Exploring teachers' use of Information and Communication Technologies in their teaching

by

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Supervisor

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Declaration

I declare that the dissertation, which I hereby submit for the degree of Magister Educationis at the University of Pretoria, is my own work and has not previously been submitted by me for a degree at this or any other tertiary institution.

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Ethics statement

The author, whose name appears on the title page of this dissertation, has obtained, for the research described in this work, the applicable research ethics approval. The author declares that she has observed the ethical standards required in terms of the University of Pretoria's *Code of ethics for researchers and the Policy guidelines responsible for research.*

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ABSTRACT

The purpose of this study was to explore teachers' use of Information and Communication Technology (ICT) in their teaching. The study explored the ways in which teachers are utilising new technologies in three schools that have been integrated with ICT in the Nkangala district (Mpumalanga). ICT has largely been integrated in South African private and public schools. This study used a framework for integration of technology known as Technological Pedagogical Content Knowledge. The research design was a qualitative case study that followed descriptive and explorative approaches. Convenient sampling was used where data was collected through interviews, written documents and field notes. Six educators amongst the teachers who were trained on how to use ICT were interviewed. The data was analysed using Atlas.ti. The study discovered that not all teachers are using ICT effectively in their classrooms. There are still teachers who believe that ICT is time consuming. It has also been discovered that teachers still need support and training on how to use ICT for teaching and learning, and how to use technology to teach the content or to develop their pedagogy. The study concluded that there is still a gap between education and technology and that a lot still needs to be done in order to implement ICT effectively in education. The study recommended that the Department of Education together with schools, need to fully equip schools with ICT resources and to train educators on how to use technologies for teaching and learning.

Key Terms: Information Communication Technology, Pedagogy, Content knowledge, Technology integration, TPACK framework

LANGUAGE EDITOR'S DISCLAIMER

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List of Acronyms

ATMs	Automatic Teller Machines
CD	Compact Disc
CK	Content Knowledge
DIAL	Digital Impact Alliance
DVD	Digital Versatile Disc
ICT	Information and Communication Technology
IICBA	International Institute for Capacity Building in Africa
LDCs	Least Developed Country
PK	Pedagogical Knowledge
PCK	Pedagogical Content Knowledge
TK	Technological Knowledge
TCK	Technological Content Knowledge
TPK	Technological Pedagogical Knowledge
SSG	State Street Global Advisors
SSL	Spread sheet Supporting Learning
TPACK	Technological Pedagogical and Content Knowledge
UNESCO	United Nations Educational Scientific & Cultural Organization

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CHAPTER ONE INTRODUCTION

1.1 Introduction

This study intended to explore teachers' use and integration of Information and Communication Technologies (ICT) in teaching and in learning in South African high schools. This study explored the ways in which teachers use ICT resources in their classrooms to improve their content knowledge, pedagogy and content. ICT entered society and became its vital daily tool and as a result most people in the world rely on ICT to access information, communicate and stay associated in a growing globalized community.

In schools that have been equipped with ICT, technology is still confined to administration (Kafyulilo, 2012). Teachers are still struggling to prepare a lesson that is technologically integrated; they still think that a technological lesson plan will consume a lot of their time as compared to the traditional lesson plan (Kafyulilo, 2012). Other researchers have specified that some of the things that inhibit ICT from being integrated is the teachers' attitude towards ICT and their limited understanding of the way in which ICT can enhance their teaching and the work of the learners (Peeraer & Van Petegem, 2011). ICT can be valuable to education if teachers know how to use it and know the value that ICT can bring to teaching and education. ICT can be used for creating new atmospheres for learning and for equipping local and global communities for learning (Berenfeld & Yazijian, 2010).

ICT is used as the major factor to shape the global economy and to produce quick changes to society. In the last decade, the use of ICT has helped people to transform the way that they communicate and the way that they conduct their business (Khvilon & Patru, 2012). ICT is believed to have improved and supported education for the past decade (Voogt, Knezek, Cox, Knezek & Brummelhuis, 2011). ICT is believed to have brought almost unprecedented transformation in the community that creates people who are far away from each other to be able to communicate in a faster way using information technologies. The ICT currently used has made communication easier in the global village (Akkalwar, 2013). Implementing ICT in pedagogy has enabled students to be active in learning and interacting with one another. The use of ICT in

pedagogy has helped students understand the content better (Anila, 2017) and also to learn through recorded programs. ICT has helped to improve discipline in the classroom because students become absorbed in interactive learning and there is less time for disruption (Anila, 2017). ICT can assist teachers to transform the approach in which they use to teach and it is also meaningful to support environments with student-centered approaches. Recognising the significance of ICT for teaching and for learning, most countries in the world have provided training of teachers for ICT (Ndlovu, 2016).

1.2 Background to the problem

In the Mpumalanga Province, there were some public schools that were not using technology for teaching and learning as they were not yet integrated with ICT. Ten schools were piloted and integrated with internet, data projectors and tablets in 2013. The School Management Team (SMT) together with two teachers from each school were trained in how to use ICT resources. Two teachers were trained together with the SMT members with the aim to train other staff members in their schools in ways in which they could use ICT resources for their teaching and for learning. Each SMT member together with the two teachers received a laptop and they were also trained in how to use ICT resources. The teachers were trained in how to use data projectors, whiteboards, internet, Microsoft Word, Microsoft Excel, PowerPoint and emails. The teachers were never trained in how to use ICT in their pedagogy. The schools have now moved from chalk and talk to teaching in a way that is more interactive in teaching style; providing a platform where teachers and learners are capable of interacting with technology throughout the progression of teaching and during the process of learning. It has been an added advantage for the schools as teachers are able to use Microsoft Excel to prepare their mark sheets, use Microsoft Word to teach and prepare some of their documents and also send and receive emails form others. Teachers are able to use the internet to gather information and use data projectors together with whiteboards to deliver their lessons. The schools have access to free Wi-Fi and that makes it easy for teachers and learners to find information on the internet. In some of the schools, learners are allowed to access Wi-Fi through their cell phones during study time and they have blocked access to WhatsApp and Facebook to avoid learners spending time on social media instead of searching for useful information. I

decided to carry out the research in some of the piloted schools to explore how teachers are using ICT resources to improve the content, content knowledge and their own pedagogy.

1.3 Problem statement

Many schools are integrated with ICT but only use ICT for administrative purposes and teachers are still struggling to prepare a lesson using technology (Kafyulilo, 2012). Teachers may be finding difficulties in preparing lessons supported by educational technology as they lack the knowledge and training in how to prepare them. A large number of South African teachers wish to attain the vital skills to use ICT inventively in their pedagogy (Bliganut, Els, & Howie, 2010). It becomes a challenge when schools are integrated with ICT, yet fail to implement it in their classrooms; when teachers lack the necessary skills to use ICT to their advantage or to the advantage of the learners and the subject.

1.4 Purpose and aims of the research

The objective of the research was to discover how teachers use ICT in their teaching to improve their pedagogy from the old-style which is chalk and talk to the current technological curriculum. I also wanted to explore the way in which teachers use ICT to help themselves improve their content knowledge or enhance their prior knowledge of the subject that they teach, and how ICT has helped to improve the subject content that is being taught.

1.5 Research questions

The subsequent questions channelled the study:
The main research question:
How do teachers use ICT in their pedagogy to improve their knowledge of their subjects?

Sub research questions:

1.1 How do teachers use ICT to improve their pedagogy? (TPK)
1.2 How does the use of ICT improve the subject content? (TC)
1.3 How does the use of ICT improve the teachers' content knowledge? (TCK)

1.6 Limitations of the study

The following were regarded as research limitations for this study.

- The fact that I had to interview the participants after school hours limited this study from observing the site and gathering more information from the site because some of the participants were not comfortable to stay behind after hours and preferred to be interviewed at a different site.
- The fact that only three schools were investigated is a limitation, as the findings cannot be generalised; they will instead provide a deeper understanding of the concerned schools and can only be relevant to the schools that participated.

1.7 Significance of the study

The curriculum should be enhanced by integrating ICT to improve classroom teaching and learning. The new technologies were first integrated in private schools and in developed areas. Most of the teachers were never trained in how to utilise the new technologies although some were advantaged by the fact that they learned more about technology in their studies. Some of the schools that were integrated with ICT were only using it for administrative purposes and not for teaching and learning. It captured my interest when the technology started trending and some schools in the rural areas were also integrated with ICT. I became very passionate about knowing how ICT was being used for teaching and learning and how ICT has brought improvements in different learning areas. This study will be of great value in knowing how to use the ICT programs on hand so that they do not go to waste. The future impact of the study is that teachers can learn how other teachers are using ICT in their classrooms and how using those technologies have helped them improve their pedagogy and the content knowledge. One may learn or find ways of applying technology in classrooms to move from chalk and talk, to deliver information and learn anywhere at any time.

1.8 Conclusion

This chapter indicated what the study investigated and also introduced the concept of ICT; what is happening in the country and the background of the researcher concerning ICT. The goal of this research, problem statement and the research questions that guided the study were outlined.

CHAPTER TWO LITERATURE REVIEW

2.1 Introduction

To precisely understand the meaning of ICT in education it is important to first understand what ICT means. “ICT is defined as a diverse set of technological tools and resources used to communicate, create, disseminate, store and manage information” (Meenakshi, 2013, p. 3). Mdlongwa (2012, p. 256) defines ICT as a “global network in which ideas are exchanged, or information and knowledge is shared, through using communication technology, like computers, to connect people”. Surajo and Rislan (2013) have defined ICT as a practice of information transfer through technological media, hence, technology here serves as the means used to transfer or communicate information. In the context of this study, ICT is described as a way of gathering, sharing and communicating information by instructional technology, using computers, the internet and telephones to enhance effective teaching and learning.

2.2 ICT in education

When integrating ICT into education, there are numerous benefits that are suggested. Some of the benefits are: distribution of resources in learning environments and to promote collaborative learning and a wide-ranging change towards greater learner independence (Eze, Adu, & Ruramayi, 2013). However, the integration of technology goes beyond equipping computers and accessing the internet; it implicates evidence of learning activities with pedagogically educated use of ICT tools (Mereku & Mereku, 2015). Studies by Nkula and Krauss (2014) and Padayachee (2016) show that there are insufficient educators who ensure that there is effective integration of ICT in the classroom. I also believe that there is more to the new technologies than computers and the internet. Teachers need to be educated in how to use the new technologies. Teachers should be offered support both technically and pedagogically. There may be fewer educators who ensure that ICT is fully integrated in the classrooms because many teachers are still not familiar with using technologies in their pedagogy, or they may not know how or when to use these technologies.

There are digital tools that are frequently used in the classroom with the integration of ICT. These digital tools are: word processors, data projectors, PowerPoint, Excel

spread sheets, search engines, interactive whiteboards, mobile technologies, smart phones (e-mails, blogs, videos etc.), tablets, instant messaging, podcasts, CD-ROMs, Wikipedia, simulations, animations and e-books (Mooketsi & Chigona, 2014; Mereku & Mereku, 2015; Assan & Thomas, 2012; Lorenz, Banister, & Kikkas, 2015; Batchelor & Olakanmi, 2015; Govender & Govender, 2014; Molotsi, 2014; Tamim, Borokhovski, Pickup, & Bernard, 2015). Accordingly, these studies have shown that the integration of ICT has been successful in the classroom; however, there is still a need of in-depth knowledge in order for one to understand the kind of technologies that are used and the way in which they facilitate pedagogy and content knowledge.

