and learning."

The principal of School A highlights that:

Lack of computer skills by teachers is the problem as teachers need to be trained to use computers first before they can teach learners. The school has only 7 computers and 7 tablets and this is a challenge as teachers need to share this computer.

The findings further indicate teacher's lack of digital capacities as the secondary cause of the minimal use of technology.

The current study findings are in line with (Timothy, 2009) who stressed that "perceived usefulness and attitude towards computer use have an effect on behavioural intention of teachers to use computers."

The findings of this study supports (Mundy, Kupczynski & Kee, 2012), who stated that "despite the fact that school principals indicated that teachers' ease of use of classroom technology are positive, in contrary, studies reveal that more than half of the teachers who are equipped with computers use them for administrative purposes only". The reason was that teachers "lack the technological proficiency needed to take advantage of these new

technologies” (Mundy, et al., 2012). In support to the current study, (Timothy, 2012) indicated that technology acceptance by teachers determines the extent to which technology would be implemented in the classroom. However, in these case schools, such a positive relationship is obscured by access challenges.

In summary, this theme emerged with three sub-themes, namely, positive attitude towards the use of classroom technology, and that factors that cause a delay in the implementation of the prescripts of the White Paper on e-Education as access constraint; and a lack of teachers’ digital skills. School principals think that the access constraint is an overarching challenge facing the implementation of White Paper on e-Education policy by case schools. To some extent, teachers are also found to be the cause of the delay in the full implementation of DCT because of their lack of digital skills. In support of a lack of teachers digital skills, (Balanskat, Blamire & Kefala, 2006) identified a “lack of teacher confidence; inadequate teacher competence to synergize teaching and learning process by merging conventional teaching with ICT; and inevitable resistance to change.” This finding is in line with the findings of (Mukhari, 2016) who identified “inadequate ICT infrastructure, teachers’ lack of ICT skills and low level of ICT proficiency as factors that impede the successful digital classroom technological integration in urban schools.” Mundy & Kee (2020) findings show that that teachers “need not only to learn how to use technology at a basic level but also to learn how to integrate that technology into their curricula.” In line with this finding, (Du-Plessis & Webb, 2012) identified second order barriers as “insufficient ICT resources for the large classes that have to be taught, lack of project leadership within the schools, and a need for on-going training and support.”

5.2.5 Classroom technology influences effective teaching and student learning

This theme emanated from the research question “how does classroom technology influences teaching and learning?” All the principals from all four selected secondary schools highlighted that technology has positive influences on effective teaching and student learning.

Principal B indicated that:

Technology makes teaching more interesting and Internet provides teachers an opportunity to teach learners to access the quality of information they find online while removing the one-sided restriction of a textbook.

The views of the Principal of B are supported by the principal of school C, who declared that:

Technology makes the work of teachers very interesting and simple and it helps slow learners to learn more easily.

This is in line with studies which stress that DCT can help teachers to “harness the power of digital devices, apps and tools to increase engagement, encourage collaboration, spark innovation and enhance student learning” (Himmelsbach, 2019). Moreover, (Armstrong, 2014) found “ICT influences effective teaching and student learning and enable learners to take control of their learning.” The current study supports the study conducted by (Sabin, Snow & Viola, 2016) who stated that “classroom technology influences teaching and learning, promotes workplace soft skills, such as critical thinking, independent research and cross-technology proficiency.” Furthermore, this current study finding is in line with (Costley, 2014) finding, highlighting that “technology has a positive impact on student learning and causes students to be more engaged; thus, students often retain more information.”

5.2.6 Transiting from teacher centred pedagogy to learner centred pedagogy through the use of DCT

This theme emerged from the question, “does transiting from teacher centred pedagogy to learner centred pedagogy through the use of DCT facilitate change from teacher-centred pedagogy to student-centred pedagogy?” Principals believe that the use of educational

technology and the integration of DCT in the school curriculum, in particular can facilitate the teachers' transition from teacher-centred pedagogy to learner-centred pedagogy.

However, because of a lack of adequate DCT infrastructure and the challenges associated with internet connectivity, teachers resort to their old teaching practices that are aligned to teacher-centred pedagogies; with little effort made to change to learner-centred pedagogies that promote learner active participation, learner engagement and collaborative learning. Efforts by the Limpopo Department of Education in the implementation of outcomes-based education (OBE) that was rolled out with Curriculum 2000 that emphasises learner centred pedagogy were not successful because, to date, teachers still use their old tactics and techniques for teaching and learning.

Two sub-themes, emerged from this theme, namely, (1) teachers are still using teachers-centred pedagogy; and (2) principals believe that DCT integration can facilitate change from a teacher-centred pedagogy to a learner-centred pedagogy

The research finding found a resistance to change from teachers-centred pedagogy to learner-centred pedagogy, which was revealed when the principal of school B highlighted that:

Teachers are still using chalkboard and duster, and textbook strategies in this school.

The pedagogy is still teacher centred the main reason being teachers' lack or insufficient knowledge and understanding of learner centred pedagogy.

The principal of school D echoed this:

Teachers-Centred pedagogy is a dominating pedagogy in our school. OBE introduction stresses the use of learner-centred pedagogy, which was new to the education system. However, trainings were not geared of best pedagogical practices replace old teaching practices that promote learner-centred pedagogy.

The same sentiment was echoed by other two school principals, who indicated that teachers in all four selected Limpopo secondary schools did not change from traditional teaching strategies to digital teaching strategies. Teachers were still using chalkboard and textbook methods of teaching at the time this study was undertaken.

This finding is in line with (Mangele,2017) who identified many challenges in the implementation of learner centred pedagogy by rural schools, namely, “the lack of relevant resources, poor quality of teachers, insufficient and inappropriate teacher support programmes for teachers as well as the rural environmental challenges.” Furthermore, this study supports (Otukile-Mongwaketse, 2018,) findings that “teachers’ delivery of instruction was mostly teacher centred, a move which seemed to leave some learners minimally benefitting from the teaching and learning process.” There is a belief by principals that the availability of digital resources will create digital teaching and learning spaces that are focused on learner-centred approaches. The Department of Basic Education and Limpopo Department of Education, under the leadership of Angie Motshekga and Polly Boshielo, respectively, have to be blamed, and held responsible and accountable.

It was found that the school principals believe that DCT integration can facilitate change from teacher-centred pedagogy to learner-centred pedagogy.

Principal of School B highlighted that:

There was no training that succeeded in helping teachers with knowledge and skills of learner-centred pedagogy. There is a gap in their knowledge and skill on alternatives to replace teacher centred pedagogies. I think digital technologies can create a platform for teachers to learn digital pedagogies.

Other principals also believe that educational technology and DCT can facilitate the transition from traditional teacher-centred pedagogies to learner-centred pedagogies.

This finding is in line with (Muianga, 2019) finding that ICT offers “the adapted flexibility-activity framework can combine any teaching and learning methods and strategies, with a

focus on a student-centred approach.” Contrarily, the study of pre-service teacher by (Du Plessis, 2016) shows that DCT tools are used in teacher centred ways, yet teachers as users held learner-centred beliefs. The study by (Du Plessis, 2016) further recommends that should lecturers in teacher education should “model constructivist learner-centred pedagogy to students and provide opportunities for students to plan and model such practice.”

5.2.7 Digital classroom technology promotes learner- centred pedagogy and collaborative learning

This theme emanated from the question, “does digital classroom technology promote learner- centred pedagogy and collaborative learning?” Insufficient technologies within four selected schools were great impediments that made it hard for teachers to use technology to promote learner pedagogy and collaborations amongst learners.

Principal of school A said that:

Digital classroom technology promotes learner pedagogy and collaborations amongst learners but insufficient technologies make it hard for teachers and learners to collaborate effectively.

Principal of school B indicated:

Digital classroom technology does not promote learner pedagogy in our school because learners are not being taught using it. We have inadequate technologies in our schools and learners are still being taught using traditional teaching strategies.

This study is in line with (Moate & Cox, 2015) who argued “that infusing learner centred pedagogy into teaching facilitates a deep learning experience for learners.” The current study support the study conducted by (Du Plessis, 2020) who highlighted the benefits of learner-centred pedagogy that “learners learn how to solve problems, think critically, apply

in-formation, and integrate knowledge; learners can learn to think like experts in a discipline.” Furthermore, learners learn to know how they can improve their learning, which is critical in today’s environment where information is easily accessible and exponentially growing.

The current study is in line with (Barron & Darling-Hammond, 2010) who revealed that student inquiry leads to higher performance, but it is necessary for the pedagogy to access 21st century skills, like critical collaborative thinking and problem-solving.

The current study findings is in line with the study conducted by (Zhou &Chen, 2019) who revealed that “digital classroom technology promotes learner-centred pedagogy and collaborative learning which made learners have a positive perceptions about team work, collaborations and mobile learning.”

All principals in four selected schools indicated that digital classroom technology does not promote learner pedagogy and collaborative learning in their schools. They all indicated that teachers are still using traditional teaching strategies because of the inadequate technologies in their schools.

5.2.8 Schools provide in-service training of digital technology to teachers?

This theme originated from the question, “does teacher receive adequate training and support on digital classroom technology?” Out of four selected schools only one school principal revealed that the school provide in-service training of digital technology to teachers in her school, while the other three principals revealed that there was no in-service training of digital classroom technology to teachers in our schools because we do not have computers.

The principal of School A indicated that:

In our school we have CoLab co-coordinator who works together with the University of Limpopo CoLab to assist all teachers with the use of technology. The school

provides in-service training of digital technology to teachers with the help of the CoLab coordinator.

The principal of School B said that:

There was no in-service training of digital classroom technology to teachers in our schools because we do not have computers from the Department of Basic Education and from the University of Limpopo CoLab.

The study is in line with (Baylor & Ritchie, 2002) stated that “ICT training has an imperative influence on how well teachers embrace technology in the classroom.”