Previous studies have revealed that teachers lack self-efficacy and have misconceptions that lead them to be unable to engage ICT in their classroom (Nkula & Krauss, 2014). Tamim et al. (2015, p. 2) proclaim that “there is a misconception that by simply putting this technology in the hands of students, educational access issues will be resolved and educational transformation will occur”. There are some issues that prevent the practice of ICT in the classroom, these issues include lack of time (Assan & Thomas, 2012), lack of clarity regarding the e-Education policy (Vandeyar, 2015), there is a lack of support both in relation to the infrastructure and the policy and insufficient skills (Vandeyar, 2015). Tamim et al. (2015), identified one of the major challenges being that when ICT is integrated there is less focus on the pedagogical, instead the focus is on the technical aspects of ICT. The researcher suggests that to overcome barriers that inhibit the practice of ICT in education such as lack of time, educators need help to understand and use the new technologies in their pedagogy so that they will not feel that the technologies are time consuming. But, according to Meenakshi (2013), the use of ICT resources require less time to teach as compared to the time needed when teaching using traditional teaching tools such as chalkboard and talk. I agree with the above-mentioned researcher that ICT requires less time to teach. With the help of ICT all the information needed is ready for the learners to view rather than the teacher starting by marking notes and diagrams on the board. Computers can arrange data speedily; for example if you want to create a mark sheet, you would insert the names and the formulas in Excel and the computer can do the calculations and conversions. A computer would take seconds to do calculations and arrange names in order which is less time consuming than using a pen and a paper to arrange names in alphabetic order and to insert marks and do calculations and

conversions. If educators require less time for teaching and administration, they will have enough time to cover the curriculum, do revision and also address topics that are more challenging to learners to understand. ICT can enrich the excellence of education by promoting learner motivation and commitment, enabling the required elementary skills, improving teacher training and shift to a learner-centered environment (Meenakshi, 2013).

Policymakers globally have broadly accepted that access to ICT in teaching can contribute to individuals coping in a universal economy by generating a trained labor force and facilitating societal mobility (Wallet, 2014). In current years there has been a rise of curiosity in knowing the way in which computers and the internet are used to increase the competence and success of education in schools. The old technologies like radio and television are no longer preferred as an instructional tool (Meenakshi, 2013). ICT has become the building block in modern society and it is considered the core of teaching and learning. Technology in education is considered to be one of the major tools to enrich young minds as they are open-minded enabling them to absorb new information, and to demonstrate creativity and improve critical thinking, as well as to acquire information for knowledgeable decision-making at an early phase (Meenakshi, 2013). In this regard ICT becomes immensely important.

Since ICT has been developing rapidly, it is necessary to balance it in the educational system by integrating it into educational activities. Learning activities ought to be re-oriented and revised from paper source to the open source (Meenakshi, 2013). The implementation of ICT has not been a priority trend of educational reform and the developing countries paid little attention to it (Menasha, 2013).

The use of videos have been believed to be the most effective form of ICT use in education as it is stressed that there is creativity in presentation. It is seen that videos can be used in a range of learning environments such as enhancing learning in classrooms and encouraging learners to make their own videos. Videos can also be useful to the blind by doing audio descriptions for them to be able to use the video. I believe that the use of videos at some point can serve as a lesson to learners in the absence of the teacher, because videos have images to display and there is already someone to explain whatever is being taught and watched on the video. It might be a

disadvantage when one wants to pose a question because they cannot be answered; however, videos can be a good substitute for teachers when they are otherwise committed and cannot attend to a lesson.

Some studies encouraged the addition of ICT grounded curricula, showing that sensible use of radical instructional technologies adopts information building, theoretical understanding and evocative learning (Barak & Dori, 2005; Romeo, Lloyd & Downes, 2012). When teachers' and students' perceptions on how to use technology are well linked then teachers are able to use technology to enrich the way in which they teach, "teaching, learning, and technology are more than blurred and thus, integrated and inseparable" (Weston & Bain, 2010, p. 8). Education is transforming by preparing students for an information and communication technology constructed society. ICT is believed to have great potential in transforming education from the current isolated, teacher-centered approach and the text-bound classroom into a rich student-focused interactive informative surrounding (Daniel, 2012). Educators were not integrating ICT as they were only taught how to run a computer and the basic skills instead of developing pedagogical aspects of ICT (Bingimlas, 2009). For high quality teacher education to be achieved, the United Nations Educational, Scientific and Cultural Organization-International Institute for Capacity Building in Africa (UNESCO-IICBA) believed that it is essential to introduce teacher education programs that will work towards taking education to greater heights in pedagogical integration of ICT (Trucano, 2012). The researcher believes that ICT is transforming education in such a way that learners depend less on teachers and become focused on their studies, as they are encouraged by the technologies and ICT programs to create an interactive informative environment.

2.3 ICT in South Africa

ICT was initially introduced to South African schools in the 1980s. It was initially introduced in private schools and well-resourced government schools (Mdlongwa, 2012). Mdlongwa further indicates that ICT is now integrated in South African disadvantaged schools. It has been ascertained that the integration of ICT in South Africa is conceptualized in three stages; the first stage was the readiness of one to use ICT, the second stage was integrating ICT widely and the last stage was

integrating ICT at all levels (Blignaut & Howie, 2009). Teachers were using ICT to maintain, improve and for the accompaniment of traditional classroom practices instead of redesigning the subject contents, goals and their pedagogy (Abdullahi, 2014). The researcher believes that the private schools are always one step ahead as they were the first South African schools to be integrated with technology while the government schools are one step behind. The disadvantaged schools will always be the last to receive transformation as the word itself states that they are disadvantaged.

In the Action Plan of its 2019 report, the Department of Basic Education (2015) has acknowledged that technology-enhanced learning is not yet progressive in South Africa as would be expected. Mooketsi and Chigona (2014) discovered that there was a disproportion between the government expectations and the teachers' practice. Vandeyar (2015, p. 348) maintains that "there are a number of studies considering the challenges involved in Information Communication Technology integration in schools, however explorative studies on the practical enforcement of the e-Education policy seemed to have escaped the focus of academic researchers". There needs to be a deeper understanding on how to use ICT in the classroom so that the understanding can be linked between theory and practice in order to develop training programs that train teachers. The integration of ICT in the classroom requires a deeper understanding that can be used to connect the gap between theory and training in increasing training programs for new teachers (Padayachee, 2017).

Leendertz, Blignaut, Ellis, and Nieuwoud (2015) endeavoured to improve a policy for mathematics educators to use ICT in their teaching. One of the writers accepted that they were not able to discover a suitable policy for qualified development of mathematics teachers with respect to the instructive use of ICT. Du Plessis and Webb declared that the present guidelines "provide very little information on how teachers and schools are expected to practically integrate or make use of ICT within the South African context" (Du Plessis & Webb, 2012, p. 46). Smith and Hardman suggest that it is essential to undertake most qualitative studies in order to gain a "nuanced picture of computer usage" (Smith & Hardman, 2014, p. 22). Adukaite, van Zyl, Er, and Cantoni (2017) also claim that there is a lack of literature in the field of ICT usage for tourism education in South African schools. A study conducted by Ndlovu (2016) considered the pedagogical value of ICT integration of South African secondary school

teachers' practices, even though the study was a case-based study and only limited to seven teachers. The study by Ndlovu revealed that teachers who worked in schools where there are minimal ICT resources, integrate ICT at a lower level. It is still necessary for teacher training programmes to train teachers on how to utilise ICT to assist teachers to maximise their use of digital technologies that they have in their schools. An analogous study by Adu (2016) considered the practice of e-learning amenities by Economic and Management Science educators (*n* = 200) in high schools in the Eastern Cape Province. The study by Adu found that most high schools did not have the essential e-learning devices that they can use for teaching and learning. In the study it was also discovered that school authorities did not give adequate support to e-learning initiatives (Adu, 2016). I believe that the Department of Education together with the schools should ensure that there are sufficient ICT resources in schools to avoid situations where ICT is integrated at a lower level. Upon the integration of ICT there is still a gap in using technologies that allows the teacher to deliver a lesson away from the classroom, such as e-learning and using a Learning Management system.

Research undertaken by the Khanya Project demonstrated that one of the main influences of presenting technology assets into schools, was the transference from the traditional chalk and talk approach to educating towards an added, collaborative teaching style where educators and students work together through the teaching and learning procedure (Chigona, Chigona & Davis, 2010). A strategic integrated project was launched to expand access to ICT in 2012. The aims of the project was to ensure that there is service, reliability, affordance and secure broadband services to all South Africans in rural areas and under-serviced areas (Ndlovu & Lawrence, 2012). There are still challenges in integrating ICT such as limited access to ICT services due to high levels of unemployment, lack of disposable incomes and high costs of acquiring access via cellphones or broadband services. Communicating via landlines has declined while communicating via cellphones has shown a greater increase (Chetty, 2016). I believe that communicating using cellphones has provided users the opportunity to communicate more cheaply than when they use landlines, as cellphones now have WhatsApp, Facebook and Twitter that allow them to communicate cheaply. Data can also be used to communicate through these apps; the data is affordable and one is able to purchase data that can last the whole month.

This makes communicating with cellphones much easier than having to constantly buy airtime when you need to make a call. Many shops and restaurants have free Wi-Fi for customers while they make use of their services and that also increases the use of cellphones for communication.

The Khanya project in the Western Cape stated that every educator should be ICT capable and has rolled out equipped computer laboratories to 1102 schools. As at 2015 the Khanya project has not yet completed its target as there are still ordinary public schools that do not have access to computer laboratories (Chetty, 2016). Padayachee (2017) claimed that secondary schools are still in shortage of most digital tools like having access to the internet, having web based learning, there are no email facilities and there are no multimedia projectors. The South African government has endeavoured to equip schools with computers in the country as it has been recognized that technology ii beneficial in making administration work faster and manageable, making communication easy even beyond the school, supporting teaching and learning by making learning more interactive and it is also a specialized support for learners with special needs (Department of Basic Education, 2013). In most of the institutions in South Africa students are able to find information in their required field of study by using ICT and are able to view their academic progress in their courses (Behnam, 2012). I believe that ICT has transformed the world and not only education. It has eliminated queueing to get your results printed for you in order to view them and now allows peple to view their results and academic progress online. Some of the job applications are made online where one can upload documents or just fill a form online and apply for that job. Companies are able to conduct interviews using technologies like Skype; it also saves time and money to travel from one place to another for a job interview. There are also online registrations which saves time travelling and waiting for others to be assisted first.

2.4 ICT in other countries

Internationally, the policy for integrating ICT for development stated that new technology benefits should be made available to all as ICT plays a vital role in achieving education for all goals (United Nations, 2012). ICT is pervasive in Asia in high income groups where more advanced forms of ICT and broadband connectivity

are available. Children and the youth acquire more knowledge in the way that they should use ICT easily out of the classroom as compared to learning how to utilise ICT inside the classroom (Wallet, 2014). The South together with West Asia, have their own distinct national sector which includes wide-ranging ICT practices; integrated into educational procedures and which include new technologies in education with its Master ICT plan (Bangladesh, 2013).