This study supports the study conducted by (Lai & Pratt, 2004) who stressed that teachers need support in respect of classroom technology to able them to integrate technology into teaching and learning.

The findings of the current study are in line with (Johnson et al.,2016) who revealed that “if teachers are not provided with effective professional development on new technologies, they will not be capable of using it to its full potential.”

Moreover, this study highlighted the support barriers to technology integration into teaching and learning, including “inadequate technical administrative/peer support teacher’s acquisition of required computer and digital skills are very important in the 21st century teaching and learning” (Johnson et al., 2016).

The research finding of the current study supports the study conducted by (Mathevula, 2019) indicated that “the impact of DCT training in schools benefit teachers and principals in learning and teaching.”

One principal of the selected schools indicated that “the Limpopo CoLab frequently visited her school where members of the CoLab team helped teachers who had problems with using classroom technology.” In the remaining three secondary schools, no training of DCTs was offered to teachers and Limpopo CoLab never visited the schools.

In summary, this section offered a presentation and analysis of data from the one-to one interviews conducted with the school principals of the four case schools. Ten themes emerged from ten questions raised during the interviews. These themes were:

- classroom technologies available in schools;
- level of classroom technology usage by teachers;
- teachers changed from traditional teaching strategies to digital strategies,
- teacher's perceived level of usefulness of using digital classroom technologies;
- digital classroom technology influences effective teaching and learners learning;
- transiting from teacher centred pedagogy to learner centred pedagogy;
- digital classroom technology promotes learner pedagogy and collaborative learning;
- and,
- schools provide in-service training for teachers on DCT.

5.3 QUALITATIVE FINDINGS FROM HEAD OF DEPARTMENTS (HoDs)

In this section, the researcher presents findings of data collected from the interview with the heads of department (HoDs). HoDs play an important role in managing teaching, learning and assessment in a school, and they work together with the principal for the effective running of the school. Their experiences, perceptions and reflections on DCT in schools were found to be crucial in teaching and learning. Moreover, HoDs are responsible for monitoring the use of DCTs available in the school. Tondeur, Braak & Valcke (2006) noted that, by engaging the HoDs in the integration of DCT, gives them an opportunity to reflect on their engagement with teaching, learning and educational use of CT in schools. Dawson & Rakes (2003) argued that the HoDs form part of school leadership and the school's instructional leadership, in particular; therefore, they have the responsibility to ensure improved learner outcomes from the use of classroom technologies available. HoDs are a crucial component of SMTs because they work hand in hand with the teachers. Nine

themes emanated from data generated by interviews with HoDs interviews, captured in the table below.

Table 5.2: Themes and sub-themes emanating from HoDs' interviews

	Research question	Theme	Subthemes
1	Do teachers' have access to classroom technology and connectivity?	Teachers' access to classroom technology and connectivity.	The HoDs of all selected secondary schools confirmed that not all of the teachers have access to classroom technology and connectivity because they are inadequate technologies in schools.
2	Do teachers have experience with the use of computers?	Teachers' experience with the use of digital computers.	The HoDs believe that not all teachers in their schools have experience with the use of computers.
3	What is the level of proficiency in relation to computer technology?	Teachers level of digital and computer literacy.	HoDs noted that not all teachers in their school have low level of proficiency
			in relation to computer technology.
4	Does your school have a policy on computer education?	Schools' policy on computer education.	HoDs confirmed that their schools did not have a policy governing computer education

5	Does your school have a budget for computer equipment?	Schools' budget for computer equipment's and applications.	HoDs highlighted that all their schools have a budget for computer equipment.
6	Teachers possess competencies required to influence digital teaching and student learning	Teachers possess competencies required to influence digital teaching and student learning.	The HoDs confirmed that not all teachers in their schools possess the competencies required to influence student learning.
7	Is there management of computers in schools?	Management of computers in schools.	HoDs indicated that there was no management of computers because everyone needed to use a computer and there were simply not enough computers to meet this demand.
8	How many teachers are trained with the use of computers in schools?	Number of teachers trained with the use of computers your schools.	HoDs indicated that there were no teachers trained with the use of computers in their schools.
9	Who offered teachers digital training?	Teachers digital training	HoDs of school B, C and D confirmed that no teachers in their schools received digital training while the HoDs of school A had received digital training.

Table 5.2 displays themes and sub-themes that emanates from HoDs' interviews. A detailed discussion of each of the themes follows below:

Teachers' access to classroom technology and connectivity; teachers' levels of use of digital classroom technology; teachers level of digital and computer literacy; School policy on computer education; school has any budget for computer equipment and applications; teachers possess the competencies required to influence digital teaching and student learning; management of computers in schools and number of teachers trained with the use of computers in the schools. A detailed discussion of each of the themes follows in sections 5.3.1 to 5.3.9 below:

5.3.1 Teachers' access to digital classroom technology and connectivity

This theme emanated from the question, "do teachers' have access to digital classroom technology and connectivity?" The HoDs of all selected secondary schools confirmed that not all of the teachers have access to classroom technology and connectivity because they are inadequate technologies. The HoDs in four selected schools revealed that Technology in schools is used for administration and management purposes.

The HoD of school D pointed out that:

Teachers in our school do not have access to digital classroom technology because they have to share digital classroom technology and some of them end up not using computers.

The current study is in line with the study conducted by Valadez and Duran (2007) who stated that "the use of digital classroom technology expands access to teaching and learning by including the amount connectivity teachers connects online using internet in school and at home."

The current study supports the study of (Evoh, 2007) who argued “that deployment of digital classroom technology in schools could bring about access to DCT in both rural and urban areas.” The current study is in line with the findings of (UNESCO, 2014) which revealed “that access to classroom technology can help individuals to compete in a global economy by establishing a skilled workforce and by facilitating social mobility.”

The current study supports the study conducted by (Bourne, 2017), who revealed that “teachers who have access to DCT should be at a high level of adopting technology through the constant professional development to acquire the necessary DCT skills and knowledge to reach these advanced levels of competence.”

The HoDs of selected Capricorn secondary schools indicated “that teachers do not have access to classroom technology because of the inadequate technology available and that they have to queue for computers when preparing for teaching and learning.” The research finding shows that all case schools have insufficient technology in their schools and the technology available does not cater for teachers, together with their learners. The HoD in school A said that:

In our school technology is available but it is insufficient and does not cater all teachers and learner.

The HoDs of schools B indicated that:

In our school we had the same problem of inadequate computers, and teachers had to queue in order to access a computer.

The HoD of School C indicated that:

The non-availability of computers in our school made teachers not deliver teaching content effectively and this make their work very difficult.

The current study is in line with the study of (Russel, Bebell, O’Dwyer & Duffany, 2003) who stressed that “access to computer-based technology in schools and classrooms increases preparation of teachers with the use technology for instructional purposes.”

The current study supports the study of (Isik & Buran, 2012) who stated that access to DCT play a great role in education and in teaching and learning through the use of the internet to find more information.

The findings of this study are in line with the findings of the study conducted by (Noor-UI-Amin, 2013) who indicated that “access to DCT foster better learning and teaching which improve academic achievement of learners.”

The findings of the current study were supported by the study of (Timperley, Wilson, Barrar & Fung, 2018) who stressed that “access to DCT encourages active learning, knowledge construction, allow remote communication and support the sharing of data between learners and teachers.” All HoDs from the selected secondary schools agreed that there is an inadequacy of DCTs in their schools. They all need sufficient computers to cater for all teachers and learners in their school in order to harness the opportunities provided by access to technology that make teaching more meaningful, interesting and rewarding.

5.3.2 Teachers’ experience with the use of digital classroom technology

This theme originated from the question, “do teachers have experience with the use of computers?” The HoDs from all four selected secondary schools highlighted the fact that not all teachers in their schools have experience with the use of computers. The HoD school of School B indicated that:

Teachers in our school not all teachers have experience with the use of computers but because of inadequate technology they don't use their skills.

The HoD of school of School C highlighted that:

Some teachers in our school have experience with the use of computers but because of inadequate technology they don't use it in teaching and learning.

This study is in line with the study of (Hanks, 2002) who stated that “teachers who are exposed to computer experiences are more likely to learn new and necessary skills quicker than those who had no prior experience.”

This current study supports the study conducted by Woodbridge (2004) who argued “that teachers need to understand technology and the use of computers more completely in order to use technology in teaching and learning.”

The finding of this study was supported by (Ndlovu & Lawrence, 2015) who stressed that “the experience of teachers in using technology allows the transmission of subject content.” Furthermore, all HoDs from the four selected secondary schools agreed that majority of teachers in their schools did not have experience with the use of DCTs.

5.3.3 Teachers level of digital and computer literacy

This theme originated from the question, what is the level of proficiency in relation to computer technology?” The HoDs in four selected secondary schools noted that “not all teachers in their school have low level of proficiency in relation to computer technology.”

The HoD from School B said that:

Not all teachers in our school are computer literate; some teachers are not using computers because there are insufficient computers in the school but because they are computer illiterate.

The current study is in line with the study conducted by (Regina, 1999) who stressed that “the level of proficiency in relation to computer technology involves not only knowledge and values of classroom technology; it required teachers to feel confident but to also have a positive attitude towards a teacher’s ability to apply the theory concepts in the classroom.” The current study supports the study of (Bayhan, Olgun & Yelland, 2002) who argued that “teachers’ low level of confidence and lack of professional technology training contribute to teachers not using computers in teaching and learning.”

The finding of this study is in line with the study of (Russell, Bebell, O'Dwyer & O'Connor 2003) who stressed that “although new teachers shows higher levels of comfort with

technology and use it more for preparation, more experienced teachers use technology more often in the classroom when teaching.”

The findings of this study are in line with the study of (Guerriero, 2011) who indicated that “all teachers have to be at higher levels of comfort with technology and use, better decision making, better perception of classroom events, greater sensitivity to context in order to integrate technology, teaching methods and teaching content for effective teaching and learning to take place.” Teachers need to have knowledge of how to use classroom technology to achieve success.

All four HoDs from the selected secondary schools indicated that the majority of teachers in their schools had higher levels of comfort with the use technology while some the teachers do not have skills of using computers.

5.3.4 School policy on computer education

This theme emanated from the question, “does your school have a policy on computer education?” All HoDs from the four selected secondary schools confirmed that their school did not have a policy governing computer education. The HoD in School A noted that:

We do not have a well-structured procedure to follow and guide us on how to implement e-education policy in our school and we are willing to seek information to have e-education policy because we have computers.

The HoD of School D confirmed that:

We don't have policy on computer education in our school.

The current study is in line with the study conducted by (Adu, 2013) who stressed that “the school principals should have a proper ICT school policy in order to achieve the integration of ICT and technological solution in schools.”

The current study supports (Tondeur et al., 2006) who argued “that teachers in schools with an ICT policy shared goals on how to use ICT more regularly in teaching and learning.

The findings of the current study are in line with the study of (Vandeyar, 2015) who stressed that “schools were informed by the national department of education about e- Education policy and did not introduce how the policy should be implemented into teaching and learning.”

The current study supports the findings of the study conducted by (Mooketsi & Chigona, 2016) who revealed that “it is important for teachers to appreciate the changes that might have affected the implementation of e-Education policy outcome and appreciate the changes brought about by the implementation by e- Education policy in schools.”

The research findings revealed that “all four HoDs from the selected secondary schools indicated that there was no policy on computer education in their schools. All four secondary schools did not implement an e-education policy.”

5.3.5 School has any budget for computer equipment

This theme emerged from the question, “does your school have a budget for computer equipment?” Schools A, C and D did have a budget for computer equipment.

The HoD of school A said that:

Our school has a budget for cartridges and maintenance of computers for in case they need to be repaired.

School B’s HoD confirmed that this school did not have a budget for computer equipment.

In our school we have a budget for computer equipment’s because we don’t have sufficient technology.

The finding of the current study is in line with the finding in the study of Keludis and Stine (2001), who stressed that “educational institutions in South Africa should develop a process

for controlling costs rather than seeking to control expenses, which means a shift from managing expenditures to managing costs.”

The current study supports the study conducted by (Rusten & Hudson, 2002) who stated that “the budget of the school should cover the maintenance, upgrading and purchasing of new software to enhance the use of computers in schools.” The findings of the current study are in line with the study of (Akinsola, Herselman & Jacobs, 2005) argued that, in disadvantaged communities, schools need more than ICT equipment donations or funding, there is the need to pay attention to the computer centres’ sustainability.

The findings of the current support the study of (Bialobrzaska & Cohen, 2005) who argued that schools should ensure that there is security before they buy any technology equipment’s. There is high rate of crime in South Africa and the security of computers in schools should be given first priority.

All the HoDs from the selected schools agreed that there was a budget for computer equipment which was money obtained from fundraising. All selected secondary schools buy consumables, namely: toners, cartridges and A4 paper.

5.3.6 Teachers possess the competencies required to influence digital teaching and student learning

This theme emanated from the question, “teachers possess competencies required to influence digital teaching and student learning?” The HoDs from all four selected secondary schools confirmed that not all teachers in their schools possess the competencies required to influence student learning.

The HoD from School C indicated that:

Not all teachers in our school possess competencies required to influence student learning.

The HoD from School D indicated that:

Not all teachers in our school possess the competencies required to adopt digital teaching and student learning.

The current study is in line with a study conducted by (McGarr & McDonagh, 2019) who stressed that “teachers should possess digital competence as a unitary skill or a multitude of competencies.”

The current study supports the study by (Fallon, 2020) who stated that “teachers’ digital competency should focus on collaborative participation that leads to professional benefit for the individual and the online community as a whole.”

The findings of current study are in line with the study conducted by (Ghavifekr & Rosdy, 2015) who revealed that “the integration of ICT in classroom needs serious teacher’s consideration to increase the competency of the country’s education system.”

The findings of current study support the study by (Mirete, 2020) who revealed that teachers should possess the competencies to influence digital teaching and student learning and their teaching approaches should also change and in the have a direct impact on the quality of the teaching offered.

The HoDs from the four selected secondary schools highlighted that teachers do not possess the competencies required to adopt digital teaching and student learning. Teachers need to acquire a high level of digital skills in order to be able to implement lessons with significant use of technology.

5.3.7 Management of computers in schools

This theme originated from the question, “is there management of computers in schools?” In all selected secondary schools, there was no management of computers because everyone needed to use a computer and there were simply not enough computers to meet this demand. The HoD from School A noted that:

In school we have computers but there is no management of computers in the computer lab as teachers and students need to share these computers and they are not enough.

The HoD from school B said that:

In our school we have only five computers we cannot manage them because every teacher wants to use them. We do not use computers in our school for teaching and learning.

The current study is in line with the study conducted by Rusten and Hudson (2002) who highlighted that “computer facilities need to be managed by maintaining computers and funded to provide effective learning and teaching.”

The current study supports (Adu, 2013) who stressed that “school principals should adhere to some strategies that are discussed and suggested by teachers in managing the use of ICT in schools.”

The findings of this study are in line with the study conducted (Merering, 2013) who revealed that “management of computers in schools is hindered because of unavailability of computer integration and insufficient computers.”

The findings of current study support the findings of the study conducted by (Deryakulu, 2014) who revealed that “to manage computers in schools ICT teachers should set clear instructional and disciplinary rules to learners regarding the use of computers,” otherwise; computers can easily become a source of distraction for students and a management problem for teachers. Therefore, teachers who must teach lessons in computer labs need to gain classroom management skills accordingly.

The HoDs from the four selected secondary schools stated that there was no management of computers in their schools. All the HoDs agreed that schools had inadequate number of computers and that teachers find it difficult to use them. This is a challenge since some teachers end up not having access to computers.

5.3.8 Number of teachers trained with the use of computers in schools

This theme emanated from the question, “how many teachers are trained with the use of computers in schools?” HoDs of all selected schools indicated that no teachers were trained with the use of computers in the schools.

The HoDs from School A indicated that:

Our school had computer training offered by the University of Limpopo CoLab and they train teachers who now trained all staff members with the use of computers.

The HoD from this school said that:

I am the University of Limpopo CoLab coordinator in our school and I am working together with the University of Limpopo CoLab to assist all teachers with the use of classroom technology. In our school half of our teachers are being trained.

The HoDs from schools B, C and D confirmed that “all teachers in their schools were not trained with the use of computers.”

The HoD from School C indicated that:

The department of education did not provide our teachers with training with the use of computers. None of our teachers was trained with the use of computers.

The HoD from School D noted that “In our school no teacher was trained with the use of computers.”

The current study is in line with the study conducted by (Evoh, 2007) who argued “that the deployment of classroom technology in secondary schools, including the training of teachers in the use of technology, would enable teachers in South Africa to use ICT to accomplish the goals of improved secondary education.”

The current study supports the study of (Carlson & Gadio, 2012) who stressed that “teacher professional development is essential if technology provided to schools is to be used effectively.”

The findings of the current study are in line with the study of (Ghavifekr & Rosdy, 2015) who revealed that “professional development and training programs with the use of DCT play a key role in enhancing learners’ quality learning.”

The findings of the current support the findings of the study of (Johnson, Jacovina, Russell & Soto, 2016) who revealed that “schools and teachers should look out for training from educational software companies and educational technology researchers to assist them with the use of ICT.”

The findings of HoDs from the selected Capricorn District schools indicated that teachers were not being trained in the use of computers but one HoD from school A indicated that teachers in their school received training in the use of computers and this training was provided by the Limpopo CoLab.

5.3.9 Teachers digital training

This theme emerged from the question, “who offered teachers digital training?” HoDs of school B, C and D confirmed that no teachers in their schools received no digital training, while the HoDs of school digital training. The HOD from School A noted that “We received computer training from service providers and the University of Limpopo CoLab.”

The HoDs from schools B, C and D indicated that the teachers in their schools had not received any training from any service providers, or from the University of Limpopo CoLab. The HoD from School C noted that:

The department of education had never provided us with teachers training. Nobody had offered us with any computer training.

The HoD from School D said that:

There was no training done by anybody in our school. We are still waiting for the department of education to provide us with computers and computer training the way they promised”.

The current study is in line with the study of (Cheung & Hew, 2009), who stressed that “the professional development of teachers in the use of technology should go beyond teaching skills in technology use, and should focus on the effective pedagogical use of technology to support the aims of teaching and learning.”

The current study support the study conducted by (Mweli, 2013) who stated that “the provincial departments of education are responsible for the training and development of teachers in the DCT skills and for the integration of technology into teaching and learning.” The current study findings are in line with the (Baylor & Ritchie, 2002) who stated that “ICT training has an imperative influence on how well ICT is embraced in schools.” The findings of the current study support the findings of the study of (Gilakjani, 2013) who revealed that “training programs assist teachers to use computer technology more effectively in their teaching and learning.”

The HoDs from the selected secondary schools agreed that there was no one to offer DCT training t teachers. Only one school had received training but teachers still needed to be trained in the use of new digital technology skills.

Analysis and presentation of data from one-to-one interviews were conducted on the information received from the HoDs school principals from the four case schools on.

Nine themes emerged from ten questions raised. These themes were:

- teachers access to classroom technology and connectivity;
- teachers experience with the use of DCT;
- teachers level of computer literacy;
- school policy on computer education,
- budget for computer equipment's;
- teachers possess competencies required to influence digital classroom technology to students and learning;
- management of computers in schools;
- number of teachers trained with the use of computers in schools; and
- teacher's digital training.