India lacks a national strategy in ICT in education and made it the accountability of discrete countries to cultivate ideas to transmit a policy that is set at the central level (India, 2012). It was noted that in India they experienced four barriers in accessing the internet. These barriers are unaffordable internet access, deficiency of digital literacy, an absence of internet coverage in the mobiles and an incentive to access information (McKinsey & Company, 2014). It was indicated that the four issues ring true for South Africa as well (Statistics South Africa, 2014). The number of people accessing the internet in India was increasing as 61% of the population were able to access the internet and it was expected that there would be 33 million internet users by the end of 2015 (McKinsey & Company, 2014). Schmida, Bernard, Zakaras, Lovegrove & Swingle (2017) claimed that almost half of the population in the world are now connected to the internet yet there are still 2.5 billion of the 4 billion that are still currently not using the internet. The Digital Impact Alliance (DIAL) requested the State Street Global Advisors to assess the global response to increasing entrance to ICT and the access of Internet in least developed countries (LDCs) (Schmida et al., 2017, p. 12). In Bhutan, there have not been any formal approvals for assimilating ICT diagonally to the curricula; however computers are given as an elective subject in high schools (Nepal, 2012).

Other developing countries (such as Pakistan) and developed countries (such as the United Kingdom) have established endorsements for integrating ICT in teaching in entire subjects and levels. Bangladesh emphasizes ICT in mathematics and in natural science but did not emphasize ICT in second languages (Islamic Republic of Iran, 2012). In Pakistan they faced a challenge of electricity and schools had to be connected to an electrical grid but it was hindering the reliable use of ICT (Pakistan, 2012). China is believed to be the world's largest importer and exporter of ICT products, but ICT sales growth has slowed down from 7.3% in 2015 to 3.0% in 2016

and a slight increase of 2.4% was observed in 2017. ICT manufacturers are facing increasing challenges as large numbers of mainland Chinese enterprises have joined the component manufacturing industry (Atradius monitor, 2017).

In the UK there is still a need for digital skills of ICT professions and development of new digital technologies to invest and utilise ICT. The digital skills that are needed are the skills required by individuals to be computer literate and the development of new products and services (Ecorys UK, 2016). One of the barriers to integrate ICT in the UK is that teachers lacked qualifications in ICT, primary teachers have no knowledge of using computers while 44.9% secondary school ICT teachers have qualifications relevant to ICT. ICT training should be offered to teachers to ensure that it can be valuable to their ICT lessons and address the skills gap as 60% of the teachers lacked confidence in delivering the new ICT curriculum (Ecorys, 2016). A new ICT curriculum was introduced in England in 2014 yet there has been a concern from schools, teachers and industry in England, that the new ICT curriculum lacked inspiration and does not ensure that pupils have the skills and knowledge to be digitally confident. The new curriculum is not achieving its intended goal of supporting students to gain computer skills and adapt to emerging technologies (Ecorys, 2016).

In the USA computers were introduced in the early 1990s and the productivity development increased until the 2000s. The productivity decreased in 2005 due to the changing prices of ICT equipment and software. “The digital transformation of the U.S. economy is highly visible in the plentiful supply of new software apps, powerful wireless devices, and widespread access to high-speed broadband” (Bryne, 2016, p. 3). An innovative quality-adjusted value index was introduced for communication apparatus, high-end supercomputers and computers with storage systems that have a greater broadband speed that lead to the development of labour productivity (Bryne, 2016). In USA and developing countries, there have been new opportunities created by ICT to empower women and support productive activities.

In many developing countries there is still insufficient, adequate and affordable ICT connectivity (Guterres, 2017). In developed countries the production of ICT goods and services have shown a greater increase and 100 million people are employed in the ICT services (Guterres, 2017). Exports of ICT services (countries like United Kingdom,

Ireland, Canada, Japan, Germany, China, Brazil & Netherlands) increased by 40% from 2010 to 2015. According to Alexin (2017) the exports of ICT enabled services have increased to 5000 in 2016. Policies in other countries such as Bulgaria, Cyprus and Romania have not yet upgraded the opportunities for workers and teachers to upgrade their ICT skills and make future skills more attractive to students and workers (Guterres, 2017).

2.5 Training in the use of ICT

2.5.1 Training in the use of ICT in South Africa

Ostrowick (2015) has revealed that primary and secondary school teachers in the Gauteng and Free State Provinces attended service training courses where they were trained in basic troubleshooting, computer network and empowering minds using control technologies. Teachers in the Gauteng Province were introduced to digital media, they were taught how to use the internet, use e-mail for learning and also how to use digital videos for learning (Ostrowick, 2015). Teachers both in the Gauteng and Free State Provinces were taught how to use ICT for improving planning and timetabling and how to teach ICT to students for them to be able to use it for learning (Amory, 2015). A study by Amory (2015) has exposed that some of the teachers in provinces like Mpumalanga have not yet received training on how to use ICT for digital imaging, how to use computer troubleshooting, how to use certain software applications for teaching and learning or in their pedagogy. One of the most important facts is that teachers in South Africa have not yet received training or attended courses on how to use ICT in the area of special educational needs (Amory, 2015). On the other hand teachers were not trained on how to integrate ICT in the subjects that they teach. There is still a gap between ICT and pedagogy as teachers have not been trained in how to use teaching methods that include ICT. At the same time teachers were not trained in how to use ICT to improve teamwork and collaborate skills (Ostrowick, 2015). Upon the integration of ICT, teachers teaching in provinces like Gauteng, Free State and Western Cape have received training in how to handle and use computers, they were also trained in how to use multimedia and presentations in the classroom and they were trained in how to use the basic computer applications (Amory, 2015).

2.5.2 Training in the use of ICT in other countries

In the United Kingdom teachers received training in operating computers and on how to use the internet, CD and DVD for teaching and learning in education. Teachers received training in preparation for learning activities in Microsoft Office, Microsoft Paint, Movie Maker, tablet computers and You Tube videos. They were also trained in how to explore the internet, conduct classroom presentation and engage in classroom discussions using ITC (Agyei & Voogt, 2012). In the UK and USA teachers were trained in how to use computers and how to use educational software when ICT was introduced. They were also trained in how to use technological hardware and software during teaching and learning (Guo & Yang, 2016). In the USA teachers were trained in how to use networked computers, make use of the internet and how to make use of computer centres. Teachers in the USA were taught how to use ICT in their pedagogy and in their classrooms, they were taught how to use ICT to support teaching, learning and administration. Teachers in the USA were also taught how to use mobile devices and use e-mails in their teaching. They were also taught how to use social media to improve teaching and learning (Zeng, Huang, Zhao, & Zhang, 2012). In China teachers were taught about the basics of computers and how to use technology in their pedagogy and how to use computer laboratories and internet services (Guo & Yang, 2016). Khan & Hasan (2013) discussed that in developing countries like Bangladesh, teachers were trained in how to use ICT for teaching, planning, evaluating and assessing in education. On the other hand teachers in Bangladesh have not yet been trained in how to organise their classrooms so that all learners can have equal opportunities of using computers in the classroom (Hasan & Khan, 2013). Teachers in Bangladesh were not trained in what they should do if learners encounter technical problems while using computers in the classroom (Hasan & Khan, 2013).

During the integration of technology, teachers in Rwanda were trained in how to use ICT in educational internet and how to use e-mail and social media for education. Teachers were trained in the introduction to Microsoft Office (which includes Microsoft Word, Microsoft Excel, and Microsoft PowerPoint) in the classroom. Teachers received training in how to use ICT resources for professional development and they were also trained in how to use ICT to support traditional pedagogy and the curriculum (Republic of Rwanda, 2017). Mathematics teachers in Rwanda received training in

how to use Spread sheet Supporting Learning (SSL) to solve problems in Mathematics. After teachers received the training, they were able to prepare mathematical lessons using spread sheets (Agyei & Voogt, 2012). Prior research revealed that in other countries like Rwanda teachers were trained in how to use ICT to enhance lesson plans, they were introduced to Learning Management System (LMS) and trained in how to use an LMS to create courses, materials and evaluate assignments using Moodle. Teachers were introduced to, and taught how to use Content Access Point (CAM), they were trained how to use Media Cam, Project based learning and Problem based learning through the use of ICT (Ahmas & Un Nisa, 2016). I believe that ICT in Rwanda is successfully integrated in schools and teachers have undergone training and are also able to apply ICT for teaching and learning. According to the information provided by Agyei & Voogt (2012) and Ahmas & Un Nisa (2016), it shows that in Rwanda there is support in schools for the integration of ICT and ICT is regarded as a priority in education because teachers received training to develop their knowledge and skills in ICT for teaching and learning.

2.6 Advantages and disadvantages of ICT

Some of the advantages of ICT is that it avoids the linear contraints of an old-fashioned curriculum, and education can happen at any place such as training centers and homes. People are capable of learning at their individual time and place and at their own pace of learning (Behnam, 2012). Everybody is able to be connected to anyone using videos, video conferences, chatting, interactive TV, virtual classes and be able to remove physical parting simultaneously. There is straight access to several training resources and electronic copies of resources are available for individulas to use at anytime (Behnam, 2012). Other advantages apply when using ICT in the higher educational context, as it provides faster production of knowledge at a reduced cost, it transforms teaching and learning by means of online open courses and open educational resources which can be accessed instantly, faster and increased communication between students and facilitators and online assessment allows immediate electronic feedback (Farham, 2014).

Velmurugan and Ramasamy (2014) mentioned that e-learning can merely be proficient if one uses advanced ICT systems together with powerful tools that can

deliver teaching and learning contributions. Farham (2014) and Talebians, Mohammadi and Ahmad (2014) have stated that one significant advantage of using e-learning is that it creates a bond between the teacher and the learner who are in distant places. ICT allows people to access the training system at any time and to receive all the information that they need. The use of e-learning in education opens opportunities for learners to have access to higher education institutions in any situation. It further provides equal access and equivalent competence in education where learners are able to connect with one another using video and voice meetings, virtual classes that decrease physical separation and interactive television. It also encourages learners to be interactive in all active learning (Sridevi, Krishnan, & Kumar, 2017).

ICT allows people to communicate with other people for less money over long distances. New technologies such as texting, video conferencing and instant messaging allow people who are using it to communicate instantly with other people throughout the world for a minimal fee. The text-based computer message allows people who have speech challenges or those with social problems an opportunity to communicate with their peers (Walton, 2018).

One disadvantage of using ICT is that when there are technical problems, more time will be used on technical problems than guiding the pupil (Velmurugan & Ramasamy, 2014). Plowman, McPake and Stephen (2010) defined some of the shortcomings of using ICT. ICT endangers the student's socio-cultural development because students spend more time on technologies and less time playing with their peers or doing physical activities. ICT endangers the growth of imagination because it can stimulate passivity instead of activity and slow down the improvement of language as students have less time to communicate with peers. Students also spend more time sitting indoors instead of being outdoors or interacting with family members, and the well-being of students is endangered as the risks of obesity are increased (Plowman, McPake & Stephen, 2010).

One of the disadvantages of ICT is that communicating with voice chat or using instant messaging will not take body language into consideration. There is a possibility that the message may be misunderstood if the communication is not face-to-face (Walton,

2018). ICT delivers a variety of ways for thieves to be able to get access to private details and that may result in people losing their cash. Online banking can allow a third party who has the relevant security information to gain access into people's personal finances without permission (Walton, 2018).

2.7 Theoretical framework

This study used a framework for integration of technology known as Technological Pedagogical Content Knowledge (TPACK) which was earlier known as a TPCK. The framework was constructed on Lee Schulmans framework which was called Pedagogical Content Knowledge (PCK) (Koehler & Mishra, 2009). The TPACK framework was used as it describes "the kinds of knowledge needed by teachers for effective technology integration. The framework emphasizes how the connections amongst teachers' understanding of content, pedagogy, and technology interact with one another to produce effective teaching" (Koehler & Mishra, 2013, p. 101). The best way to understand how teachers can practice ICT in their own classrooms is by focusing on the kind of information that is desirable by educators in order to integrate technology more successfully (Koehler & Mishra, 2013).