5.4 QUALITATIVE FINDINGS FROM TEACHERS

In this section, the researcher presents the third set of findings from the data collected from interviews with teachers from the participating secondary schools. These findings are important because the teachers are responsible for teaching and for the implementation of DCTs for teaching and student learning. According to (Wheeler, 2000), classroom technology brings benefits to teachers and learners if used effectively in teaching and learning. The findings are important to this study because teachers have all relevant information and knowledge about the implementation of CT in the schools.

Table 5.3: Themes emerged from interviews with teachers

	Research question	Theme	Sub- theme
1	Does your school have access to school internet?	Schools have access to school internet.	Teachers confirmed that all four selected secondary schools have internet access.
2	Are lesson plans and assessment activities typed with Microsoft Word	Lesson plans and assessment activities typed with Microsoft Word.	Teachers confirmed that not all teachers used Microsoft Word to type lesson plans and assessment activities.
3	Is PowerPoint used when doing presentations	Usage of PowerPoint for lesson presentations.	Teachers confirmed that all the teachers from the selected secondary schools did not use PowerPoint when doing presentations.

4	Do teachers use Excel to compile mark-sheets and schedules?	Teachers use excel to compile mark-sheets and schedules.	The teacher from School A confirmed that “In our school, we use Excel for calculating the average, min, max and doing school reports.” Teachers of schools B, C and D are were using Excel when making calculations.
5	Are all teachers using Spread sheets when doing schedules?	Teachers use Spread sheets when doing work schedules.	Teachers of all selected schools confirmed that all teachers use Spread sheets when doing schedules.
6	Are all programs or records grouped together using Microsoft-Database?	Programs or records grouped together using Microsoft- Access.	All teachers of the four selected secondary schools confirmed that they are not using Microsoft Access to group programmes and records together.
7	This theme emerged from the question, “does your school communicate with teachers using email?”	Schools communicate with teachers and students using email.	Teachers from all the selected secondary schools had email.
8	Does your school use Microsoft Publisher 2007 to	Schools use Microsoft Publisher to create webpages and calendars.	Teachers in all selected secondary schools were not using Microsoft

	create webpages and calendars?		Publisher 2007 to create webpages and calendars.
9	How often does your school receive ICT support from the Department of Education?	ICT support from the Department of Education	All teachers from the four selected secondary schools confirmed they did not receive support from the department of education.

Table 5.3 above displays eight themes that emerged from interviews with teachers.

A detailed discussion of each of the themes follows below:

schools have adequate educational technology and internet access; educational technology available is use for lesson planning and assessment; usage of PowerPoint and other software for lesson presentation; teachers use Excel and spread sheets to compile mark sheets and schedules; all teachers using spread sheets when doing work schedules; schools communicate with teachers and students using email; schools use Microsoft Outlook 2007 to create webpages and calendars and ICT support from the National Department of Education.

5.4.1 Schools have adequate educational technology and internet access

This theme emanated from the question, “does your school have access to school internet?” All four selected secondary schools have internet access. The teacher from School A indicated:

In our school teachers are able to plan and research their lessons more easily using internet.

Schools B, C and D also had internet in their schools, but they are not using the internet for teaching and learning since it was reserved for administrative and management purposes.

The teacher from School B said that:

In our school internet is only used to send emails. We don't use the internet to search information because of inadequate computers.

The teacher from School C indicated that:

Our school has internet but teachers are not using it for learning and teaching because of inadequate technology.

The current study is in line with the study of (Balanskat, 2007) who stressed that “where there is availability of internet, computers can be used for responding to official email messages, creating and maintaining the official school website and for seeking information.”

The current study supports the study of (Kruger, 2010) who highlighted that “the internet plays an important role in moving an educational environment to more globally acceptable levels through collaboration and information sharing.”

The findings of the current study are in line with the findings of the study of Clark & Lyons, 2004) who revealed that “internet connection makes it possible for teachers to search for images and videos to supplement explanations in the classroom.” The findings of this study support the findings of the study of (Yadav, 2017) who revealed that “learners and teachers from both rural and urban area are using the internet to access information in their learning and teaching process.”

Teachers in 3 of the selected secondary schools agreed that their schools had internet but that teachers did not have access to the internet and that they did not use the internet for teaching because of inadequate classroom technologies. In only one school did teachers have access to the internet.

5.4.2 Lesson plans and assessment activities typed with Microsoft Word

This theme originated from the question, “are lesson plans and assessment activities typed with Microsoft Word?” All the teachers from the four selected secondary schools confirmed that not all teachers used Microsoft Word to type lesson plans and assessment activities.

The teacher from School A noted that:

Computers and laptops are available in our school but not all lesson plans and assessment activities are typed because some teachers are unwilling to migrate to technology.

The teacher from School B said that:

In our school we are unable to use computers to type our lesson plans and assessment activities because we have to queue for five computers.

The current study is in line with the study of (Schreiber & Valle, 2013) who argued that “ICT helps to change teaching into a practice that promotes active learning, social interaction and knowledge creation.”

The current study supports the study of (Prince, 2007) who stressed that “computers are used for printing and typing of official documents, such as time tables and school reports.” Teachers in all selected secondary schools agreed that not all lesson plans and assessment activities were typed using a word processor.

The findings of the current study are in line with the study of (Kozma, 2003) who revealed “that teachers belonging to schools engaged in ICT planning are more likely to apply technology for lesson planning and assessment.”

The findings of the current study support findings of the study conducted by (Prince, 2007) who revealed that “technology is used for administrative purposes by administrative, managerial and teachers, such as typing learner’s tests and assignments.”

Teachers in all four selected secondary schools indicated that learners’ tests and assignments are not typed using Microsoft Office.

5.4.3 Usage of PowerPoint for lesson presentation

This theme emanated from the question, “is PowerPoint and other software used when doing presentations?” All the teachers from the selected secondary schools indicated that they did not use PowerPoint when doing presentations. Teacher in school A noted that “We don’t use PowerPoint when doing presentations in our school.” The teacher from School B said that “Due to a lack of classroom technologies in our school we don’t use PowerPoint when doing presentations.”

The current study is in line with the study of (Lawrence & Veena, 2013) who stated that “teachers can arrange classroom presentations using computers, projectors and slides and get students to do the same.”

The current study support the study of (Shelly, Cashman, Gunter & Gunter, 2008) who highlighted that “teachers and learners should use Microsoft PowerPoint to present graphics programmes and multimedia presentations that incorporate text, audio, video, animation, graphic, links and interactivity.”

The current study support the study of (Gambari, 2015) revealed that “learners exposed to PowerPoint presentation perform better than their counterparts taught with chalkboard, chalks and textbook methods of teaching.”

The findings of the current study are in line with the study of (Nouri & Shahid, 2005) who revealed that “PowerPoint improves learners’ attitudes toward the teacher and lesson presentation.”

The findings of the current study support findings of the study conducted by(Othman, Tarmuji & Zulkifli, 2017) who revealed that “learners perceive positively to the PowerPoint presentations with respect to mobility and learning satisfaction than traditional teaching strategy.”

All teachers from the selected secondary schools agreed that they did not use PowerPoint to make presentations. They agreed that they gave feedback in meetings verbally and they did not present any information using PowerPoint.

5.4.4 Teachers use Excel to compile mark sheets and schedules

This theme originated from the question, “do teachers use Excel when making calculations?” The teacher from School A said that “In our school, we use Excel for calculating the average, min, max and doing school reports.” Teachers of schools B, C and D did not use Excel when making calculations.

The teacher from School B indicated that:

Teachers in our school do not use Excel when making calculations due to lack of computers in the school. We calculate using the calculator.

This study is in line with the study of (Shelly et al.,2008) who stated that “productivity tools enhance classroom technology in teaching and learning.”

This study supports the study of (Miller, Naidoo & Van Belle, 2006) who stated that “using Excel when calculating learner’s marks reduces the human error factor and increases accuracy.”

The findings of the current study are in line with the findings of the study of (Clark & Lyons, 2004) who revealed that “internet connection makes it possible for teachers to search for images and videos to supplement explanations in the classroom.”

The findings of this study support the findings of the study by (Aydin, 2016) who revealed that “Excel has eye-catching tables and graphs which help teachers and learners to construct new concepts easily.”

Teachers from three of the four schools indicated that teachers were not using Excel when doing calculations. Teachers were using calculators when teaching mathematics and

drafting schedules. Only one of the four selected secondary schools used Excel when calculating and drafting school budgets.

5.4.5 All teachers using spread sheets when doing work schedules

This theme emerged from the question, “are all teachers using spread sheets when doing work schedules?” All the teachers from the selected secondary schools indicated that they use spread sheets when doing work schedules.

The teacher from School C indicated that:

In our school, all teachers use spread sheets when doing work schedules. We carry the instruction from the Department of Education that all schools must use Spread sheet when doing work schedules.

The teacher from School D highlighted that:

The department of education had instructed all schools to use Spread sheet when doing work schedules and all schools are abiding by the instruction.

The current study is in line with (Alessi & Trollip, 2001) who highlighted that “the notion that productivity tools, like spread sheets, create tables and teachers use spreadsheets when doing all schedules to enhance technology in teaching and learning.”

The current study supports the study of (Prince, 2007) who stated “that technology can be used to create a spread sheet for maintaining the school budget.”

The findings of the current study are in line with the study conducted by (Shelly et al., 2008) who highlighted that spread sheet software allows teachers to organise numeric data in rows and columns.”

The findings of the current study support the study of (Ahmed, 2008) who highlighted that “spread sheet based teaching and learning equips teachers with computer literacy in the areas of management accounting and finance.”

5.4.6 Programs or records grouped together using Microsoft Database

This theme arises from the question, “are all programs or records grouped together using Microsoft Database?” All teachers of the four selected secondary schools confirmed that they are not using Microsoft Database to group programs and records together.

The teacher in school A highlighted:

In our school there are computers but we don't use Microsoft- Database to group records together because no one among us had the skill to do that.

The teacher in school B indicated:

We don't use Microsoft Database in our school to group records together because of lack of technologies.

The current study is in line with the study of (Shelly et al., 2006) who highlighted that “Microsoft Database is one of the tools of technology that enhance teaching and learning by storing information for reference, reporting and analysis.”

The current study supports the study of (Prince, 2007) stated that “schools keep records of assessments using Microsoft Database.”

The findings of the current study support the findings of (Heinich, Molenda, Russel & Smaldino, 1996) who revealed “that Microsoft Access is a versatile and easy tool that learners can use to access inquiry and research studies, create their own database and retrieve data in different ways.”

The findings of the current study support findings of the study conducted by (Ghavifekr, 2015) who revealed that “Microsoft Database is one of the ICT tools that enhance the learning process.”

Teachers in all selected secondary schools agreed that they are not using Microsoft Database to group together programs and records. All teachers in the four selected secondary schools are not using Microsoft Base.

5.4.7 Schools communicate with teachers using email

This theme emerged from the question, “does your school communicate with teachers using email?” Teachers from all the selected secondary schools communicate with teachers using email.

The teacher from School B said that:

We have email and all teachers communicate with each other using it.

The teacher from School C noted that:

Our school communicates with all teachers, learners and parents using email to announce everything happening in the school including school meetings and workshops.

The current study is in line with (Wheeler, 2000) who stated that schools use discussions and other forms of computer-mediated communication, such as email, to promote collaboration between learners and teachers.

The current study supports the study of (Kruger, 2010) who stated “that teachers are able to interact with each other using email.” The findings of this study support the findings of the study of (Laho, 2019) who revealed that “most families have internet access and that parents and teachers are comfortable using digital tools to communicate.” Emails make communication easy and fast to everyone in the world. It is related to this study because teachers communicate with each other online, prepare lesson plans, communicate with parents and learners in order to improve learner’s academic achievements. All teachers from the four selected secondary schools agreed that their schools communicate with teachers and students using email.

5.4.8 Schools use Microsoft Publisher 2007 to create webpages and calendars

This theme emanates from the question, “does your school use Microsoft Publisher 2007 to create webpages and calendars?” Teachers in all selected secondary schools are not using MS Publisher 2007 to create webpages and calendars.

The teacher in school A highlighted;

In our school we don't create webpages and calendars. We don't have skills to create webpages and calendars. We are working on it and we will create our own calendar this year for 2020.

The teacher in school D highlights that:

In our school we do not create webpages and calendars. We do not have the skills to create them.

Teachers in four selected secondary schools agreed that they do not create webpages and calendars. Teachers are not creative and they do not have skills to create webpages and calendars.

5.4.9 DCT support from the National Department of Education

This theme emanated from the question “how often does your school receive ICT support from the Department of Education?” All teachers from the four selected secondary schools confirmed they did not receive support from the department of education.

The teacher from School A noted that:

In our school we received ICT support from the University of Limpopo CoLab more often and from ICT coordinator in our school only. The department of education does not provide us with ICT.

The teacher from School B indicated that:

The department of education had promised schools with computers and ICT support and until now they had not fulfilled their promises.

The current study is in line with the study of (Holland, 2001) who stated “that all teachers should be trained, and need to be competent, in the use computer applications in teaching and learning successfully, effectively and appropriately.”

The current study supports the study of (William, Coles, Wilson, Richardson & Tuson, 2000) who stated that “mechanisms need to be provided to ensure that teachers have adequate access to classroom technology support.”

The findings of the current study are in line with the study of (Ntombovuyo, 2006) who revealed that “teachers lack support from the National Department of Education with the use of DCT for teaching and learning.”

The findings of the current study support the study conducted by (Mirzajani, Mahmud & Ayub, 2016) who revealed that “insufficient technical support from the DOE discourage teachers from implementing DCT in schools.”

All teachers from the four selected secondary schools agreed that the department of education did not provide ICT support to schools. In all four selected secondary schools there were no DCTs provided by the department of education.

In the above section, the researcher provided an analysis and presentation of the data obtained from one-to-one interviews conducted with teachers from the four case schools. Themes emerged from ten questions raised. These themes were:

- o teachers have access to school internet and connectivity;

- lesson plans and assessment activities typed with Microsoft Word;
- usage of PowerPoint when doing lesson presentations;
- teachers use Excel to compile mark sheets and schedules;
- all teachers use spreadsheets when doing work schedules,
- programs or records are grouped together using Microsoft Database;
- schools communicate with teachers using email;
- schools use Microsoft Publisher 2007 to create webpages and calendars; and
- DCT support from the National Department of Basic Education.

5.5 QUALITATIVE FINDINGS FROM DOCUMENT STUDY

A document study was conducted on the premises of the four case schools. The following documents were studied: school governing body (SGB) minute books, staff minute books, purchase books, computer room rosters, asset and maintenance files, ICT policy documents, lesson plans, minutes of departmental meetings, duty allocations book and marks schedules. All four selected schools provided the researcher with all the relevant documents needed for this study.

Table 5.4: Summary of data from document study

	Availability	Accessibility	Comment
SGB minutes book	Yes	Yes	Well kept. In three of the schools the minute books were not typed.
Staff minutes book	Yes	Yes	Well-kept and were not typed in all schools.
Purchase books	Yes	Yes	Well-kept and not typed in all schools.
Computer room rooster	No	No	All schools did not have a roster.
Computer maintenance file	Partly yes	Partly yes	Not kept in three of the four schools.
ICT policy	No	No	All schools did not have an ICT policy

Lesson plans	Yes	Yes	Some teachers did not use computers when making lesson plans.
Departmental meetings minutes book	Partly yes	Partly yes	Not typed.
Duty allocations	Yes	Yes	Were all typed
Mark schedules	Yes	Yes	Were all typed
Asset register	Yes	Yes	Available and functioning

Table 5.4 above shows the documents used in the document study. Data from the selected Capricorn secondary schools is presented and discussed in the following sections of this chapter. SGB minutes books, staff minute books, departmental meeting minute books and purchase books were well kept by all selected secondary schools but the contents of these books were not typed. In all of selected schools there was no computer roster, ICT policy or computer maintenance file. Lesson plans were available but some are not typed. Duty allocations and mark schedules were well kept and were all typed.

There is no new knowledge provided by document study from SGB book, staff minutes' books, purchase book, computer roster, computer maintenance file, lesson plans, departmental meetings minutes' book and duty allocations. The only contribution that document study offered is lack of ICT policy in the case schools.

5.5.1 Lack of ICT policy

Document study revealed that all selected secondary schools do not have ICT or e-Education policy that regulates the integration of educational technology in teaching and learning. As a result, ICT integration in school's curriculum implementation remains teachers' choice and autonomy, and necessarily compliance to the school policy. This finding is in line with (Harding, 2018) who found a "lack of time as a considerable barrier" to teaching staff in transiting to digital teaching and learning; " (UNESCO, 2020) finding that

“turning teaching materials into digital format at short notice has been a challenge as few teachers have strong digital and ICT skills”.

5.6 CHAPTER SUMMARY

In this chapter, the researcher dealt with the analysis and presentation of data from interviews with 4 principals, 4 HoDs and 4 teachers from the 4 case schools. Participants were interviewed on their school premises. The presentation and discussion of qualitative findings of data obtained from interviews covered the responses with respect to the level of use of DCT from the school principals, the heads of department (HoD) and from the teachers. The documents that were studied were the SGB minute books, staff minutes' book, purchase books, computer room rooster, asset and maintenance file, ICT policy, lesson plans, minutes of departmental meetings, duty allocations and marks schedules.

CHAPTER 6 SUMMARY, RECOMMENDATIONS AND CONCLUSION

6.1 INTRODUCTION

Chapters 4 and 5 presented and analysis data obtained from the document study and interviews. This chapter provides a summary of the qualitative findings that emerged from data presentations and analysis. The summary of this study includes the key findings, namely, low levels of digital classroom technology integration; in adequacies of digital classroom technologies; high levels of teachers' perceived level of the usefulness of using digital classroom technology; learner-centred pedagogy and collaborative learning were promoted through DCT; lack of adequate teacher training on digital classroom technology; lack of teacher competencies required to influence digital teaching and student learning; failure in the implementation of e-education policy in schools; lack of e-education policy in schools; and lack of teacher support from the national department of education.

6.2 KEY FINDINGS

The specific aim for the collection of evidence was to analyse digital classroom technologies and teacher's perceived usage and ease of the use of technology at selected Capricorn secondary schools in Limpopo Province. A discussion of the key findings follows.

Table 6.1: Key findings

Key findings
Low levels of digital classroom technology integration;
Inadequacies of digital classroom technologies;
Resistance of transition from teacher-centred pedagogy to learner-centred pedagogy;
High degree of teachers' perceived level of the usefulness of using digital classroom technology;
Lack of adequate teacher training on digital classroom technology;
Lack of teacher competencies required to influence digital teaching and student learning;
Failure in the implementation of e-education policy in schools;
Lack of e-education policy in schools; and
Lack of teacher support from the national department of education

6.2.1 Low levels of digital classroom technology integration in teaching and learning

The first key finding that emerged from the analysis of data is the low levels of digital classroom technology integration in teaching and learning in the selected CoLab secondary schools in Capricorn district. The research findings identify low levels of digital classroom technology integration into teaching and learning. There was a dismally low level of use of digital classroom technology for teaching and learning by teachers in all selected schools. Teachers do not integrate DCT into teaching and learning because of the insufficient number of computers to cover all of them. Sicilia (2005) highlighted that teachers find it difficult to always have access to computers because they had to be booked in advance and be shared with other teachers. Teachers find it hard to integrate DCT into teaching and learning because of insufficient technologies at schools. Protheroe (2005) stated that the use technology provides opportunities to support new models of learning, including opportunities for students to collaborate and construct knowledge. Isaacs (2007) highlighted the notion that resources should be made available to schools to provide telecommunication infrastructure for learning and teaching to enhance the quality of teaching.