2.7.1 TPACK

Mishra and Koehler (2013) have broken the TPACK into three components which they have classified: the first one as content knowledge (CK), the second one as pedagogical knowledge (PK) and the last one as technological knowledge (TK). They defined the content knowledge as knowledge that the educator should have or know about the subject that they teach, pedagogical knowledge was defined as the knowledge that the teachers have on how to deliver or teach their subject or the methods that teachers use to teach their subject. Technology knowledge was defined as the knowledge that the teachers have about the new technologies that can be used in the curriculum (Koehler & Mishra, 2013). They believed that these three components are crucial for teachers to understand for them to be able to integrate new technologies into teaching and learning. Furthermore, they explained that the three components should interact with each other practically and theoretically so that they can produce the kind of desired knowledge to put technology into good use in education (Koehler & Mishra, 2009).

I believe that teaching with technology is very difficult considering the new technologies available to teachers. It was very important to disclose the TPACK as a framework for the study so that teachers are able to be familiar with the tools that are needed for effective and successful integration of ICT into their classrooms. This is an approach that is needed that can help teachers to interact with what they already know and the way in which they apply this knowledge in their classrooms. Mishra & Koehler (2013) stated that teaching with technology is very complex and they proposed that for one to understand the approaches for effective integration of ICT, educators need to cultivate new ways of realizing and accommodating the complexity. The TPACK was constructed from the Pedagogical Content Knowledge (PCK) framework which described the way in which teachers use their teaching methods to deliver the content that they know using the educational technologies (Koehler & Mishra, 2009). Koehler & Mishra (2009) described three core components that they regarded as teachers' knowledge. The components are pedagogy, content and technology. They showed that the three components are correspondingly significant to the model (figure 1) and the interactions between the bodies of knowledge which are denoted as pedagogical content knowledge (PCK), technological content knowledge (TCK), technology pedagogical knowledge (TPK), and the TPACK.

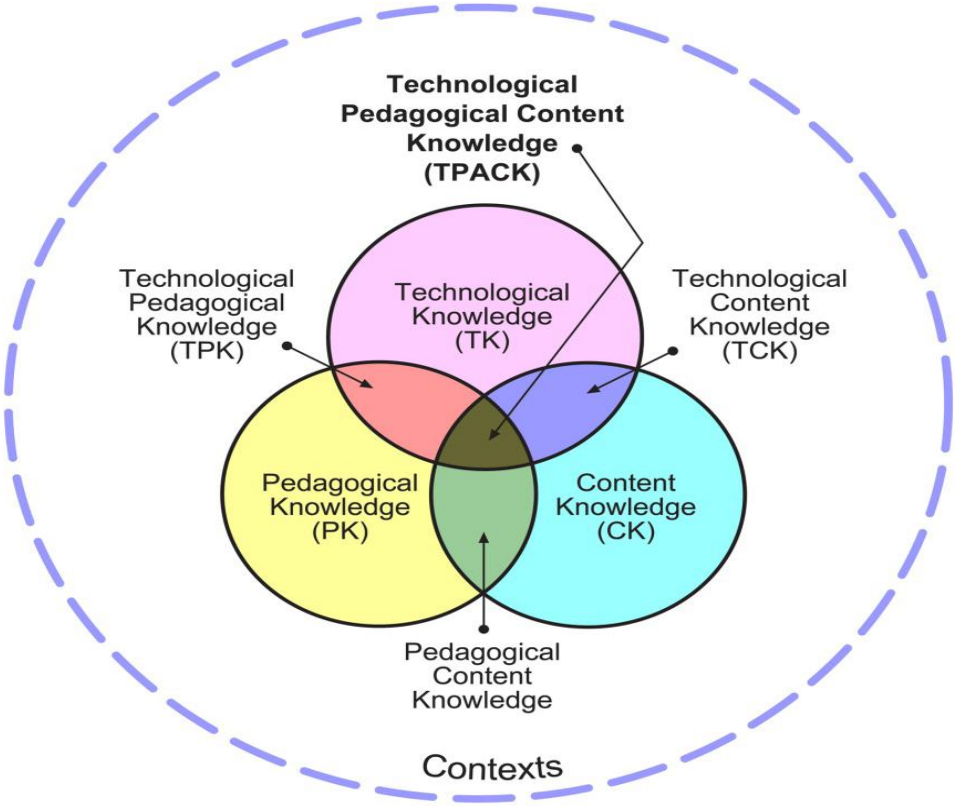

Figure 2.1: The framework using TPACK and its knowledge components (Koehler & Mishra, 2013, p 63).

2.7.2 Content knowledge (CK)

The content knowledge is the knowledge known by the teachers about the content that they teach (e.g. English). The content knowledge is very important to teachers as they should know the concepts, the theories, ideas, understanding of suggestions and proof of the subject that they teach. Teachers ought to understand the deepened information of the subject that they deliver (Koehler, Mishra, Kereluik, & Shin, 2014).

2.7.3 Pedagogical Knowledge (PK)

The pedagogical knowledge is the teachers' understanding of how to teach the content that they know to the learners and their understanding of the way in which learners learn so that they can meet all their learning needs. Pedagogical knowledge is a diverse range of methods to deliver the subject taught in order make learners understand. Teachers who have deep knowledge of pedagogy understand how learners construct knowledge and acquire skills within their minds (Mishra et.al, 2014).

2.7.4 Pedagogical Content Knowledge (PCK)

Pedagogical content knowledge is defined as the knowledge of teaching or instruction that is used to teach the content that is already known by the teacher. Pedagogical content knowledge may also be understood as the knowledge that is used to transform the subject matter in teaching. The transformation takes place when the teacher interprets the subject and discovers various ways to present the subject and also familiarizes and addresses the prior knowledge of the learners. The pedagogical content knowledge allows the teacher to accommodate or create situations that encourage learning and addresses the misconceptions that exist within learners (Koehler & Mishra, 2013).

2.7.5 Technological Knowledge (TK)

Technological knowledge is defined as the knowledge known by teachers about the old and new technologies that are used in education. Technological knowledge enables the teacher to use different technologies and use different tasks in their pedagogy to make meaning of the subject that they teach. Technological knowledge also allows learners to use different methods of technology to accomplish a given task. The concept technological knowledge changes with time (Koehler et.al, 2014).

2.7.6 Technological Content Knowledge (TCK)

Technological content knowledge is understanding the technologies that are used to teach the content that is already known by the teacher and the impact that the technology can bring to teaching and learning. Technological content knowledge also includes the kinds of technologies that are used to transform education. Koehler & Mishra (2009, p. 65) defined technological content knowledge as “an understanding of the manner in which technology and content influence and constrain one another”.

2.7.7 Technological Pedagogical Knowledge (TPK)

Technological Pedagogical Knowledge is defined as the knowledge of knowing how to use technology in a different way for teaching. One needs to understand how pedagogy can transform when certain technology tools are utilised in multiple methods (Koehler & Mishra, 2009). Koehler and Mishra (2009, p. 65) have stated that “to build

Technological Pedagogical Knowledge, a deeper understanding of the constraints and affordances of technologies and the disciplinary contexts within which they function is needed".

The framework was found to be suitable for the study as the study investigated how teachers used technology in their pedagogy to enhance the content knowledge. The researcher argued that the framework was very helpful in understanding the types of knowledge needed by educators for effective technology to be integrated and for their understanding of the content that they teach as well as the appropriate methods to deliver the content using the new technologies (Even, Elen & Depaepe, 2015). It is necessary to develop the TPACK so that there is effective teaching using the new technologies in education. Teaching using technology is an approach that is essential to guide teachers to apply what they already know and to know how to apply this knowledge within the context of their classrooms (Koehler & Mishra, 2009). The TPACK was considered when constructing the research questions for the study and explored the teachers' understanding of the technologies that they used in their pedagogy. The study also addressed the relationship between the knowledge of the teachers and the content**.**

2.8 Conclusion

This chapter introduced and described Information and Communication Technology (ICT) and also identified the theoretical framework used for the study. A literature review was discussed that focused on ICT in education, in South Africa, in other countries and the advantages and disadvantages of ICT has been provided by looking at other prior studies. A detailed brief of what the TPCK framework entails has been provided and how the framework was used. The framework emphasized how teachers should be connected to technology; the content that they teach and their teaching methods for the integration of ICT to be effective.

CHAPTER THREE RESEARCH DESIGN AND METHODS

3.1 Introduction

This section describes the plan that was chosen to undertake this study, the way in which the plan was used and why the plan was chosen to achieve this study, as well as the way in which, where and when the data was collected. A brief explanation of the instruments used to collect and analyse the data provided. I also explained how the issues of credibility, transferability, dependability and confirmability were ensured in the study.

3.2 Research design

Parahoo (2010, p. 205) defines “research design as a plan that describes how, when and where data are collected and analysed”. This resonates with De Vos (2011, p. 87) who defines “research design as the overall plan for conducting the whole research study”. A research design outlines how the researcher carried out the study, when the study was carried out and the site in which the study was carried out.

Butt (2001, p. 194) describes epistemology as referring to “how people know what they know, including assumptions about the nature of knowledge and reality”. Epistemology is what is already known by the researcher and the way in which it is known, and the assumptions that he/she has about the original knowledge and the reality that exists among them. Epistemology is the prior knowledge that exists within the mind of the researcher. The epistemology of this study is that the researcher already knew that there was an integration of new technologies in the schools and that there were some teachers who had undergone training on how to use the new technologies. The reality known by the researcher is that the new technologies could be used for teaching and for learning.

Ontology entails the manner in which one sees the social world (Livesey, 2006). The ontology of the researcher in this study is an assumption that the new technologies that have been integrated in schools are well used for teaching and learning and also beliefs that teachers know how to use these technologies in teaching and learning. The difference between ontology and epistemology is that epistemology is what is

known and the way in which certain facts are known whereas ontology is the assumptions and beliefs about what exists (Butt, 2001).

Constructivism is the impression that mental structures and actions are dynamically built by one's mind instead of being inactively developed (Burman, 2007). Constructing is building knowledge step by step rather than the knowledge that is being injected in an individual (Burman, 2007). This study will use a constructivist paradigm. The multiple realities that exist within the perspectives of individuals were revealed in this study. The constructivist paradigm was used to construct meaning from the gathered information so as not to change a thing, so that the information can be reflective of the phenomena as it is. The advantage of using constructivism as a paradigm was that it helped me to construct knowledge and understanding of the gathered information in the study. I did not focus on an objective truth.

3.3 Methodology

Creswell (2011, p. 256) defines qualitative research as "an inquiry process of understanding social or human problems based on building a complex, holistic picture, formed with words, reporting detailed views of informants, and conducted in a natural setting". Qualitative research is defined as a research that looks at people by observing them in the environment that they interact with, with the aim to understand and explain their phenomena by looking at the people with their own eyes (looking through the eye of the participant) (Nieuwenhuis, 2007). One important fact of qualitative research is to focus on the depth and quality of the information that will be acquired (Nieuwenhuis, 2007). A qualitative approach can be described as a process of understanding that happens in a certain environment by engaging with the individuals that exist in the environment. It stresses the value and the deepening of the investigated evidence (Nieuwenhuis, 2007). It enables one to gather empirical evidence of the aspects that exist in their surroundings and how they interact with these situations (Nieuwenhuis, 2007). The qualitative approach guided the study to gather a comprehensive understanding of how teachers use ICT in their pedagogy and how the resources at hand add value to teaching and learning.