6.2.2 Inadequacies of digital classroom technologies provisioning at the participating schools

The second key finding that emerged from the analysis of data is the inadequacies in the provisioning of digital classroom technologies in the participating schools. The participating schools had limited access to computers or laptops and challenges with internet connectivity. Teachers in the selected schools are using chalk and chalkboard, and traditional and contemporary pedagogies to deliver the curriculum in their classrooms. All selected schools do not have adequate computers or a fast internet connection. Teachers do not use technology due to inadequacies in the supply of technology and they use chalks, textbooks and chalkboard. Blake (2009) highlighted the fact that teachers continue to use chalkboards and textbooks instead of technology in their teaching and learning, even in cases where technology is available. Toprakci (2006) indicated that low numbers of computers and slowness of ICT provision in schools are the barriers to the successfulness implementation of ICT. Habibu, Mamun & Clement (2012) noted that educational institutions provide ICT capacity (resources) to ensure that all teachers and students have immediate access to all software that are required to support the curriculum and adequate support to implement its use in classroom teaching-learning process without any difficulties.

6.2.3 Teachers' resistance from transiting from teacher-centred pedagogy to learner-centred pedagogy through the use of DCT

Teachers from the participating schools resist to transit from teacher-centred pedagogy to learner-centred pedagogy. Teachers were using chalkboard and textbook methods of teaching at the time this study was undertaken. They indicated that inadequate access to technologies hinder the integration of digital classroom technology in their teaching and learning. Thaba-Nkadimene (2019) indicated that the failure to transit from traditional pedagogies to digital pedagogies is common in Limpopo schools. In times when many teachers across the globe have already migrated to digital classroom technologies, this was

not the case in these four participating schools. Schreiber and Valle (2013) stated that social constructivism helps to change teaching to a practice that promotes active learning, social interaction and knowledge creation. Moustafa, Ben-Zvi-Assaraf & Eshach (2013) highlighted that student-centred constructivist classrooms document increases students' higher order thinking, learning and motivation. Lekgothoane & Thaba-Nkadimene (2019) highlighted that there are still teachers who prefer traditional pedagogies instead of blending their teaching with digital ones.

6.2.4 High degree of teachers' perceived level of the usefulness of using digital classroom technology

Teachers in four selected Limpopo secondary schools perceive the level of using digital classroom technology useful in teaching and learning. Teachers in selected schools perceive digital classroom technology to be useful and they are likely to use it as a mode of learning and teaching, but insufficient technologies in their schools is a barrier. Teachers attitudes towards the use of technology is positive but a lack of access of digital classroom technologies is an impeding factor towards successful implementation of digital classroom technology, as prescribed by the White Paper on e-Education. Rana (2020) highlighted that most teachers have positive attitudes towards the general role that information and communication technology can play in education and in the educational process. Habibu, Abdullah- Al-Mamun & Clement (2012) stated that teachers had a strong desire to integrate ICT into the teaching and learning process even though with difficulty. Tella et al highlighted that teachers perceive ICT very useful for teaching and learning.

6.2.5 Lack of adequate teacher training on digital classroom technology

Teachers from the selected secondary schools indicated that there was no one to offer DCT training to teachers. Only one school had received training but teachers still need to be trained in the use of new digital technology skills. Digital classroom technology changes

time and again and teachers need frequent training on the new DCT changes. Lack of adequate teacher training on digital classroom technology hinders teachers to implement DCT in teaching and learning. Evoh (2007) stated that training of secondary school teachers in the use of ICT will enable South Africa to use technology to accomplish the goals of improved secondary education and human development. Meyer & Gent (2016) highlighted that teacher training is required to ensure that ICTs are integrated into teaching and learning. Teachers and learners must be supervised and controlled in the use ICTs in support of teaching and learning.

6.2.6 Lack of teacher competencies required to influence digital teaching and student learning

Some of teachers may have computer or digital skill challenges, but they hide behind the inadequacies of educational technology supply in schools. Teachers in selected schools are not using Microsoft Outlook 2007 to create calendars and webpages, in their presentations; they do not use PowerPoint and learner assignments are not typed. Teachers complain that lack of technology in their school is the main reason that impedes them from using classroom technology for teaching and learning. In cases where non-use of education technology lies with a lack of teacher's skill. Hyndman (2018) recommended that "the right professional development to help teachers become proficient in digital technology. Newhouse (2002) stated that many teachers lack the knowledge and skills to use computers and do not integrate technology into their teaching and learning. Pelgrum (2001) indicated that teachers' lack of skills and knowledge is the main hindrance preventing teachers from using ICT in primary and secondary schools. Lack of teacher competence is one of the factors involved in resistance of teachers towards change.

6.2.7 Failure in the implementation of e-education policy in schools

In all four selected secondary schools there is failure in the implementation of e-education policy. There is no well-structured document to assist teachers on how to implement e-education policy in schools to support teaching and learning. Teachers indicated that the

lack of implementation e-education policy in schools is due to inadequate technology availability. The national department of education should develop principals together with teachers to create the conditions to develop a shared ICT policy in schools. Teachers should be encouraged to form ICT communities of practice to support their teaching practice and foster policy implementation. Vandeyar (2015) highlighted that schools were informed by the national department of education about e- Education policy and did not introduce how the policy should be implemented into teaching and learning. Ramorola (2010) stated that e-education policy needs to be well planned and integrated into teaching and learning to assist schools to implement technology into the curriculum.

6.2.8 Lack of e-education policy in schools

There is lack of e-education policy in all selected schools. Teachers indicated that they do not have a guide to assist them on how to implement e-education policy in their schools, the reason being inadequate digital technologies. School policies play an important role in promoting ICT integration in the classroom. Lekgothoane & Thaba-Nkadimene, (2019) revealed that the South African Government did not succeed in addressing the immense expenditure required to make e-education policy implementation possible. Isaacs (2007) highlighted that e-education is the ability to apply ICTs, access, analyse, evaluate, integrate, present, and communicate information, create knowledge and information by adapting, applying, designing, inventing, and authoring information using appropriate technology and mastering communication and collaboration skills.

6.2.9 Lack of teachers support from Limpopo Department of Education

All teachers from the four selected secondary schools confirmed that the Limpopo Department of Education did not provide ICT support to schools. The department of education did not provide schools with DCT equipment and training. Teachers need to be supported by the department of education throughout the implementation of e-Education

policy. The department of education adds to teachers' low self-efficacy by not providing them sufficient amount of professional development on how to implement e-education policy. Ramirez (2011) indicated that continuous support elaborates that job-embedded support was essential component of implementing technology into learning practices.

Harrell & Bynum (2018) highlighted that self-efficacy plays a significant role in the desire to use such tools in the classroom and teachers must be supported with the implementation of e-education policy to support teaching and learning. Meyer & Gent (2016) highlighted that integration of ICT in schools is successful when teacher professional development, ICT competence, developmental educational beliefs, and ICT vision and policy are being in order in a school.

6.3 RECOMMENDATIONS

Recommendation 1

Schools should be equipped with technologies, for example, the internet and computers. Technology should cover teachers and learners to enhance teaching and learning. According to (Shah, 2013) technology is used in learning, teaching and assessment to help teachers with the delivery of teaching content and to enrich the learning experience. Digital classroom technology changes the role of learners into explores and teachers into facilitators who guide learners to be able to take control of their learning. Teachers should not waste teaching time queuing for computers the department of education should make sure that each teacher has a computer.

Recommendation 2

Teachers should perceive and accept the use of technology. Both perceived usefulness of technology and perceived ease of use of technology affect attitudes toward the usability and acceptance of technology in schools. Martin (2000) stated that the teacher's acceptance of technology in teaching and learning is regarded as the major factor in

education systems. Teachers should perceive classroom technology as beneficial for learners in the learning process and in the post-school environment. Oncu, Delialioglu & Brown (2008) highlighted that teacher's attitude towards using classroom technology in teaching and learning is an imperative factor for successful technology- classroom integration.

Recommendation 3

Teachers should change their attitudes towards the use of technology. Digital classroom technology enhances teachers' job performance, saves time and makes teaching and learning more interesting and easy. Timothy (2009) highlighted that perceived ease of use of CT has direct effects on behavioural intention of computer use. Classroom technology improves teachers' work, increases their productivity and enhances their effectiveness. Digital classroom technologies make the work of a teacher more relevant and interesting.

Recommendation 4

The national department of education should assist teachers with workshops of the use of DCT to assist them to transit from teacher centred pedagogy to learner centred pedagogy. Digital classroom technology should change teacher-centred to students- centred pedagogy and facilitated collaborative pedagogy. Bahati (2010) stated that in an improved learning environment technology is used to support teacher-centred and learner-centred approaches where the teacher facilitates and guides and learners are active, giving feedback in the process of learning. Digital classroom technology creates a distributed environment where learners can be able to share workspaces, communicate with each other and their teachers using text messages. Armstrong (2014) stated that technology is credited as the principal factor that changes the role of teachers into facilitators who guide and encourage learners. Digital classroom technology had an impact on the school as a physical learning environment.

Recommendation 5

The Department of Education should develop, design and help schools to implement a common policy of technology education. Principals should create conditions to develop a shared ICT policy in schools. School policies play an important role in promoting ICT integration in the classroom. Trigs & John (2004) argued that digital classroom technology policy in schools should help teachers to implement CT to contact colleagues who shared similar interests, interaction that involves skills exchange, encouragement to take risks and how CT could be improved. Ramorola (2010) stated that e-education policy needs to be well planned into teaching and learning to assist schools to implement technology into the curriculum. E-Education policy promotes the use of technology in strengthening teaching and learning in public schools.

Recommendation 6

Teachers should possess competencies required to influence digital teaching practice and student learning. Teachers should possess competencies to use technology to create webpages, create calendars and be able to use technology in their presentations. Pelgrum (2001) stated that teachers' lack of skills and knowledge is the main hindrance preventing teachers from using ICT in primary and secondary schools. Lack of teacher competence is one of the factors involved in resistance of teachers towards change.

Recommendation 7

The Department of Basic Education should provide teachers with digital classroom technology (DCT) training to assist teachers with skills and knowledge of using technology in teaching and learning. DCT increases rapidly and teachers need support to assist them to adapt to new changes in technology. Teachers should be able to deliver teaching utilizing tools such as online videos to expand their communication and to address learners.

The department of education adds to teachers' low self-efficacy by not providing them sufficient amount of professional development on how to implement DCT in teaching and learning. Harrell & Bynum (2018) highlighted that self-efficacy plays a significant role in the desire to use such tools in the classroom and teachers must be supported with the implementation of e-Education policy to support teaching and learning. Meyer & Gent (2016) highlighted that integration of ICT in schools is successful when teacher professional development, ICT competence, developmental educational beliefs, and ICT vision and policy are being in order in a school.

Recommendation 8

The national department of education should provide teachers with support of the use of DCT on how to implement technology in all schools. Holland (2001) has argued that all teachers should be trained, and need to be competent, in the use computer applications in teaching and learning successfully, effectively and appropriately. William, Coles, Wilson, Richardson & Tuson (2000) indicated that mechanisms need to be provided to ensure that teachers have adequate access to classroom technology support. All teachers from the four selected secondary schools agreed that the department of education did not provide ICT support to schools. In all four selected secondary schools there were no DCTs provided by the department of education.

Recommendation 9

National department of education should provide their schools with security to protect digital classroom technologies from theft. The Department of education should provide schools with systems to minimise theft and vandalism of technological systems. For example, security guards, alarms and burglar proof to put digital classroom technology in safe hands. Schools should make sure that their infrastructure is well structured. Their computer rooms are well built with bugler doors and bugler windows and the fence is in good condition.

SASA (1996) highlighted that a school which occupies immovable property owned by the State has the right, for the duration of the school's existence, to occupy and use the immovable property for the benefit of the school for educational purpose.

Recommendation 10

Schools should have a fulltime technician to deal with user problems and maintenance of technologies. The technician should be appointed by the Department of education and must maintain the centre fulltime. The duty of the technician will be to support and help teachers at school levels with problems they may encounter when using digital classroom technologies. Teachers should find the use of technology easy to use and useful to use and with assistance from the technician in the school's teachers won't find it difficult to implement technology in teaching and learning. Cattani & Farris (2001) highlighted that National Centre for Education Statistics; (NCES) found that 99% of full-time public school teachers reported having the need to have technicians in their schools to boost teachers' technical expertise.

6.4 ASSUMPTIONS FOR FURTHER RESEARCH

Since the study focused on digital classroom technologies and teacher's perceived usage and ease of the use of technology at selected Capricorn secondary schools in Limpopo Province similar studies are necessary which focus on teachers in Capricorn primary schools. The researcher contemplates that their counterparts in primary schools could experience predicaments experienced by secondary school teachers. Furthermore, learners favour subjects that were delivered through classroom technologies. Despite some limitations with other teachers, school performance improved. Digital classroom technologies were found to be primary cause of change in school performance. For

teachers to be grounded in classroom technology usage, the study recommends further research in other districts in the province and in private schools.

6.5 CONCLUSION

The problem this study examined is the lack of classroom technology and connectivity, and teachers' circumstances that makes them fail to transit to digital pedagogies. The purpose of the study was to investigate the levels of digital classroom technologies and teacher's usage of technology in selected schools in Limpopo Province. This study was guided by three main research questions, namely, "What is the level of classroom digital technologies in schools? What is the teachers' level of use of using digital classroom technology? What is the teachers' perceived ease of use of new digital classroom technology?" The study is qualitative in nature and interpretivism paradigm and a theory of technology acceptance model were used to guide in assessment of this phenomenon. The study concludes that schools that were serviced by Limpopo CoLab Project lack digital classroom facilities to practice what were learnt from training. This study recommends the Department of Basic Education to provide Limpopo schools with school connectivity and digital technologies. This study further recommends that training of teachers on the use of digital classroom technologies should be made a priority.

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APPENDICES

APPENDIX A: A LETTER TO THE UNIVERSITY OF LIMPOPO RESEARCH OFFICE

Stand no 336
Zone 1 Mankweng
Sovenga
0727
29 November 2018

The Research Office
University of Limpopo
Private Bag X1106
Sovenga
0727

Dear Sir\ Madam

APPLICATION FOR APPROVAL FROM THE UNIVERSITY OF LIMPOPO: ETHICAL CLEARANCE

I am hereby applying for ethics clearance for my studies in Master in Education studies entitled: An investigation into the level of digital classroom technology and teachers'

perceived usage and ease of the use of technology at selected Capricorn secondary schools in Limpopo Province, under the supervision of Prof M.J. Themane.

Yours faithfully

Lekgothoane Raesetja Letjobana Cathrine (201100906)

Email: cathyletjoba@gmail.com

APPENDIX B: APPROVAL FOR DOING RESEARCH WITH UNIVERSITY OF LIMPOPO



University of Limpopo
Department of Research Administration and Development
Private Bag X1106, Sovenga, 0727, South Africa
Tel: (015) 268 3935, Fax: (015) 268 2306, Email: anastasia.ngobe@ul.ac.za

TURFLOOP RESEARCH ETHICS COMMITTEE
ETHICS CLEARANCE CERTIFICATE

MEETING: 05 March 2020

PROJECT NUMBER: TREC/29/2020: PG

PROJECT:

Title: Investigating levels of digital classroom technologies and teacher's usage of technology in selected schools in Limpopo Province
Researcher: RLC Lekgothoane
Supervisor: Dr KL Thaba-Nkadimene
Co-Supervisor/s: Mr A Scholtz
Prof MJ Themane
School: Education
Degree: Master of Education in Curriculum Studies

PROF P MASOKO
CHAIRPERSON: TURFLOOP RESEARCH ETHICS COMMITTEE

The Turfloop Research Ethics Committee (TREC) is registered with the National Health Research Ethics Council, Registration Number: REC-0310111-031

Note:

- i) This Ethics Clearance Certificate will be valid for one (1) year, as from the abovementioned date. Application for annual renewal (or annual review) need to be received by TREC one month before lapse of this period.
- ii) Should any departure be contemplated from the research procedure as approved, the researcher(s) must re-submit the protocol to the committee, together with the Application for Amendment form.
- iii) PLEASE QUOTE THE PROTOCOL NUMBER IN ALL ENQUIRIES.

Finding solutions for Africa

**APPENDIX C: APPLICATION LETTER TO CAPRICORN DISTRICT: LIMPOPO
DEPARTMENT OF EDUCATION**

Stand 336
Zone 1 Mankweng
Sovenga
0727
18 January 2018

District Director
Capricorn South
P\Bag XO3
Chueniespoort
0745

Dear sir\ Madam

I am hereby applying to conduct research at secondary schools in your district. I am currently studying towards my Master's Degree in Education through the University of Limpopo and request to carry out fieldwork research at secondary schools in Capricorn District. The day-to-day functioning of the school will not be disrupted because all activities will be conducted after hours at a convenient time for teachers. My topic research is "investigating levels of digital classrooms technologies, teacher's perceived usage and ease of technology in selected secondary schools in Capricorn District, Limpopo Province. After completion of studies, I will take it upon myself to communicate to the research results.

Yours in Education

Lekgothoane Raesetja Letjobana Cathrine (201100906)

Email: cathyletjoba@gmail.com



LIMPOPO
PROVINCIAL GOVERNMENT
REPUBLIC OF SOUTH AFRICA

DEPARTMENT OF
EDUCATION

CONFIDENTIAL

Ref. 2/2/2 Enq: Mabogo MG Tel No: 015 290 9365 E-mail: MabogoMG@edu.limpopo.gov.za

Lekgothoane RLC
P.O Box 336
Sovenga
0727

RE: REQUEST FOR PERMISSION TO CONDUCT RESEARCH

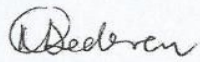
1. The above bears reference.
2. The Department wishes to inform you that your request to conduct research has been approved. Topic of the research proposal: **"INVESTIGATING LEVELS OF DIGITAL CLASSROOM TECHNOLOGIES AND TEACHER'S USAGE OF TECHNOLOGY IN SELECTED SCHOOLS IN LIMPOPO PROVINCE"**
3. The following conditions should be considered:
 - 3.1 The research should not have any financial implications for Limpopo Department of Education.
 - 3.2 Arrangements should be made with the Circuit Office and the School concerned.
 - 3.3 The conduct of research should not in anyhow disrupt the academic programs at the schools.
 - 3.4 The research should not be conducted during the time of Examinations especially the fourth term.
 - 3.5 During the study, applicable research ethics should be adhered to; in particular the principle of voluntary participation (the people involved should be respected).
 - 3.6 Upon completion of research study, the researcher shall share the final product of the research with the Department.

REQUEST FOR PERMISSION TO CONDUCT RESEARCH: LEKGO THOANE R.L.C.

4 Furthermore, you are expected to produce this letter at Schools/ Offices where you intend conducting your research as an evidence that you are permitted to conduct the research.

5 The department appreciates the contribution that you wish to make and wishes you success in your investigation.

Best wishes.



Mrs Dederen KO
Acting Head of Department

09-03-2020

Date

REQUEST FOR PERMISSION TO CONDUCT RESEARCH: LEKGOTHOANE R.L.C.

APPENDIX E: APPLICATION LETTER TO KGAKOTLOU CIRCUIT OFFICE

Stand 336
Zone 1 Mankweng
Sovenga
0727
18 November 2018

Circuit manager
Kgakotlou circuit
Nobody
0726

Dear Sir

I am hereby applying to conduct research at secondary schools in your circuit. I am currently studying towards my Master's Degree in Education through the University of Limpopo and request to carry out fieldwork research at secondary schools in Mankweng circuit. The day-to-day functioning of the school will not be disrupted because all activities will be conducted after hours at a convenient time for teachers.