3.4 Research Design

Yin (2009, p. 187) defined a case study research method as “an empirical inquiry that investigates a contemporary phenomenon when the boundaries between phenomenon and context are: not clearly evident, not under the investigator’s control or influence, and in which multiple sources of evidence are used”. A case study is defined as a study that involves the full and intensive analysis that focuses on a single case (Bryman, 2004). A case study also uses multiple sources of evidence to entail detailed information of the single case (Yin, 2009). Since this study wanted to get access into schools that are known to have integrated ICT recently and sought informed knowledge about the benefits that ICT has, a case study was valuable to use as it helped this study to investigate the empirical evidence of the phenomenon. A case study as a design helped to investigate the aspects of the chosen schools in obtaining empirical evidence of the ICT which is accessible and obtaining clear evidence of the value of ICT in the schools. A case study also allows one to use multiple sources to gather evidence. In this case the multiple sources viz; interviews, document analysis and field notes were used to validate the existing information.

Descriptive research can be defined as a research method that is used to describe the phenomena as precisely as possible. One fundamental goal of descriptive research is to define critically the present phenomena that is being studied (Atmowardoyo, 2018). This study described the situation that was studied and did not decide the reason and outcome of the phenomena. This study was not only a descriptive research, it was also an exploratory single case study design where the researcher explored the way in which teachers were using ICT for teaching and learning. An explorative case study is defined as a study that examines distinctive phenomena (Yin, 2009). An explorative research is a research that is undertaken to get answers for problems that have not been clearly answered and more research is still needed on those particular problems (Yin, 2009). An explorative case study was selected for the study because the researcher believed that there is insufficient information about how teachers in Mpumalanga are using ICT for teaching and learning in their classrooms since ICT was integrated into their schools. I felt that it is important to know if ICT is being used for teaching and learning, and if the ICT used brings any benefit to teaching and learning.

3.5 Sampling

The convenience sampling method is “a set of techniques in which respondents are selected by convenience due to their proximity, availability, accessibility or other way that researcher decides” (Abrams, 2010, p. 13). Convenient sampling was used as the participants were easily accessible and the schools were within the same area so the researcher was able to visit the sites. The schools where data was collected are within 30km of the researcher’s location. I used purposive sampling with the aim to collect data from the teachers who received training for integrating technology in their schools. In this study, the Mpumalanga province was used, which captured my interest since most of the schools have recently been integrated with ICT and the new technologies are now used for teaching and learning. Three high schools within the Nkangala district were sampled for this study, as these schools have recently been integrated with ICT. The schools were able to identify the advantages that are added by ICT since they have moved from chalk and talk. Schools with a large number of enrolments (P5) were used to ensure that there is more than one teacher who received ICT training in each school. Six teachers, two from each school, who received training and are using technology in their pedagogy, were the participants of the study. The following table provides the demography of the participants:

Table 3.1: Demography of participants

Pseudonyms	**Gender**	**Teaching experience**	**Subject taught**
Karabo	Female	5	Physical science
Kenny	Male	13	Geography
Samuele	Female	9	English
Bethuel	Male	4	Economics
Julia	Female	6	Technology
Isaac	Male	6	Mathematics

3.6 Data collection and documentation

Data collection is a way of collecting evidence from individuals that exist in a certain event. Data collection in a qualitative approach is meant for investigating who, what

and where uses take place (Sandelowski, 2000). The study identified and used three methods of collecting data which is semi-structured interviews, field notes and documentation. Semi-structured interviews are defined as a set of open-ended questions which were prepared in advance and did not guide the respondents to a certain response (Hoepft, 1997). The semi-structured interviews were arranged and conducted with the contributors of the study, open-ended questions were asked from the interview guide that was prepared beforehand (Hoepft, 1997). See Appendix A. Participants were asked similar questions that included the use of ICT in their schools and the ways in which ICT added value to teaching and learning. The rationale for using semi-structured interviews was to increase access and understanding of the perception of the participants, how their interventions work and how they can be improved.

A written document is a piece of paper that is readable and relates to the event that it was gathered from (Shah & Corley, 2006). Written documents (such as lesson plans and mark sheets) as sources of information were used to validate the semi-structured interviews and enhance a better understanding of the events. By requesting lesson plans and mark sheets from the participants it was possible to observe if the documents were hand-written or computerised to support what was said during the interviews. An advantage of using a document is that it can be scanned into a computer and a qualitative analysis package can be used to analyze the data.

Field notes are qualitative notes recorded by a researcher who is engaged in an event that is being studied (Yin, 2011). The researcher visited the site during the period of collecting data and made field notes using a field notes schedule. Other field notes were made during the interview session with the participants. Notes were made on how they responded to questions, gestures and the postures they made during the interviews. The field notes were recorded in the researcher's journal. The field notes were then summarized to make sense of the entire event.

3.7 Data analysis

Data analysis is about processing data with the aim of providing answers to the research questions which guided this study. Furthermore, it served to communicate

the findings of the participants. These resonate with McMillan & Schumacher (2010), who use qualitative data analysis as a principal inductive method of grouping your data into categories and identifying patterns in the category. Data analysis is a way of processing the gathered data to provide solutions to the research questions which directed this study and discussing the discoveries of the respondents (Elliott & Timulak, 2005). A content data analysis using descriptive and explorative research methods together with a qualitative data analysis method was used to pursue the responses to the projected questions of the study (Atmowardoyo, 2018). The data was analysed using the Atlas.ti. The interviews which were recorded provided written documents and the summarized field notes were entered into Atlas.ti. The rationale for using Atlas.ti to analyse data was that it is able to mark recurring ideas and create codes through open coding, to avoid analysing data manually which is time consuming.

3.8 Methodological norms

According to Sandelowski (1997) trustworthiness is a matter of persuading where the investigator is regarded to have completed the practices audibly and visibly. A study is considered to be trustworthy when the person reading the research report is able to judge it to be as it is (Gunawan, 2015).

3.8.1 Credibility

Credibility can be defined as the “confidence that can be placed in the truth of the research findings” (Holloway & Wheeler, 2002, p. 127). The study ensures the credibility through the use of triangulation. “Triangulation involves the use of multiple and different methods, investigators, sources and theories to obtain corroborating evidence” (Onwuegbuzie & Leech, 2007, p. 237). The triangulation of semi-structured interviews, written documents and field notes provided a more complete and accurate account than one of them could (Maxwell, 1996). The data was triangulated by comparing the results of the interviews, field notes and the written documents to verify the data.

3.8.2 Transferability

Bitsch (2005, p. 83) defines transferability as “the degree to which the results of qualitative research can be transferred to other contexts with other respondents”. Adequate contextual information about the field work was provided to permit the readers to make transferability. “Sufficient dense explanation of the site was provided to allow readers to have a proper understanding of it, and to be able to compare it with their own use” (Bitsch, 2005, p. 83). The researcher referred to the research context in the study and provided the participants with the research report to associate occasions of the phenomena. The researcher provided the necessary information of where the research took place, processes of the research and the participants of the study so the reader could decide how the findings of the research could be transferable (Gunawan, 2015).

3.8.3 Dependability

Dependability is referred to as the “consistency of findings over time” (Bitsch, 2005, p. 85). The participants were given a chance to evaluate the results and the interpretations of the researcher to ensure that all are braced by the data acquired from the participants of the study (Cohen, Minion & Morrison, 2011).

3.8.4 Confirmability

Baxter and Eyles (1997, p. 47) referred to confirmability as “the degree to which the results of an enquiry could be confirmed”. Triangulation was used to reduce the effect of bias. The findings were the factual results obtained from the participants and ideas of the participants. The ideas of the participants were confirmed by the field notes and the written documents such as lesson plans to ensure the researcher was not biased.

3.9 Ethical considerations

The participants of the study were informed that their participation is of their own will (voluntarily) and they would be allowed to withdraw from the study at any time of the study without explanations to the researcher (Joncas & Foy, 2011). Schools were contacted and given the opportunity of accepting or declining participation in the study (Joncas & Foy, 2011). Anonymity and confidentiality of participants was secured

through the entire research process and pseudonyms were used. Informed consent letters were given to the teachers and principals. The researcher adhered to the moralities of ethical research as described by the University of Pretoria, under the Faculty of Education guiding principle for ethical clearance that was established by the ethics committee.

3.10 Conclusion

This study explored how teachers integrated the new technologies in teaching and learning; how they use technology and the benefits that technology has added to their teaching practice. This study will be beneficial to schools and teachers that will be integrated with technology in the future. It will also help teachers who already have integrated technology in their schools, yet do not know how to use technology to improve their pedagogy.

CHAPTER FOUR DATA ANALYSIS

4.1 Introduction

In this chapter, the data analysis of the study which was gathered from the three schools that were investigated is being analysed. The data analysed for this study came in the form of semi-structured interviews, field notes and documents such as lesson plans and mark sheets. The participants were interviewed verbally at their places of interest (restaurants) and their responses were noted down in the investigator's journal. The site was visited in the afternoon during study time and field notes were made, the documents were also collected. The data obtained was read time and again to gain a broad image of the project through the eyes of the participants. The researcher analysed the data by making use of Atlas.ti. All the semi-structured interview responses were imported into the Atlas.ti where it marked all the recurring ideas from the data. The open coding was used to create codes.

4.2. Data analysis

4.2.1 Semi-structured interviews

4.2.1.1 The use of ICT to improve teachers' pedagogy

The research investigated the way in which teachers use the new technologies to teach and how these technologies helped teachers to improve the way in which they teach their subject content.

None of the participants use a Leaning Management System in their teaching and learning. Teachers were not familiar with the software applications of the Learning Management System and had no information as to how it works and how to use it. This statement is supported by Blignaut and Howie (2009) who specified that computers are not effectively used in schools and the expected outcomes of improving education have not yet been observed.

Only one teacher uses spreadsheets to capture data gathered from experiments. The statement is supported by Govender and Govender (2014, p. 156) who state that "the

use of spreadsheets and programs have made data capture and representation less time-consuming".

The use of technology to prepare lesson plans

Teachers are not using online lesson plans to prepare their lessons. One teacher indicated that she only searches for information on the internet and uses her own lesson plan to prepare her lessons. Another teacher indicated that he is not familiar with using online lesson plans and that is the reason he is not using it. According to the teachers' responses, it shows that the teachers still need support in order to use resources like online lesson plans from the internet. This is supported by Govender and Govender (2014, p.155) who state that "research in ICT skills, however, suggested that teachers are not well prepared to teach with the internet as its current use is limited in scope and substance and they will need more support to identify subject-related internet resources".

Another teacher mentioned that she only accessed an online template (an empty lesson plan that shows how a lesson should be prepared) and uses it to prepare her own lesson plans. The online template helps the teacher to know how her lesson plan should be structured. She is still not using online lesson plans as she only uses the template and not the lesson plan. This statement is supported by Govender and Govender (2014) who mentioned that teachers are not ready to use the internet in their pedagogy and are still in need of support to know other resources from the internet that can help them to teach.

Another teacher logged into the Department's website and downloaded online prepared lesson plans. He was the only teacher using online lesson plans to teach. This is supported by Du Plessis and Webb (2012) who mentioned that schools should organise online resources in the form of a ready-made lesson plan to motivate teachers to be able to integrate ICT into their contextualised classrooms.

Sam indicated: *"I use my laptop to prepare for my lessons. I research learning materials online and present my information that I have researched on PowerPoint slides".*

Teachers are using computers to prepare for their lesson plans by using the information retrieved online. Five teachers prepared their lessons using PowerPoint and created slides to present during their lessons. These responses are supported by Kolb (2014) who mentioned that a PowerPoint presentation is another good way of sharing ideas and information.

Isaac stated: *"I don't use technology in preparing lesson plans, I prefer the traditional way as typing Mathematics consumes time".*
Isaac is a Mathematics teacher. He believes that using technology to prepare lesson plans will take up most of his time. He does not use technology to prepare his lessons; instead he uses pen and paper. Govender and Govender (2014) suggests that some of the barriers for good ICT integration include training, technological knowledge, time constraints and their pedagogical beliefs. This statement is supported by Warschauer and Matuchniak (2010) who reported that teachers are not yet trained in how to integrate ICT and they face the challenge of a lack of time to prepare their lessons using ICT.

How participants used technology to create and organize assignments for teaching and learning

Kenny indicated: *"I prepare assignments by downloading information on the internet and prepare assignments using Word and send them to learners' tablets".*
Teachers used the internet as a source of information to help them to prepare for their lesson plans. Microsoft Word has also been used as a very effective tool to help teachers prepare for their lessons. This statement is supported by Mereku and Mereku (2015) who indicated that teachers are comfortable with using the internet and Word processors to prepare their lessons.

How technology was used to communicate with learners

Sam indicated: *"If a learner requires communication, it usually will be via e-mail. We only use the e-mail when I am not at work so I send learners activities to do in my absence".*

Teachers prefer to communicate with learners through e-mail and only send and receive school-related activities.

Karabo indicated: *"I use WhatsApp and Facebook that is created especially for the subject that I teach. This is where learners ask questions in my absence and I get to answer them".*

Teachers also created WhatsApp and Facebook groups where they allow their learners to interact. These WhatsApp and Facebook pages are only used when the teacher and the learners are not physically in contact with each other, and that is where they communicate. This statement is supported by Padayachee (2016) who mentioned that WhatsApp is one of the important tools for communication while Facebook is supposed to be a vibrant tool for sharing information. According to Georgsen and Zander (2013, p. 17) "The availability of a vast body of information through a smartphone is made possible through the combination of internet, telecommunication, search engines and cheap storage".

The use of technology in assessments

Bethuel indicated: *"With certain topics I create a quiz and give it to the learners. The quiz has four possible answers and they get to choose the most correct answer by clicking on it, press submit when they are done then they get assessed immediately they finish writing the quiz".*

Teachers were using quizzes to assess the progress of the learners. One good thing about using a quiz is that one receives feedback immediately once the quiz has been completed. This statement is supported by McMahon, Johnson and Hecht (2017) who mentioned that for integration of ICT to be effective in assessment, teachers should be able to handle the essential ICT software that could expand assessment.

Isaac indicated: *"I have never used technology in assessment as the subject that I teach requires lots of writing so it would take time for learners to complete one question".*

Some teachers still don't believe in integrating ICT in their classrooms. They are still not using the new technologies effectively. This statement is supported by Cuban (2000) who mentioned that the integration of ICT for the purpose of classroom

assessment is still not successful as teachers still have negative attitudes towards ICT, their limited beliefs and lack of skills towards the use of ICT.

The use of technology to give feedback to learners after assessments

Kenny indicated: *"I use CDs and DVDs to give feedback, the CDs and DVDs are presented to learners in class using a computer and a projector. I also use e-mails to send them memorandums".*

Teachers are able to give feedback using technology and have been using CDs and DVDs in helping them to give feedback to learners. The statement is supported by Tracey (2009) who stated that the teachers and the learners can both be well resourced by using CD-ROMs in teaching. McMahon et al., (2017) mentioned that using ICT to give feedback can allow individuals and groups to be evaluated, and their improvement can be outlined.

The use of technology to gather data from experiments

Karabo mentioned: "*There is no data gathering technology in our school so I use spreadsheets to capture data gathered from experiments"*

Five of the teachers that were interviewed teach subjects that do not require them to perform experiments. Only one teacher teaches a subject that requires her to perform practicals and that subject is Physical Science. One of the teachers mentioned that the subject that she teaches does not require her to do experiments as she is an English teacher. When she captures data, it will only be for the mark sheets and the assessments that the learners have done and that data will be captured through spreadsheets. The teacher's statement is supported by Padayachee (2016) who stated that spreadsheets can be used to capture marks.

The use of technology to create and organize assignments for teaching and learning

The teachers that were interviewed stated that they did not use technology to create and organize assignments as these were provided as common tasks by the district. There is one teacher who mentioned that she used a computer and created the

assignments using Microsoft Word and then organized the assignments into folders classifying the folders from the grades. Each grade had its own folder where you would only find the assignments or tasks relevant to that grade. This statement is supported by Padayachee (2017) who mentioned that Microsoft Word can be used for typing out question papers.

How to use technology in assessments

Five teachers were not using technology to assess the learners; they mentioned that assessment tasks were provided to them by the district and are all common tasks. They used the tasks provided as hard copies for their assessment in their classrooms and did not prepare their own assessments. One teacher mentioned that he used his smart board to assess by preparing tasks using Microsoft Word and then connected learners' tablets to the smart board and sent the assessment tasks to learners' tablets. This statement is supported by Marine (2015, p 24) who mentioned that "computers can be used as the medium for testing, to score students' tests using automatic scoring software and as a tool for doing assessment tasks".

How technology is used to give feedback to learners after assessment

One of the teachers using technology to give feedback mentioned that he was using his smart board which he connects to the leaners' tablets and sends the feedback immediately after assessing them. Learners received feedback on the tasks that they had done on their tablets. This statement is supported by Ihechu (2017) who mentioned that using ICT to give feedback can enable individuals and groups to be assessed, and their progress can be tracked.

4.2.1.2. The use of ICT to improve the subject content

This research investigated the way in which teachers use technology to improve the subject that they are teaching. This study focused on the technologies that teachers use to enhance understanding with the aim of improving the content that is being taught.

The use of technology to enhance the content that teachers were presenting in their classrooms

Isaac indicated: *"I sometimes let learners watch videos from You Tube regarding the content and then later we discuss the content. It really helps them to be exposed to a different teaching method of delivering a lesson".*

Teachers relied more on the internet to find information for their subjects. Teachers used the internet to download videos and previous question papers. Using videos and previous question papers for teaching and learning benefit teachers in that they get to develop their teaching strategies and learn other new approaches of delivering the same content. The statements are supported by Menasha (2013) who believed that the use of videos is one of the most effective forms of ICT use in education with creativity in presentation. Videos can be used in a range of learning environments such as enhancing learning in classrooms and encouraging learners to make their own videos. Menasha (2013) further stated that videos can also be useful to the blind by doing audio descriptions for them to be able to use the video. The ability of using videos is also to simplify complex subjects and engage children by pointing out strong visual contexts that are difficult to grasp if taught using conventional methods (Menasha, 2013).

The use of technologies to benefit teaching and learning when technology is used to give feedback

Karabo stated: "*Giving feedback using technology is faster than giving feedback in the traditional way and enhances more understanding as the feedback is given as a revision*".

Teachers believed that technologies are very effective in helping them to give feedback to learners. Technology makes it quicker to give feedback and the feedback enhances deeper understanding because it clarifies what was done earlier and embeds the information. Teachers also believed that using technologies to give feedback benefited both teachers and learners as feedback can be received anytime, anywhere and makes it easier for learners to point out their mistakes in their assessment. Learners do not have to wait until they are in class or meet with the

teacher to receive feedback; feedback reaches them wherever they are. This statement is supported by Meenakshi (2013) who mentioned that the use of technologies to give feedback is one of the most effective tools to use in education and encourages a room for improvement for learners.

Using technology to support lesson plans to improve content development

Isaac indicated: *"I use videos and they help learners to learn at their own pace (pause, rewind) and to re-watch the video time and again if they did not understand".*
Teachers are able to use technologies that help learners to learn at their own pace and time. The video is very useful as learners can learn in the absence of the teacher and are able to re-learn. This statement is supported by Behnam (2012) who stated that one advantage of using ICT is that people are capable of learning at their own time and place and at their own pace of learning.

Using technologies to improve experiments that are carried out during lessons

Karabo indicated: *"Videos provide images on how the experiments should be carried out, errors are eliminated as learners see how they should carry out their experiments. Videos provide demonstrations of what should be done".*
The teacher emphasized that technologies help to improve experiments that are carried out by using videos. The video helps learners to see how the experiment should be done; they are like pre-experiments. It also becomes easy for the learners to write a pre-test for the experiment because what is seen is more embedded on the mind than what is said or read. Teachers also believed that online experiments help teachers and learners know what they are expecting as part of their findings. This statement is supported by Padayachee (2017) who mentioned that teachers use data, projectors and videos to show experiments.

The use of technology to create and organise assignments to enrich the content

Karabo stated: "*When I use technology*, *I am able to find other teaching methods and resources that will make the content of the lesson more enriching and interesting for*

the learners. I am also able to use other assessments and assignments. As a result, many learners tend to improve on their learning".

Teachers mentioned that technology helps them to access and acquire different kinds of sources or information. They also learn other ways of improving their pedagogy to make their lessons fruitful. They stated that the information on the internet is always researched and up to date. By using technology frequently they get to enrich the content that they are teaching. This statement is supported by Marine (2015) who stated that for teachers to become digital teachers they have to catch up with the development of technology in education.

4.2.1.3 The use of ICT to improve teachers' content knowledge

This research focuses on the ICT that is used by teachers to help them gain more knowledge about the subjects that they teach. The study investigated how these technologies helped the teachers to improve the knowledge that they already have about the subjects that they teach.

Using technology to communicate with the purpose of improving the content knowledge

Sam indicated: "*If I am communicating with learners using technology, technology helps me to improve by receiving immediate feedback that learners provide about the lesson and indicating whether they have understood the previous lesson or they still have misconceptions. When they did not understand, I have to find more information on how to make them understand. The more information I research, the more knowledgeable I become."*

Teachers have benefited from the new technologies that help them to share ideas and find more information that enhances the content knowledge. Learners provide teachers with feedback so that teachers can reflect on their lessons, identify weaknesses and find ways to overcome them. This statement is supported by Farham (2014) who mentioned that the use of technology to give feedback is faster and increases communication amongst learners and teachers.

The use of technology to improve the content knowledge by gathering information on the internet

Karabo indicated: *"Using the internet to gather information makes me an expert, it is unlike using the textbook because the textbook does not give me enough information. The internet gives me a lot of theories, images, videos, audios, etc."*

The internet provides a variety of information for all the subjects that are taught in schools. It allows teachers to address confusions and provides teachers with additional knowledge of the subject matter. A lot of problem-solving strategies are discovered and applied and serve as an advantage for learners as they are given the opportunity to choose and use the problem-solving strategies that they are comfortable with or prefer the most. This statement is supported by Ferrara (2010) who mentioned that technology has created opportunities for obtaining materials from the internet to enrich education.