My topic research is "investigating levels of digital classrooms technologies, teacher's perceived usage and ease of technology in selected secondary schools in Capricorn District, Limpopo Province.

After completion of studies, I will take it upon myself to communicate to the research results.

Yours in Education

Lekgothoane Raesetja Letjobana Cathrine (201100906)

Email: cathyletjoba@gmail.com

APPENDIX F: APPROVAL FROM KGOKATLOU CIRCUIT OFFICE



LIMPOPO
PROVINCIAL GOVERNMENT
REPUBLIC OF SOUTH AFRICA

DEPARTMENT OF
EDUCATION

**CAPRICORN SOUTH DISTRICT
KGAKOTLOU CIRCUIT**

Ref: 8/2/1

Eng: Rammala MF

Tel: 082 386 9542

Office: 079 209 5834

Email: kgakotloucircuitoffice@gmail.com

CONFIDENTIAL

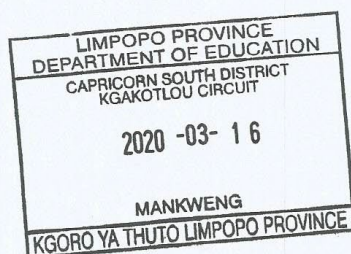
DATE: 16/03/2020

TO: THE PRINCIPAL

PERMISSION TO CONDUCT RESEARCH AT YOUR SCHOOL BY LEKGOHOANE RLC

1. The above matter refers.
2. Kindly allow **Ms. Lekgothoane RLC** to conduct research at your school. The research must be conducted in the afternoon so that teaching and learning should not be compromised.
3. Topic "**INVESTIGATING LEVELS OF DIGITAL CLASSROOM TECHNOLOGIES AND TEACHERS'S USAGE OF TECHNOLOGY**".
4. Thanking you in advance.

**DR. SEPURU MG
KGAKOTLOU CIRCUIT**



APPENDIX G: A LETTER TO SCHOOLS PRINCIPALS

Stand 336
Zone 1 Mankweng
Sovenga
0727
18 November 2019

Mapeloana Secondary School
P.O. Box 68 Nobody
0726

Dear Sir

I am hereby applying to conduct research at yours schools. I am currently studying towards my Master's Degree in Education through the University of Limpopo and request to carry out fieldwork research at secondary schools in Capricorn District. The day-to-day functioning of the school will not be disrupted because all activities will be conducted after hours at a convenient time for teachers. My topic research is "investigating levels of digital classrooms technologies, teachers perceived usage and ease of technology in selected secondary schools in Capricorn District, Limpopo Province After completion of studies, I will take it upon myself to communicate to the research results.

Yours in Education

Lekgothoane Raesetja Letjobana Cathrine (201100906)

Email: cathyletjoba@gmail.com

MAPELOANA SECONDARY SCHOOL

LEBOWAKGOMO DISTRICT

EMIS NO: 0923240686
ENQ: Mr. Letsoalo T.J.
☎ : 072 948 8434
chioneletsoalo@gmail.com



KGAKOTLOU CIRCUIT

P.O. ☒ 68
Nobody – Ga Mothiba
0726

16 March 2020

Sir/ Madam

PERMISSION TO CONDUCT RESEARCH

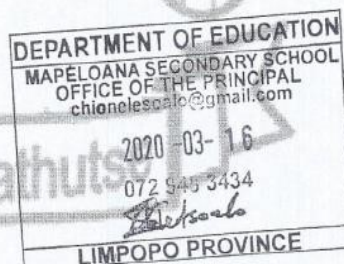
This letter serves to confirm that **Lekgothoane Raisetja Letjobana Cathrine**, Student Number: 201100906, is granted permission to conduct research at Mapeloana Secondary School. She is allowed to meet all stakeholders of the school including Educators, Heads of Departments and Principal. Her research topic is: **“INVESTIGATING LEVELS OF DIGITAL CLASSROOM TECHNOLOGIES AND TEACHER’S USAGE OF TECHNOLOGY IN SELECTED SCHOOLS IN LIMPOPO PROVINCE”**.

This permission is granted for research purposes only.

We wish her great success in her studies.

Kind regards

Letsoalo T.J. (*Letsoalo*)
Mapeloana School principal.



APPENDIX I: CONSENT FORM

RESEARCH PROJECT TITLE: Investigating levels of digital classrooms technologies, teachers perceived usage and ease of technology in selected Capricorn secondary schools, Limpopo Province.

(It is compulsory for the researcher to complete this field before submission to the Ethics Committee)

RESEARCH PROJECT LEADER/SUPERVISOR: Ms Raesetja Letjobana Cathrine Lekgothoane

(It is compulsory for the researcher to complete this field before submission to the Ethics Committee)

I, Raesetja Letjobana Cathrine Lekgothoane hereby voluntarily consent to participate in the following project: **An investigation into the level of digital classroom technologies and teachers perceived usage and ease of the use of technology at selected Capricorn secondary schools in Limpopo Province.**

(It is compulsory for the researcher to complete this field before submission to the Ethics Committee)

I realise that:

1. The study deals with people's experiences, perceptions, and experiences. (E.g. effect of certain medication on the human body) *(It is compulsory for the researcher to complete this field before submission to the Ethics Committee)*
2. The procedure or treatment envisaged may hold some risk for me that cannot be foreseen at this stage.
3. The Ethics Committee has approved that individuals may be approached to participate in the study.
4. The research project, i.e. the extent, aims and methods of the research, has been explained to me.
5. The project sets out the risks that can be reasonably expected as well as possible discomfort for persons participating in the research, an explanation of the anticipated advantages for myself or others that are reasonably expected from the research and alternative procedures that may be to my advantage.

6. I will be informed of any new information that may become available during the research that may influence my willingness to continue my participation.
7. Access to the records that pertain to my participation in the study will be restricted to persons directly involved in the research.
8. Any questions that I may have regarding the research, or related matters, will be answered by the researcher/s.
9. If I have any questions about, or problems regarding the study, or experience any undesirable effects, I may contact a member of the research team or Ms Noko Shai-Ragoboya.
10. Participation in this research is voluntary and I can withdraw my participation at any stage.
11. If any medical problem is identified at any stage during the research, or when I am vetted for participation, such condition will be discussed with me in confidence by a qualified person and/or I will be referred to my doctor.
12. I indemnify the University of Limpopo and all persons involved with the above project from any liability that may arise from my participation in the above project or that may be related to it, for whatever reasons, including negligence on the part of the mentioned persons.

SIGNATURE OF RESEARCHED PERSON SIGNATURE OF WITNESS

SIGNATURE OF PERSON THAT INFORMED SIGNATURE OF
PARENT/GUARDIAN
THE RESEARCHED PERSON

Signed at _____ on this _____ day of _____ 2018

APPENDIX J: PRINCIPALS INTERVIEW SCHEDULES

1. What classroom technologies are available for use by teachers at your school?

2. What is the level of use of classroom technology for teaching and learning by teachers?
3. Have teachers changed from traditional teaching strategies to digital teaching strategies?
4. What is teachers' perceived level of usefulness of using digital classroom technology?
5. How digital classroom technology does influences teaching and learning?
6. Does transiting from teacher centred pedagogy to learner centred pedagogy through the use of DCT facilitate change from teacher-centred pedagogy to student-centred pedagogy?
7. Does digital classroom technology promote learner- centred pedagogy and collaborative learning?
8. Does teacher receive adequate training and support on digital classroom technology?

APPENDIX K: HEAD OF DEPARTMENT (HODs) INTERVIEW SCHEDULES

1. Do teachers' have access to digital classroom technology and connectivity?
2. Do teachers have experience with the use of computers?
3. What is the level of proficiency in relation to computer technology?

4. Does your school have a policy on computer education?
5. Does your school have a budget for computer equipment?
6. Teachers possess competencies required to influence digital teaching and student learning?
7. Is there management of computers in schools?
8. How many teachers are trained with the use of computers in schools?
9. How many teachers are trained with the use of computers in schools?

APPENDIX L: TEACHERS INTERVIEW SCHEDULES

1. Does your school have access to school internet?
2. Are lesson plans and assessment activities typed with Microsoft Word?
3. Are PowerPoint and other software used when doing presentations?

4. Do teachers use Excel when making calculations?
5. Are all teachers using spreadsheets when doing work schedules?
6. Are all programs or records grouped together using Microsoft Database?
7. Do your schools communicate with teachers and students using email?
8. Does your school use Microsoft Publisher 2007 to create webpages and calendars?
9. How often does your school receive ICT support from the Department of Education?

APPENDIX M: EDITOR CERTIFICATE



The Computer Room

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Date: 25 September 2020

To Whom it May Concern

I hereby confirm that I have proof-read the document entitled: "Investigating levels of digital classroom technologies and teacher's usage of technology in selected schools in Limpopo Province" authored by Lekgothoane RLC have suggested a number of changes which the author may or may not accept, at her discretion.

Each of us has our own unique voice as far as both spoken and written language is concerned. In my role as proof-reader I try not to let my own "written voice" overshadow the voice of the author, while at the same time attempting to ensure a readable document.

Please refer any queries to me.

A handwritten signature in black ink, appearing to read 'Andrew Scholtz'. The signature is fluid and cursive, written over a light grey rectangular background.

Andrew Scholtz

Qualifications:

- MA (Digital Media in Education) – University of Kwazulu-Natal (2006)
- Accreditation of Assessors in Higher Education (Short Course) – Rhodes University (2007)
- Postgraduate Diploma in Dispute Settlement – University of Stellenbosch Business School (2013)
- SLP Family Law (Short Course) – North West University (2013)
- Strengthening Postgraduate Supervision (Short Course) – Rhodes University (2019)
- UCT Copy-editing Online Short Course – University of Cape Town (2020)

Evidence of qualifications available on request.