Using technology to work out lesson plans to improve the content knowledge

Bethuel indicated: *"The online lesson plans help me to organize the lesson in order; how to introduce the lesson, check prior knowledge and get to the core of the lesson. I develop multiple teaching strategies".*

By making use of the online lesson plans, teachers can deliver their lessons in a better way and learn different ways of delivering the same content. The statement is supported by Nakaznyi, Sorokina and Romaniukh (2015) who mentioned that it is significant for teachers in all disciplines to be capable of preparing and delivering lessons with the use of ICT because an ICT-enhanced lesson is clear, colourful, informative, interactive and saves time for both the teacher and the learner. Koehler and Mishra (2009) further suggest that various teaching methods blend the pedagogy and the content with the intention of developing better teaching approaches in the content areas. When teachers are teaching the content, they are expected to be able to select the fitting pedagogical method and are able to select the technology that is very effective in presenting the lesson.

Karabo stated: "*I learn different teaching methods that develop my pedagogy skills. The lesson plans help me to organize the lesson in order; how to introduce the lesson, check prior knowledge and get to the core of the lesson".*

Teachers mentioned that technology is very helpful in helping them to develop and gain skills to teach the content in a better way. Teachers are able to organise their lesson plans with multiple teaching methods. This statement is supported by Even, Elen and Depaepe (2015) who mentioned that to boost teachers' understanding of the content, teachers should teach using the appropriate methods to deliver the content using the new technologies.

The use of videos to improve the content knowledge

Sam indicated: *"Videos provide a visual platform in which it allows me to relate the topic and content on the video. There is a lot of information that is found on the video and it provides a better explanation of the topic that you are teaching".*

Videos are visual aids that can be watched by the teacher and the learners; they help one to understand what is written in the book with what is seen and explained on the video. The statement is supported by Nakaznyi et al. (2015) who mentioned that teachers' activities should have a blend of achievements of pedagogical and information technologies. They further mentioned that to improve the quality of education, teachers should develop and use a variety of electronic educational resources such as videos, presentations and electronic textbooks in their teaching activities.

4.2.2 Documents

The documents that were requested from the participants were lesson plans, mark sheets and informal tests. The idea to observe the documents was that if the documents were not hand-written, then it serves as evidence that teachers utilise technology in their instruction. In the lesson plans that were collected only five teachers provided computerised lesson plans and one teacher provided hand-written lesson plans. Teachers used Microsoft Word to prepare their lesson plans and PowerPoint was also used to create slides for their lessons. All the mark sheets were computerised, even those of the teacher who provided han- written lesson plans. The

teachers used Microsoft Excel to prepare their mark sheets. All the informal tests were also computerised. The tests were created using Microsoft Word.

4.2.3 Field notes

Upon visiting the site, I went to observe the classrooms of the participants. Kenny's classroom was the only classroom that was found with each learner having a tablet with which to work; there was also a projector and a screen ready for use. The other classrooms did not have learners with their own tablets because there were not enough tablets for all the learners in the school. The tablets were therefore hardly used as they had to be shared. In Sam and Karabo's classrooms there were data projectors and screens that seemed to be in good use. In Julia and Bethuel's classrooms there were only screens; no data projectors were found in the classrooms. In Isaac's classroom there was no projector, a screen was folded and put in a corner. In the classrooms where there were no projectors, teachers were asked if they had any and their responses were that they had to share the data projectors with other teachers. Isaac explained that he would only bring a computer and data projector to the classroom when he needed to use them; he therefore did not see the necessity of having them in the classroom when they would not be used.

When interviewed, teachers were able to respond without difficulty as to how they were using ICT to enhance teaching and learning. They answered immediately after each question and showed great confidence. When teachers were asked how ICT improved their content knowledge, they took time after the question before they answered. It showed that they needed time to think, unlike when they were asked how they used technology for teaching and learning. When teachers were asked how ICT improved the content, they showed difficulty in responding to the question. They took longer to respond and they seemed to have a hard time responding to those particular questions. I might say that teachers' confidence deteriorated when we arrived at the questions on how ICT improved the content. Julia and Bethuel appeared bored as the interviews proceeded while Isaac seemed perplexed by the questions as he rarely used ICT. The other four teachers looked fine at the beginning of the interview but looked exhausted as the interview proceeded. Kenny was the only teacher that was active during the interview and he appeared to be very excited. The teachers' facial

expressions were fine; although I could not tell how they felt. All I observed in them was seriousness. All the teachers responded well to the questions without being aggressive or impatient. Teachers used little gestures when responding to questions; slight hand movements were observed from them and the way that they moved their heads showed that they were thinking. There were no gestures that revealed a negative attitude.

4.3 Conclusions

This chapter analysed the data which was collected from the six participants of three schools. The analysis shows how teachers use technologies to enhance their pedagogy, how the use of technologies improves the subject content and how the technologies improve teachers' content knowledge. This chapter also analysed the documents and field notes collected from the site. The teachers' responses were quoted in the chapter followed by a discussion. There is a brief explanation of how teachers responded to questions, their reactions when they were interviewed and the body language/ gestures that they used.

CHAPTER FIVE FINDINGS

5.1 Introduction

Chapter five commences with a discussion of the main ideas gathered from the research findings. The study focused on how teachers use Information and Communication Technology to teach their learning areas. In this chapter the findings are interpreted and associated with the context created in the literature review and the research methods adopted in chapter three. This chapter commences with a summary of the research after which the findings of this study are discussed.

5.2 Summary of the research

Information and Communication Technology is defined as a “global network in which ideas are exchanged, or information and knowledge is shared, through using communication technology, like computers, to connect people” Mdlongwa (2012, p. 256).

Studies by Nkula and Krauss (2014) and Padayachee (2016) that were conducted in South African schools show that there are only a few teachers who have successfully integrated new technologies in the classroom. The major purpose of the research was to explore the way in which teachers use ICT in their pedagogy to improve their knowledge of their subjects. Nkula and Krauss (2014) have revealed that less self-efficacy and misapprehensions of educators lead teachers to not engage in ICT in their classroom. In recent years there has been a rise of curiosity in wanting to know how computers and the internet are used to advance the efficiency and effectiveness of teaching and learning in schools. The older technologies like the telephone, radio set and television are now less preferred as an instructional tool (Meenakshi, 2013). ICT has become the building block in modern society and it is considered the core of learning and education. Technology in the primary schools is considered the major tool to enrich young minds, as they are enlightened and keen to absorb new ideas, demonstrate more creativity and cultivate critical thinking that will help to acquire information for informed decision-making at an early stage (Meenakshi, 2013).

5.3 Findings of the research

This section of the research answers the core research question: **How do teachers use ICT in their pedagogy to improve their knowledge of their subjects?** The main research question is broken down into three sub-questions, each focuses on technological pedagogical knowledge, technological content and the technological content knowledge. This chapter highlights the findings of the three sub-research questions which are:

1.1 How do teachers use ICT to improve their pedagogy? (TPK)
1.2 How does the use of ICT improve the subject content? (TC)
1.3 How does the use of ICT improve the teachers' content knowledge? (TCK)

5.3.1 The use of ICT to improve teachers' pedagogy

The findings of this study have discovered that educators were not using a Learning Management System. Blignaut & Howie (2009) stated that schools do not have the desired effect expected to enhance the integration of ICT and ICT is not fully utilised in schools. Teachers are using spread sheets to capture data gathered from experiments. Govender and Govender (2014) mentioned that the use of spread sheets and programs in education has made it easy to capture data and representation and also saves a lot of time. The study discovered that the mainstream of the instructors did not use online lesson plans in their teaching; they used the internet to find information and prepared their own lesson plans. There was only one teacher who used online lesson plans which are retrieved from the Department's website. Govender and Govender (2014) discussed that teachers are not ready to utilise the internet during their teaching; they still need assistance to be able to use resources from the internet. This study found that teachers were using e-mails to communicate with learners while other teachers created WhatsApp and Facebook groups to help them communicate with their learners. Padayachee (2016) stated that using WhatsApp to communicate is significant and using Facebook to share information is very exciting.

Table 5.1 shows the numbers of participants who use ICT in their teaching.

Table 5.1: The use of ICTs to improve teachers pedagogy

Number of participants using ICTs	
Preparing lesson plans	**Participants using**
Internet	5
Microsoft Word	2
Microsoft PowerPoint	2
Online lesson plans	2
Capturing data from experiments	**Participants using**
Marksheets	2
Spreadsheets	1
Create and organise assignments	**Participants using**
Internet	3
Microsoft Word	3
Microsoft PowerPoint	2
Communication	**Participants using**
Emails	3
WhatsApp	4
Facebook	2
Assessment	**Participants using**
Quiz	1
Feedback	**Participants using**
CD	1
DVD	3
E-mails	2
Microsoft PowerPoint	1

5.3.2 The use of ICT to improve the subject content

Findings have also revealed that teachers relied more on the internet to find information for their lessons and used Microsoft Word and PowerPoint to prepare for their lessons. Teachers also relied on the internet for information to help them prepare for the learning activities. Mereku and Mereku (2015) indicated that teachers are comfortable with using the internet and Word processors to prepare their lessons. The study also discovered that one of the teachers was able to use a quiz to assess

learners while other teachers did not use any form of ICT in assessment. McMahon, Johnson and Hecht (2017) commented that teachers must know how to use the software that is needed for assessment for it to be well assimilated into teaching and learning.

5.3.3 The use of ICT to improve teachers' content knowledge

The study revealed that teachers relied on e-mails, CDs and DVDs to give feedback to learners. The videos were not only used to give feedback but were also used to enhance the content that they were teaching and helped teachers to gain new teaching strategies. The videos were also helpful to learners as they accommodated different learning styles of the learners. The videos were considered to be very effective in improving experiments. Meenakshi (2013) mentioned that the use of videos is believed to be one of the most effective forms of ICT used in education. Videos can be utilized in many of the learning environments such as enhancing learning in classrooms and encouraging learners to make their own videos. The ability to use videos also simplifies complex subjects and engages children by pointing out strong visual contexts that are difficult to grasp if taught using traditional methods (Meenashi, 2013).

5.3.4 Questions that teachers could not answer

Some of the questions that were not answered in this study are: Teachers were not able to say how they were using online lesson plans or how they used technology to create and organize assignments for teaching and learning. They were not able to tell how ICT benefits teaching and learning when it is used to give feedback. They did not give information on how technology can be used to create and organize assignments to enrich the content, and how their content knowledge improved when they used technology to communicate. Teachers could not respond as to how their content knowledge improved when they used the internet to gather information. To my knowledge, the unanswered questions can only be answered when the teachers have received in-depth training in how to use ICT for teaching and learning and when they use ICT for teaching and learning in their classrooms.

5.3.5 Documents and field notes

Documents were also requested from the participants. The documents were lesson plans, mark sheets and informal tests. All the lesson plans that were received were computerised except for one teacher who did not use technology to deliver his lessons. Upon visiting the site and going into the classroom of the participants, two classrooms were found with data projectors and screens that were well utilised. In one classroom there were tablets for each learner to work with. In another two classrooms there were no data projectors but only screens, while in one of the classrooms there was no data projector and the screen was put aside.

5.4 Conclusions

This chapter provided a brief summary of the research and the findings of the research. The findings were interpreted and associated with the context created in the literature review and the research methods adopted in chapter three. The findings of the three sub-questions that were researched have been discussed.

CHAPTER SIX RECOMMENDATIONS AND CONCLUSIONS

6.1 Introduction

This chapter presents the recommendations and the conclusions of the study.

6.2 Recommendations

Grounded on the research and the discoveries of this research, the following recommendations are put forward concerning the teachers' use of ICT in their teaching. In South Africa, in schools that do not have Computer literacy as a subject it can be introduced as one of the subjects in the school. It could be possible for schools to introduce computer literacy in schools because teachers who have studied their Bachelor's degree have also studied computer literacy in their undergraduate studies. I think those teachers can assist learners to learn computer literacy. If there is a challenge of who will teach computer literacy because it is not one of their majors, then one or two teachers, depending on how big or small the school is, can be sent for a computer literacy course.

The Department of Education can organise a workshop to train all educators on how to use ICT for teaching and learning. The workshops can be conducted over weekends or in school holidays and be part of the curriculum to avoid situations where teachers make excuses for not attending the workshops. The training of teachers on how to use technologies for teaching and learning, can also be conducted within the schools, by inviting the people who are going to train teachers and selecting a day once or twice a week for this training. If all teachers receive training in the ways in which they can use technologies for teaching and learning, they can then use ICT for their subjects.

All subjects require teachers to present explanations or presentations and ICT tools such as data projectors, whiteboards and laptops can be used to do presentations. The internet is also needed to gather information to assist the teacher to enrich their subject. There is no subject that opposes the use of ICT. The Department of Education should provide all teachers with a tablet or laptop so that teachers are able to maximise their skills of using ICT for teaching and learning. The Department should ensure that they provide schools with sufficient projectors and whiteboards to be used in each and every classroom.

Schools should ensure that they have Wi-Fi within the school; Telkom provides affordable, payable Wi-Fi that schools can afford to pay.

I recommend further research on the questions that were not answered in this project because of ICT not being integrated in education. Teachers need to know the changes and benefits that ICT can bring to education and they need to appreciate the value of ICT. They also need to know how to use these technologies to enrich our education. The curriculum should be enhanced by integrating ICT to improve classroom teaching and learning.

6.3 Conclusions

The findings of the research show that the integration of ICT is not effective as there are still teachers who neglect technology. Classrooms are not well equipped with the ICT resources and teachers are not well trained on how to fully utilise these technologies for teaching and learning. Teachers are still not familiar with some of the software that can be used for teaching and learning.

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7. List of Appendices

7.1 Appendix A: Permission letter from Gauteng Department of Education

education
MPUMALANGA PROVINCE
REPUBLIC OF SOUTH AFRICA

Building No. 5, Government Boulevard, Riverside Park, Mpumalanga Province
Private Bag X11341, Mbombela, 1200
Tel: 013 766 5552/5115, Toll Free Line: 0800 203 116

Departement van Onderwys

Ms Nomusa Masilela
PO Box 2203
POLOKWANE
SOVENGA
0727

RE:APPLICATION TO CONDUCT RESEARCH: MS NOMUSA MASILELA – UP

Your application to conduct research study was received and is therefore acknowledged. The tittle of your research project reads:" Exploring teachers' use of information and Communication Technologies (ICTs) in their teaching". I trust that the aims and the objectives of the study will benefit the whole department especially the children who are the beneficiaries. Your request is approved subject to you observing the provisions of the departmental research policy which is available in the department website. You are requested to adhere to your university's research ethics as spelt out in your research ethics.

In terms of the research policy, data or any research activity can be conducted after school hours as per appointment with affected participants. You are also requested to share your findings with the relevant sections of the department so that we may consider implementing your findings if that will be in the best interest of the department. To this effect, your final approved research report (both soft and hard copy) should be submitted to the department so that your recommendations could be implemented. You may be required to prepare a presentation and present at the departments' annual research dialogue.

For more information kindly liaise with the department's research unit @ 013 766 5476/5148 0r a.baloyi@education.mpu.gov.za

The department wishes you well in this important project and pledges to give you the necessary support you may need.

MRS MOC MHLABANE
HEAD EDUCATION
22/08/2017
DATE

7.2 Appendix B: Permission letter directed to school principal

The Principal of _____High School

Dear Sir/Madam

INVITATION FOR YOUR SCHOOL TO PARTICPATE IN THIS RESEARCH PROJECT - Exploring teachers' use of Information and Communication Technologies (ICTs) in their teaching

I am currently enrolled for a Master's degree at the University of Pretoria. Part of the requirements for this degree is the successful completion of a significant research project in the field of education. The title of my approved research study is**: Exploring teachers' use of Information and Communication Technologies (ICTs) in their teaching.** This study is concerned with exploring how teachers who have received training in ICTs use these in their teaching.

Your school is hereby invited to participate in this research project, which aims to:

- Understand how high school teachers utilise technology to improve their pedagogy;
- Understand how teachers use technology to improve the subject content; and
- Understand how teachers use technology to improve their content knowledge.

Below is the scope and responsibility of your participation. To gather information, I need to approach the teacher(s) with an individual invitation to participate. Those who agree to participate will be interviewed about the technology that they use in their classrooms. This interview should take no longer than 60 minutes, and can be conducted at any location that the participants suggest. I have included here for your information a schedule of interview questions.

Please understand that the decision for your school to participate is completely voluntary and that permission for your participation will also be protected by the Mpumalanga Department of Education. Please also note that each individual's

participation in the study will be completely voluntary and will in no way either advantage or disadvantage them. Each participant will be free, at any stage during the process, up to and including the stage at which they authenticate the transcript of their interview, to withdraw their consent to participate. In this case, their participation will end immediately without any negative consequences. Any and all data collected from them up to that point in the study will then be destroyed.

All of the information obtained during the research study will be treated confidentially as not even the Department of Education will have access to the raw data obtained from the interviews. At no time will either your school or any of the individual participants be mentioned by name or indeed be allowed to be identified by any means in the research report.

At the end of the study, you will be provided with a copy of the research report containing both the findings and recommendations of the study. This research presents a unique opportunity for your school to get involved in the process of research aimed at exploring how teachers use technology in their teaching. If you decide to allow your school's participation, kindly show this by completing the consent form at the end of this letter.

Thanking you in anticipation,

NM Masilela
Student Researcher
University of Pretoria
masilela4667@gmail.com
(072) 081 4667

Dr M Mihai
Supervisor
University of Pretoria
maryke.mihai@up.ac.za
(082) 430 2928

LETTER of CONSENT

SCHOOL AS PARTICIPANT

VOLUNTARY PARTICIPATION IN THE RESEARCH PROJECT ENTITLED
Exploring teachers' use of Information and Communication Technologies (ICTs) in their teaching

I, _____, the principal of

_____hereby voluntarily and willingly agree to allow my school to participate in the above-mentioned study introduced and explained to me by Millicent Masilela, currently a student enrolled for an MEd degree at the University of Pretoria.

I further declare that I understand, as explained to me by the researcher, the aim, scope, purpose, possible consequences and benefits and methods of collecting information proposed by the researcher, as well as the means by which the researcher will attempt to ensure the confidentiality and integrity of the information that she collects.

_____ _____

Full name Signature

_____

Date School stamp

7.3 Appendix C: Permission letter directed to participant

Dear Sir/Madam,

INVITATION TO PARTICPATE IN RESEARCH PROJECT:

Exploring teachers' use of Information and Communication Technologies (ICTs) in their teaching

I am currently enrolled for a Master's degree at the University of Pretoria. Part of the requirements for the awarding of this degree is the successful completion of a significant research project in the field of education.

The title of my approved research study is **"Exploring teachers' use of Information and Communication Technologies (ICTs) in their teaching".** This study is concerned with exploring how teachers that received training in ICTs use it in their teaching.

You are hereby invited to participate in this research project, which aims to:

- Understand how high school teachers utilize technology to improve their pedagogy;
- Understand how teachers use technology to improve the subject content; and
- Understand how teachers use technology to improve their content knowledge.

Below is the scope and responsibility of your participation. To gather the information, I require for this research, I request permission to interview you as a teacher about the technologies that you use in your classroom. This interview should take no longer than 60 minutes, and can be conducted at any location you suggest. I have included here for your information a schedule of interview questions.

Please understand that the decision for you to participate is completely voluntary and that permission for your participation will also be protected by the Mpumalanga Department of Education. Please also take into account that each individual's participation in the study will be completely voluntarily and will in no way either

advantage or disadvantage them. Each participant will be free, at any stage during the process up to and including the stage at which they authenticate the transcript of their interview, to withdraw their consent to participate. In this case, their participation will end immediately without any negative consequences. Any and all data collected from them up to that point in the study will then be destroyed.

All the information obtained during the research study will be treated confidentially, with not even the Department of Education having access to the raw data obtained from the interviews. At no time will either you as an individual or your school be mentioned by name or indeed be allowed to be identified by any manner or means whatsoever in the research report.

At the end of the research study you will be provided with a copy of the research report containing both the findings and recommendations of the study. This research study presents a unique opportunity for you and your school to get involved in the process of research aimed at exploring teachers' use of Information and Communication Technologies in their teaching in South African schools. If you decide to participate in this research study, kindly indicate this by completing the consent form at the end of this letter.

Thanking you in anticipation,

NM Masilela
Student Researcher
University of Pretoria
masilela4667@gmail.com
(072) 081 4667

Dr. M. Mihai
Supervisor
University of Pretoria
maryke.mihai@up.ac.za
(082) 430 2928

LETTER of CONSENT

INDIVIDUAL PARTICIPANT

VOLUNTARY PARTICIPATION IN THE RESEARCH PROJECT ENTITLED
Exploring teachers' use of Information and Communication Technologies (ICTs) in their teaching

I, _____, hereby voluntarily and willingly agree to participate as an individual in the above-mentioned study introduced and explained to me by Millicent Masilela, currently a student enrolled for an MEd degree at the University of Pretoria.

I further declare that I understand, as explained to me by the researcher, the aim, scope, purpose, possible consequences and benefits and methods of collecting information proposed by the researcher, as well as the means by which the researcher will attempt to ensure the confidentiality and integrity of the information she collects.

_____ _____

Full name Signature

_____

Date

7.4 Appendix D: Teacher interview template

Teacher Interview procedure

Exploring teachers' use of Information and Communication Technologies in their teaching

Date…… Venue…….

Interviewer: ……Interviewee……...

Entirely individual information provided by the participants will remain confidential. Pseudonyms will be used in the findings of the study where needed to refer to the individual participants, identity will remain private. All information received will only be used for the purpose of the research.

Main research question: How do ICTs add value to teaching and learning when teachers use ICT resources to enhance teaching?

1.1 How do teachers use ICTs to improve their pedagogy?

1.1.1 Do you use a Learning Management System? If yes, which one and how? Give examples.

1.1.2 Do you use online lesson plans? How? Give examples.

1.1.3 How do you use technology to prepare lesson plans?

1.1.4 How do you use technology to capture data from an experiment?

1.1.5 How do you use technology to create and organize assignments for teaching and learning?

1.1.6 How do you use technology to communicate with learners?

1.1.7 How do you use technology in assessments?

1.1.8 How do you use technology to give feedback to learners after assessments?

1.2 How does the use of ICTs improve the content?

1.2.1 How do you use technology to enhance the content that you are presenting?

1.2.2 How do your lesson plans, supported by technology, improve content development?

1.2.3 How does technology benefit teaching and learning when it is used to give feedback?

1.2.4 How do technologies improve experiments that are carried out?

1.2.5 How does using technology to create and organize assignments enrich the content?

1.3 How does the use of ICTs improve the teachers' content knowledge?

1.3.1. How does your content knowledge improve if you work out lesson plans that are supported by technology?

1.3.2 How does your content knowledge improve when technology is used to communicate?

1.3.3 How does your content knowledge improve when you use the internet to gather information?

1.3.4 How does your content knowledge improve when you use videos to deliver lessons?